

# Printed Program

**2017 SIAM**

## Annual Meeting

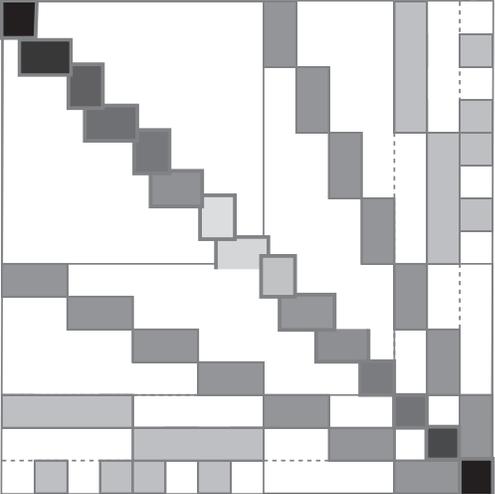


Figure courtesy Yuanzhe Xi, Ruipeng Li and Yousef Saad

**July 10-14, 2017**  
David Lawrence Convention Center  
Pittsburgh, Pennsylvania, USA

SIAM Conference on

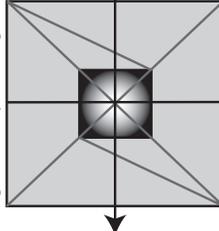
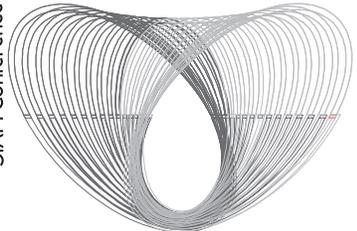


Figure courtesy Fabio Fagnani.

## CONTROL & Its APPLICATIONS

**July 10-12, 2017**  
David Lawrence Convention Center (DLCC)  
Pittsburgh, Pennsylvania, USA

SIAM Conference on



Industrial and Applied Geometry

**July 10-12, 2017**  
David Lawrence Convention Center (DLCC)  
Pittsburgh, Pennsylvania, USA

### SIAM 2017 Events Mobile App

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**siam**®

Society for Industrial and Applied Mathematics

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# General Information

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## Organizing Committees

### Annual Meeting (AN17)

#### Co-chairs

##### Des Higham

University of Strathclyde, United Kingdom

##### Jennifer Mueller

Colorado State University, USA

#### Organizing Committee

##### Andrea L. Bertozzi

University of California Los Angeles, USA

##### Paul G. Constantine

Colorado School of Mines, USA

##### Lenore J. Cowen

Tufts University, USA

##### Fariba Fahroo

DARPA, USA

##### Erica J. Graham

Bryn Mawr College, USA

##### Laura Grigori

Inria, France

##### Alan Hastings

University of California, Davis, USA

##### Tamara G. Kolda

Sandia National Laboratories, USA

##### Anita T. Layton

Duke University, USA

##### Youzuo Lin

Los Alamos National Laboratory, USA

##### Youssef Marzouk

Massachusetts Institute of Technology, USA

##### Samuli Siltanen

University of Helsinki, Finland

##### Barbara Wohlmuth

TU Munchen, Germany

## Control and Its Applications (CT17)

### Co-chairs

##### Wei Kang

Naval Postgraduate School, USA

##### Qing Zhang

University of Georgia, USA

### Organizing Committee

##### Piermarco Cannarsa

University of Rome "Tor Vergata", Italy

##### Eduardo Cerpa

Universidad Técnica Federico Santa  
María, Chile

##### Francois Dufour

Université de Bordeaux and Inria  
Bordeaux Sud-Ouest, France

##### Fariba Fahroo

DARPA, USA (AN17 liaison)

##### Leonid Fridman

Universidad Nacional Autónoma de  
México, Mexico

##### Tryphon T. Georgiou

University of California, Irvine, USA

##### Michael Hinze

University of Hamburg, Germany

##### Naira Hovakimyan

University of Illinois at Urbana-  
Champaign, USA

##### Urszula Ledzewicz

Southern Illinois University  
Edwardsville, USA and Lodz University  
of Technology, Poland

##### Hai Lin

University of Notre Dame, USA

##### Sonia Marfínez

University of California, San Diego,  
USA

##### Amit Surana

United Technologies Research Center,  
USA

##### Mario Sznaiier

Northeastern University, USA

## Industrial and Applied Geometry (GD17)

### Co-Chairs

##### David Field

General Motors Research and  
Development Center, USA

##### Jens Gravesen

Technical University of Denmark,  
Denmark

### Organizing Committee

##### Gudrun Albrecht

Université de Valenciennes et du  
Hainaut-Cambrésis, France

##### George Allen

Siemens PLM Software, USA

##### Thomas Grandine

The Boeing Company, USA

##### Stefanie Hahmann

University Grenoble, LJK, Inria, France

##### Stephen Mann

University of Waterloo, Canada

##### Konrad Polthier

Freie Universität Berlin, Germany

##### Emmanuel Tsimis

Retired

## SIAM Registration Desk

The SIAM registration desk is located in the David L. Lawrence Convention Center (DLCC), in the Ballroom Gallery - 3rd Floor. It is open during the following hours:

Sunday, July 9  
2:00 PM - 8:00 PM  
Monday, July 10  
7:15 AM - 4:30 PM  
Tuesday, July 11  
7:30 AM - 4:30 PM  
Wednesday, July 12  
8:00 AM - 4:30 PM  
Thursday, July 13  
8:00 AM - 4:30 PM  
Friday, July 14  
8:00 AM - 4:30 PM

## Conference Location

Technical sessions will be held at the David L. Lawrence Convention Center (DLCC):

### David L. Lawrence Convention Center (DLCC)

1000 Ft. Duquesne Blvd.  
Pittsburgh, PA 15222  
USA

Phone: +1-412-565-6000  
Email: [info@pittsburghcc.com](mailto:info@pittsburghcc.com)  
<http://www.pittsburghcc.com/>

Various committee meetings, Student Days Breakfast, and the Prizes and Awards Luncheon will be held at the Westin Convention Center Hotel, connected by a skywalk to the David L. Lawrence Convention Center.

## Hotel Information

### Westin Convention Center, Pittsburgh (Headquarter Hotel)

1000 Penn Avenue  
Pittsburgh, Pennsylvania 15222  
Phone: +1-412-281-3700  
Toll free Reservations (USA and Canada): +1-800-937-8461  
Fax: +1-412-227-4500  
Hotel Web Address:  
<http://www.starwoodhotels.com/westin/property/overview/index.html?propertyID=1370>

### Omni William Penn Hotel

530 William Penn Place  
Pittsburgh, Pennsylvania 15219  
Phone: +1-412-281-7100  
Toll free Reservations (USA and Canada): +1-800-THE-OMNI  
Hotel web address: <https://www.omnihotels.com/hotels/pittsburgh-william-penn>

## Hotel Check-in and Check-out Times

Check-in time is 3:00 PM.  
Check-out time is 12:00 PM.

## Childcare

The Westin Convention Center, Pittsburgh and the Omni William Penn Hotel recommend Nanny Poppinz (Pamela Watson, 412-307-4914, [www.nannypoppinz.com](http://www.nannypoppinz.com)) and The Sitter Source (412-212-3118, [www.pghsitters.com](http://www.pghsitters.com)) for attendees interested in child care services. Attendees are responsible for making their own child care arrangements.

## Corporate Members and Affiliates

SIAM corporate members provide their employees with knowledge about, access to, and contacts in the applied mathematics and computational sciences community through their membership benefits. Corporate membership is more than just a bundle of tangible products and services; it is an expression of support for SIAM and its programs. SIAM is pleased to acknowledge its corporate members. In recognition of their support, non-member attendees who are employed by the following organizations are entitled to the SIAM member registration rate.

## Corporate/Institutional Members

The Aerospace Corporation  
Air Force Office of Scientific Research  
Amazon  
Aramco Services Company  
Bechtel Marine Propulsion Laboratory  
The Boeing Company  
CEA/DAM  
Department of National Defence (DND/CSEC)  
DSTO- Defence Science and Technology Organisation  
Hewlett-Packard  
Huawei FRC French R&D Center  
IBM Corporation  
IDA Center for Communications Research, La Jolla  
IDA Center for Communications Research, Princeton  
Institute for Defense Analyses, Center for Computing Sciences  
Lawrence Berkeley National Laboratory  
Lawrence Livermore National Labs  
Lockheed Martin  
Los Alamos National Laboratory  
Max-Planck-Institute for Dynamics of Complex Technical Systems  
Mentor Graphics  
National Institute of Standards and Technology (NIST)  
National Security Agency (DIRNSA)  
Naval PostGrad

# SIAM NEWS:

*Read, Write, Discuss!*

Stay connected to *SIAM News* Online to keep abreast of *SIAM News* articles, online-exclusive blog posts, important community announcements, concise updates on cutting-edge research, and in-depth articles on new discoveries and applications.

- **Visit the site and contribute to the discussion**

Share articles on social media or sign in through Disqus, Facebook, Twitter, or Google to post a comment or provide feedback.

- **Want to submit a blog post?**

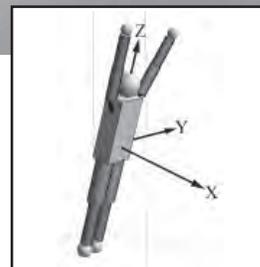
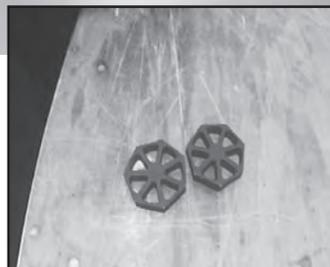
Article submissions from members of the community are welcome for consideration! Visit the guidelines page at [sinews.siam.org/Blog-Submission-Guidelines](http://sinews.siam.org/Blog-Submission-Guidelines) and e-mail your idea or article to [sinews@siam.org](mailto:sinews@siam.org). Use the subject line "SINEWS Blog submission."

- **Write about your research for the print edition of *SIAM News***

Are you conducting applied mathematical research with broad implications? Do you have a novel application of mathematics or a new mathematical method to report? Pitch an idea for an article about your work to [sinews@siam.org](mailto:sinews@siam.org) with the subject line "Story idea: Print SINEWS."

- **Are you a professional writer?**

Do you like writing about cutting-edge applied mathematical and computational science research? Do you have a background in applied mathematical sciences and experience in scientific writing? We're looking for freelancers like you! Interested writers may email a resume and three science writing samples to [sinews@siam.org](mailto:sinews@siam.org) for consideration. Please use the subject line "Science Writer – Application."



## SINEWS.SIAM.ORG

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UT-Battelle for the Department of Energy  
Sandia National Laboratories  
Schlumberger-Doll Research  
United States Department of Energy  
U.S. Army Corps of Engineers, Engineer  
Research and Development Center  
US Naval Research Labs

List current June 2017.

## SIAM Communication Doctors

Stop by this booth on Monday, July 10, between 7:15 PM and 9:15 PM in Room 302-304, to chat with representing mathematicians, science communicators and educators about how to turn your complex research into a story that appeals to the public. "Doctors" will offer feedback and advice on how to craft an effective message about your research for future employers, outreach events, or the press. Stop by with a short pitch or summary of your work and let's make it media ready!

## Funding Agency

SIAM and the conference organizing committee wish to extend their thanks and appreciation to the U.S. National Science Foundation. The U.S. National Science Foundation supports the SIAM Conference on Control and Its Applications (CT17), the SIAM Conference on Industrial and Applied Geometry (GD17) and the Workshop Celebrating Diversity (WCD).



## Leading the applied mathematics community . . .

### Join SIAM and save!

SIAM members save up to \$130 on full registration for the 2017 SIAM Annual Meeting (AN17), SIAM Conference on Control and Its Applications (CT17), and the SIAM Conference on Industrial and Applied Geometry (GD17)! Join your peers in supporting the premier professional society for applied mathematicians and computational scientists. SIAM members receive subscriptions to *SIAM Review*, *SIAM News* and *SIAM Unwrapped*, and enjoy substantial discounts on SIAM books, journal subscriptions, and conference registrations.

If you are not a SIAM member and paid the Non-Member or Non-Member Mini Speaker/Organizer rate to attend the conference, you can apply the difference between what you paid and what a member would have paid (\$130 for a Non-Member and \$65 for a Non-Member Mini Speaker/Organizer) towards a SIAM membership. Contact SIAM Customer Service for details or join at the conference registration desk.

Free Student Memberships are available to students who attend an institution that is an Academic Member of SIAM, are members of Student Chapters of SIAM, or are nominated by a Regular Member of SIAM.

Join onsite at the registration desk, go to [www.siam.org/joinsiam](http://www.siam.org/joinsiam) to join online or download an application form, or contact SIAM Customer Service:

Telephone: +1-215-382-9800 (worldwide); or  
800-447-7426 (U.S. and Canada only)

Fax: +1-215-386-7999

E-mail: [membership@siam.org](mailto:membership@siam.org)

Postal mail: Society for Industrial and Applied  
Mathematics, 3600 Market Street, 6th floor,  
Philadelphia, PA 19104-2688 USA

## Standard Audio/Visual Set-Up in Meeting Rooms

The Plenary Session Room will have two (2) screens, one (1) data projector and one (1) overhead projector. All other concurrent/breakout rooms will have one (1) screen and one (1) data projector. The data projectors support both VGA and HDMI connections. Presenters requiring an alternate connection must provide their own adaptor.

## Internet Access

SIAM has arranged for wireless Internet access throughout the meeting areas at the DLCC. This service is being provided at no additional cost to individual attendees. In addition, a limited number of email stations will be provided for attendee use during registration hours.

The Westin Convention Center Pittsburgh Hotel and Omni William Penn Hotel offer guests complimentary high speed wireless Internet access in the lobby and guest rooms.

## Registration Fee Includes

- Access to email facilities
- Admission to all technical sessions (SIAM Annual Meeting (AN17), SIAM Conference on Control and Its Applications (CT17), and SIAM Conference on Industrial and Applied Geometry (GD17))
- Coffee breaks daily
- Exhibit Hall Admission
- Poster Session and Dessert Reception
- Room set-ups and audio/visual equipment
- SIAM Business Meeting (for SIAM members)
- Welcome Reception

In addition, the following events are available to attendees at no additional cost. These events are subsidized by SIAM and are not covered by the registration fees.

- Career Fair, Graduate Student Reception, and Industry Member Reception
- Community Reception
- Fellows Reception
- Prizes and Awards Luncheon
- Professional Development Evening

## Job Postings

Please check with the SIAM registration desk regarding the location of the job postings board or visit <http://jobs.siam.org>.

## General Information

### Important Notice to Poster Board Presenters

The poster session is scheduled for Tuesday, July 11, 8:00 PM. Poster presenters must set up their poster material on the provided 8' x 4' poster boards in the West Atrium - 3rd Floor of the DLCC between Sunday, July 9 at 3:00 PM and Tuesday, July 11 at 8:00 PM. All materials must be posted by 8:00 PM on Tuesday, the official start time of the session. Posters will remain on display through Thursday, July 13. **Posters must be removed by 4:00 PM on Thursday.**

### Name Badges

A space for emergency contact information is provided on the back of your name badge. Help us help you in the event of an emergency!

### Comments?

Comments about SIAM meetings are encouraged! Please send to:

Cynthia Phillips, SIAM Vice President for Programs (vpp@siam.org).

### Please Note

SIAM is not responsible for the safety and security of attendees' electronic devices. Do not leave your devices unattended. Please remember to silence your electronic device(s) prior to entering a session.

### Statement on Inclusiveness

As a professional society, SIAM is committed to providing an inclusive climate that encourages the open expression and exchange of ideas, that is free from all forms of discrimination, harassment, and retaliation, and that is welcoming and comfortable to all members and to those who participate in its activities. In pursuit of that commitment, SIAM is dedicated to the philosophy of equality of opportunity and treatment for all participants regardless of gender, gender identity or expression, sexual orientation, race,

color, national or ethnic origin, religion or religious belief, age, marital status, disabilities, veteran status, field of expertise, or any other reason not related to scientific merit. This philosophy extends from SIAM conferences, to its publications, and to its governing structures and bodies. We expect all members of SIAM and participants in SIAM activities to work towards this commitment.

### Recording of Presentations

Audio and video recording of presentations at SIAM meetings is prohibited without the written permission of the presenter and SIAM.

### Social Media

SIAM is promoting the use of social media, such as Facebook and Twitter, in order to enhance scientific discussion at its meetings and enable attendees to connect with each other prior to, during and after conferences. If you are tweeting about a conference, please use the designated hashtag to enable other attendees to keep up with the Twitter conversation and to allow better archiving of our conference discussions:

SIAM Annual Meeting (AN17) - #SIAMAN17

SIAM Conference on Control and Its Applications (CT17) - #SIAMCT17

SIAM Conference on Industrial and Applied Geometry (GD17) - #SIAMGD17

SIAM's Twitter handle is @TheSIAMNews.

### SIAM Books and Journals

Books are available for purchase at a discounted price and complimentary copies of journals are available during the conference. The books booth will be staffed from 9:30 AM through 4:30 PM Monday through Thursday. The book booth will close at 4:30 PM on Thursday.

### Mobile App

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To enhance your conference experience, we're providing a state-of-the-art mobile app to give you important conference information right at your fingertips. With this TripBuilder EventMobile™ app, you can:

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- View Sessions, Speakers, Exhibitors and more
- Take notes and export them to your email
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- Get instant Alerts about important conference information



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### Conference Sponsors

Silver Sponsor:

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# VISIT THE EXHIBITS!

**DAVID LAWRENCE CONVENTION CENTER (DLCC)  
PITTSBURGH, PENNSYLVANIA, USA  
BALLROOM GALLERY—3RD FLOOR**



### EXHIBIT HALL HOURS

Monday 7/10  
9:30 AM–4:30 PM

Tuesday 7/11  
9:30 AM–4:30 PM

Wednesday 7/12  
9:30 AM–4:30 PM

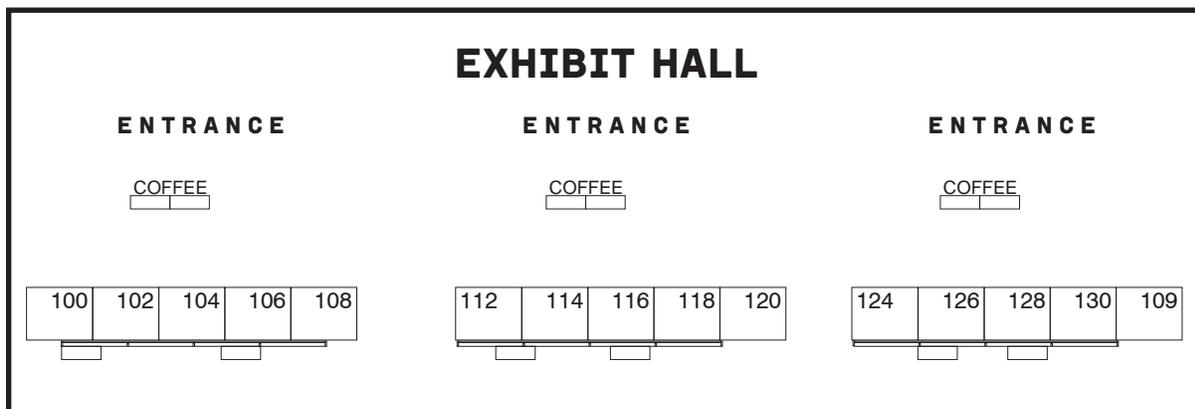
Thursday 7/13  
9:30 AM–4:30 PM

<b>BOOTH EXHIBITORS</b>	<b>BOOTH #</b>
American Mathematical Society .....	130, 109
Kadon Enterprises, Inc.....	100
MathWorks.....	108
Oxford University Press .....	106
Princeton University Press.....	124
SIAM.....	112, 114, 116, 118, 120
Springer .....	102
World Scientific Publishing Company .....	126

### TABLETOP EXHIBITORS

Association for Women in Mathematics  
The Royal Society

*This exhibitor list is current at press time.*



Coffee breaks will be served in the exhibit hall.

# Notes

## Workshops

Two workshops are co-located with the SIAM Annual Meeting. A separate registration fee is required for each of these workshops.

### **SIAM Workshop on Parameter Space Dimension Reduction (DR17)**

**July 9-10, 2017**

**Location:** *Omni William Penn Hotel, Pittsburgh, Pennsylvania, USA*

**Co-Chairs:**           **Paul G. Constantine**, *Colorado School of Mines, USA*  
                              **David F. Gleich**, *Purdue University, USA*

### **SIAM Workshop on Network Science (NS17)**

**July 13-14, 2017**

**Location:** *David Lawrence Convention Center (DLCC), Pittsburgh, Pennsylvania, USA*

**Co-Chairs:**           **Michelle Girvan**, *University of Maryland at College Park, USA*  
                              **Mason A. Porter**, *University of California, Los Angeles, USA*

## 2017 SIAM Annual Meeting Minitutorials

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Tuesday, July 11

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**10:30 AM-12:30 PM**

**MT1** Practical Ideas to Connect Academic Departments  
with Business, Industry and Government

Organizer: **Rachel Levy**, *Harvey Mudd College, USA*

Room: 317

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Wednesday, July 12

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**10:30 AM-12:30 PM**

**MT2** Mathematics for Crime Prediction and Prevention  
Organizer: **Martin Short**, *Georgia Institute of Technology, USA*

Room: Spirit of Pittsburgh A

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Friday, July 14

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**10:30 AM-12:30 PM**

**MT3** Compressed Sensing/Dimension Reduction  
Organizer: **Deanna Needell**, *University of California, Los Angeles, USA*

Room: Spirit of Pittsburgh A

## Association for Women in Mathematics (AWM) Workshop

### AWM Workshop

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Monday, July 10 - Tuesday, July 11

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The workshop held in conjunction with the 2017 SIAM Annual Meeting consists of two research minisymposia focused on Numerical Analysis and Scientific Computing, organized by Susanne Brenner, Fengyan Li and Beatrice Riviere, a Poster Session for graduate students and an informational minisymposium directed at starting a career. Selected junior and senior women from the Research Collaboration Conference for Women (RCCW): Numerical Partial Differential Equations and Scientific Computing, will give 20-minute talks in the two research minisymposia.

The AWM Workshop runs from Monday morning through Tuesday. AWM and SIAM welcome your participation. There is no additional registration fee for this workshop. The AWM minisymposia and poster session are open to all SIAM meeting attendees.

AWM Activities at the 2017 SIAM Annual Meeting:

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Monday, July 10

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#### **MS3 AWM Workshop:**

Recent Advances in Numerical Analysis and Scientific Computing–Part I of II

#### **SP1 AWM-SIAM Sonia Kovalevsky Lecture:**

Mitigating Uncertainty in Inverse Wave Scattering

Liliana Borcea, University of Michigan, USA

#### **MS11 AWM Workshop:**

Recent Advances in Numerical Analysis and Scientific Computing–Part II of II

## Association for Women in Mathematics (AWM) Workshop

Tuesday, July 11

### **MS31 AWM Workshop: Career Panel:**

Perspectives from Women in Research

**PP2** Minisymposium: AWM Posters

AWM is grateful to SIAM and their Conference Department for all their efforts on behalf of the workshop and all AWM activities. AWM also wishes to express its gratitude to the National Science Foundation for the support of the AWM workshop.

## Workshop Celebrating Diversity (WCD)

**Erica Graham**, Bryn Mawr College, USA

**Raegan Higgins**, Texas Tech University, USA

**Shelby Wilson**, Morehouse College, USA

This annual event provides a chance for students to listen to technical talks presented by minority graduate students. The workshop is intended to accomplish several goals:

- To send a clear, explicit message of enthusiastic welcome and support from SIAM to members of under-represented groups. The workshop is deliberately held as part of a regular SIAM meeting so that the participants can combine the experiences of attending a regular scientific meeting and a special occasion dedicated to them.
- To bring together a mixture of people from different levels of age and professional experience, ranging from undergraduate students to senior scientists.
- To provide an opportunity for minority graduate students to present their research.
- To provide an informal, comfortable setting (a lunch) where all the students can meet applied and computational mathematicians with a wide variety of jobs in academia, national laboratories, industry, and government.

## Workshop Celebrating Diversity (WCD)

The following sessions are part of the WCD:

---

Tuesday, July 11

---

**MS20** A Mathematical View of the Different Biological Scales: From the genomic level to the human interaction level

**MS32** Contributions of Black Mathematicians to Current Research Problems

---

Wednesday, July 12

---

**MS49** Optimal Control and Applications

---

Thursday, July 13

---

**MS73** Nonlinear Dynamics in Mathematical Biology

**MS82** Topics in Applied Mathematics in Modeling and Numerical Analysis

Also of interest to those attending the WCD:

---

Monday, July 10

---

**MS1** Adapting our Departments to learn about and Support Diversity in Mathematics

**MS18 Panel:** Celebrating Diversity in Mathematical Sciences

---

Wednesday, July 12

---

**MS62** Panel: Implicit Bias, Stereotyping and Prejudice in STEM

### **NEW in 2017!**

Join the WCD Organizers for a meet and greet on Monday, 6:15-7:15 on the South Terrace, 3rd Floor.

## Student Days

Student Days at the 2017 SIAM Annual Meeting is a day for students and about students. Organizers have got it all covered this year, with activities and sessions where students can meet with both peers and professionals in their field, participate in a career fair, attend an information session on hot areas for jobs and research, and network with SIAM Student Chapters from all over the world.

### Goals

Organized by the SIAM Education Committee (Chaired by Suzanne Weekes, Worcester Polytechnic Inst), Student Days are designed to encourage student participation in SIAM, to help students learn more about applied mathematics and computational science as both fields of study and as careers, and to provide a forum for emerging mathematicians to learn about their field from the professionals who know the answers. Organizers also hope to encourage those in the learning community to establish new student chapters of SIAM and to promote interaction between students and SIAM leadership.

### Events and Happenings

Student Days sessions include presentations by student chapter representatives and the winners of the SIAM Student Paper Prizes. In addition, students can attend plenary sessions from the SIAM Annual Meeting (AN17). Other activities that will enhance the meeting for students include a special orientation prior to Sunday's

welcome reception, a student lounge, and a session for students with selected conference invited speakers. Other activities that will be of interest to students include the Careers in Business, Industry and Government panel, career fair, and evening reception on Monday, the poster session on Tuesday, the community lecture on Wednesday, and the professional development activities on Thursday evening.

### Meeting with Leaders and Influencing SIAM

*(by invitation only)*

Student Days 2017 will also feature the Student Chapter Meeting with SIAM Leadership. This meeting gives faculty advisors and student chapter representatives the opportunity to meet with key decision makers to discuss ideas for improving student chapters and ways that SIAM can meet the needs of current and future student members all over the world. Each chapter selects one student member to attend the event as its chapter representative.

## Student Days

Student Days Schedule and other Activities of Interest to Students  
(See program content for additional details)

---

### Sunday, July 9

---

5:00 PM-6:00 PM  
Student Orientation

6:00 PM-8:00PM  
Welcome Reception

---

### Monday, July 10

---

9:30 AM-4:30 PM  
Visit the Student Lounge in the Exhibit Hall

10:30 AM-12:30 PM  
Career Fair, Undergraduate Sessions

2:45 PM-3:30 PM  
Kovalevsky Prize Lecture

4:00 PM-6:00 PM  
Career Fair, Undergraduate Sessions

6:15 PM-7:15 PM  
Industry Panel

7:15 PM-9:15 PM  
Career Fair, Graduate Student Reception, Industry Reception

---

### Tuesday, July 11th

---

9:30 AM-4:30 PM  
Visit the Student Lounge in the Exhibit Hall

7:00 AM-8:15 AM  
Student Chapter Meeting with SIAM Leadership (by invitation only)

10:30 AM-12:30 PM  
SIAM Student Chapter Presentations

2:30 PM-3:30 PM  
The John von Neumann Lecture

4:00 PM - 6:00 PM  
SIAM Student Chapter Presentations

8:00 PM-10:00 PM  
Poster Session and Dessert Reception  
Minisymposium - Student Chapter Presentations

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### Wednesday, July 12th

---

9:30 AM-4:30 PM  
Visit the Student Lounge in the Exhibit Hall

10:30 AM-12:30 PM  
Student Paper Prize Winners

3:00 PM-3:30 PM  
Wilkinson NACS Prize Lecture

4:00 PM-6:00 PM  
Student Informal Meeting with Invited Speakers

6:15 PM-8:15 PM  
I.E. Block Community Lecture and Reception

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### Thursday, July 13

---

3:00 PM-3:30 PM  
Reid Prize Lecture

6:15 PM-9:15 PM  
Professional Development Evening

## Special Events

Sunday, July 9

5:00 PM - 6:00 PM

### Student Orientation

306 & 307

This event is intended to enhance students' experience at the meeting by providing an introduction to some of the meeting organizers and to the program. There are several new events and facilities to help students get the fullest benefit from the meeting. A few very short presentations will be followed by an opportunity to network with both fellow students and other attendees prior to the general welcome reception.

6:00 PM - 8:00 PM

### Welcome Reception

South Terrace - 3rd Floor

The welcome reception is open to all attendees and their guests. Light hors d'oeuvres will be served. One drink ticket is included with each registration. A cash bar will be available for those who wish to purchase additional beverages.

Monday, July 10

10:30 AM – 12:30 PM

### MS4 Career Fair: Alternatives to Academia

302-304

4:00 PM – 6:00 PM

### MS12 Career Fair: Alternatives to Academia

302-304

6:15 PM - 7:15 PM

### PD1 Student Careers in Business, Industry and Government (BIG)

Spirit of Pittsburgh A - 3rd Floor

6:15 PM - 7:15 PM

### Workshop Celebrating Diversity (WCD) Meet-and-Greet

South Terrace – 3rd Floor

7:15 PM - 9:15 PM

### Communication Doctors, Career Fair, Graduate Student and Industry Reception

302-304

Complimentary light hors d'oeuvres, beer and wine will be served.

## Special Events

Tuesday, July 11

- 12:30 PM - 2:30 PM      **Prizes and Awards Luncheon** (Offsite at the connected Westin Hotel)  
Westin Hotel - Allegheny Ballroom  
This luncheon will recognize and honor this year's award recipients. The luncheon is open to all meeting attendees and is included in the registration fee, however, a reservation is required in advance. If you do not have a ticket, please see a SIAM representative at the registration desk. Tickets can be obtained through noon on Monday. See page 27 for the list of prizes and awards being presented.
- 6:15 PM - 7:00 PM      **SIAM Business Meeting and 2017 Fellows Recognition**  
Spirit of Pittsburgh A - 3rd Floor  
SIAM Business Meeting  
(open to SIAM members; complimentary beer and wine will be served)  
Class of 2017 Fellows will be recognized at the SIAM Business Meeting, followed by a short reception for the new Fellows.
- 7:00 PM - 7:30 PM      **Fellows Reception**  
South Terrace – 3<sup>rd</sup> Floor
- 7:30 PM - 8:00 PM      **SIAG/GD Business Meeting** (Complimentary beer and wine will be served)  
407
- 7:30 PM - 8:00 PM      **SIAG/CT Business Meeting** (Complimentary beer and wine will be served)  
Spirit of Pittsburgh B - 3rd Floor
- 8:00 PM - 10:00 PM      **Poster and Dessert Reception**  
West Atrium - 3rd Floor  
Poster presentations are in an informal setting, allowing presenters to discuss their research with individual attendees.

## Special Events

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Wednesday, July 12

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**6:15 PM - 7:15 PM**

**I.E. Block Community Lecture and Reception**

*Spirit of Pittsburgh A - 3rd Floor*

Emily Shuckburgh, British Antarctic Survey, United Kingdom, will deliver the community lecture from 6:15 PM to 7:15 PM, followed by the **Community Reception** from 7:15 PM to 8:15 PM. *Complimentary light hors d'oeuvres, beer and wine will be served.*

This event is open to all attendees, their guests and the local community.

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Thursday, July 13

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**6:15 PM - 9:30 PM**

**Professional Development Evening**

*Spirit of Pittsburgh B - 3rd Floor*

## Invited Speakers: 2017 SIAM Annual Meeting (AN17)

Monday, July 10

*Spirit of Pittsburgh A -  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT1** Nonlinear Models for Matrix Completion

**Rebecca Willett**, *University of Wisconsin, Madison, USA*

*Spirit of Pittsburgh A -  
3rd Floor*

**9:15 AM - 10:00 AM**

**IT2** Connections in Extremal Combinatorics: Ramsey Theory

**Po-Shen Loh**, *Carnegie Mellon University, USA*

*American Mathematical Society (AMS) Invited Presentation*

*Spirit of Pittsburgh A -  
3rd Floor*

**2:00 PM - 2:45 PM**

**JP1** Bio-Inspired Dynamics for Multi-Agent Decision-Making

**Naomi E. Leonard**, *Princeton University, USA*

*Joint speaker with Conference on Control and Its Applications*

Tuesday, July 11

*Spirit of Pittsburgh A -  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT3** Model-Based Learning in Imaging

**Carola Bibiane Schoenlieb**, *University of Cambridge, United Kingdom*

*Spirit of Pittsburgh A -  
3rd Floor*

**9:15 AM - 10:00 AM**

**IT4** Homogenization for Sea Ice and the Climate System

**Kenneth M. Golden**, *University of Utah, USA*

## Invited Speakers

Wednesday, July 12

*Spirit of Pittsburgh A-  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT5** Connecting Model-Based Predictions to Reality

**David M. Higdon**, *Virginia Tech, USA*

*Spirit of Pittsburgh A-  
3rd Floor*

**9:15 AM - 10:00 AM**

**IT6** Computational Methods for Personalized Medicine  
in Cardiovascular Disease

**Alison Marsden**, *Stanford University, USA*

Thursday, July 13

*Spirit of Pittsburgh A-  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT7** Creating New Sources of Data and Embedded Systems to Understand  
Cities

**Charlie Catlett**, *Argonne National Laboratory, USA*

*Spirit of Pittsburgh B-  
3rd Floor*

**IT8** Highly Accurate Numerical Methods and Error Estimates for Evaluation  
of Nearly Singular Integrals in Integral Equations

**Anna-Karin Tornberg**, *KTH Royal Institute of Technology, Sweden*

*Spirit of Pittsburgh A -  
3rd Floor*

**9:15 AM - 10:00 AM**

**IP1** Genetic Consequences of Range Expansion Under Climate Change

**Mark Lewis**, *University of Alberta, Canada*

*Spirit of Pittsburgh A-  
3rd Floor*

**2:00 PM - 2:45 PM**

**IP2** Pattern Formation in the Drylands: Self Organization in Semi-Arid  
Ecosystems

**Mary Silber**, *University of Chicago, USA*

## Invited Speakers: 2017 SIAM Annual Meeting

Friday, July 15

*Spirit of Pittsburgh A-  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT9** Mathematical Opportunities and Challenges in Sustainable Energies

**Barbara Wagner**, Weierstrass Institute, Germany

*Spirit of Pittsburgh B-  
3rd Floor*

**IT10** Transforming Combustion Science and Technology with Exascale Simulation

**Jacqueline Chen**, Sandia National Laboratories, USA

*Spirit of Pittsburgh A-  
3rd Floor*

**9:15 AM - 10:00 AM**

**IP3** Predicting Travel Time on Road Networks

**Dawn Woodard**, Uber, USA

*Spirit of Pittsburgh A-  
3rd Floor*

**2:00 PM - 2:45 PM**

**IP4** Chaos and Learning in Spiking Neural Networks

**Carson C. Chow**, National Institutes of Health, USA

*Spirit of Pittsburgh A-  
3rd Floor*

**2:45 PM - 3:30 PM**

**IP5** Laplacian Matrices of Graphs: Algorithms and Applications

**Daniel Spielman**, Yale University, USA

## Invited Speakers: Conference on Control & Its Applications (CT17)

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Monday, July 10

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*Spirit of Pittsburgh B-  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT1** Optimal Mass Transport and the Robustness of Complex Networks  
**Allen Tannenbaum**, Stony Brook University, USA

*Spirit of Pittsburgh B-  
3rd Floor*

**9:15 AM - 10:00 AM**

**IT2** The Moment-SOS Approach in Optimization and Control  
**Jean-Bernard Lasserre**, LAAS-CNRS, Toulouse, France

*Spirit of Pittsburgh B-  
3rd Floor*

**2:00 PM - 2:45 PM**

**JP1** Bio-Inspired Dynamics for Multi-Agent Decision-Making  
Joint speaker with the 2017 Annual Meeting  
**Naomi E. Leonard**, Princeton University, USA

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Tuesday, July 11

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*Spirit of Pittsburgh B-  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT3** Mathematical Challenges in Control of Large-Scale Complex Systems  
**Andrew Sparks**, *United Technologies Research Center, USA*

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Wednesday, July 12

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*Spirit of Pittsburgh B-  
3rd Floor*

**8:30 AM - 9:15 AM**

**IT6** On the Dynamics of Influence and Appraisal Networks  
**Francesco Bullo**, *University of California, Santa Barbara, USA*

**Invited Speakers: Conference on Industrial and Applied Geometry (GD17)**

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Monday, July 10

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407                    **8:30 AM - 9:15 AM**  
**IT1** Computational Design Tools for Physical Surfaces  
**Bernhard Thomaszewski**, *Disney Research Zurich, Switzerland*

407                    **9:15 AM - 10:00 AM**  
**IT2** Computational Physics at Pixar  
**Tony DeRose**, *Pixar Animation Studios, USA*

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Tuesday, July 11

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407                    **8:30 AM - 9:15 AM**  
**IT3** Design of 3D Printed Mathematical Art  
**Henry Segerman**, *Oklahoma State University, USA*

407                    **9:15 AM - 10:00 AM**  
**IT4** Shape Control in Curve Design  
**Carla Manni**, *University of Rome II, Tor Vergata, Italy*

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Wednesday, July 12

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407                    **8:30 AM - 9:15 AM**  
**IT5** Simulating Cloth, Paper, and Other Thin Shells Using Discrete  
Differential Geometr  
**Etienne Vouga**, *University of Texas at Austin, USA*

407                    **9:15 AM - 10:00 AM**  
**IT6** Efficient Developable Surface Modeling: From Garment Design, to  
Paper Animation  
**Damien Rohmer**, *Inria and ENS Lyon, France*

## Prize and Special Lectures: 2017 Annual Meeting (AN17)

**Monday, July 10**

**2:45 PM - 3:30 PM**

**SP1** AWM-SIAM Sonia Kovalevsky Lecture  
Mitigating Uncertainty in Inverse Wave Scattering

**Liliana Borcea**, *University of Michigan, USA*  
*Spirit of Pittsburgh A - 3rd Floor*

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**Tuesday, July 11**

**2:30 PM - 3:30 PM**

**SP2** The John von Neumann Lecture  
Singular Perturbations in Noisy Dynamical Systems

**Bernard Matkowsky**, *Northwestern University, USA*  
*Spirit of Pittsburgh A - 3rd Floor*

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**Wednesday, July 12**

**2:00 PM - 3:00 PM**

**SP3** Past President's Address  
The Future of SIAM: Looking to the Mathematicians of Tomorrow

**Irene Fonseca**, *Carnegie Mellon University, USA*  
*Spirit of Pittsburgh A - 3rd Floor*

**3:00 PM - 3:30 PM**

**SP4** James H. Wilkinson Numerical Analysis and Scientific Computing Prize Lecture  
Tensors in Computational Mathematics

**Lek-Heng Lim**, *University of Chicago, USA*  
*Spirit of Pittsburgh A - 3rd Floor*

## Prize and Special Lectures: 2017 Annual Meeting (AN17)

**Wednesday, July 12**

**6:15 PM - 7:15 PM**

**SP5** I.E. Block Community Lecture

From Flatland to Our Land: A Mathematician's Journey through Our Changing Planet

**Emily Shuckburgh**, *British Antarctic Survey, United Kingdom*

*Spirit of Pittsburgh A - 3rd Floor*

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**Thursday, July 13**

**3:00 PM - 3:30 PM**

**SP6** W. T. and Idalia Reid Prize in Mathematics Lecture

Feedback Stabilization of Control Systems

**Jean-Michel Coron**, *Université Pierre et Marie Curie, France*

*Spirit of Pittsburgh A - 3rd Floor*

**Prizes and Special Lectures: Conference on Control and Its Applications (CT17)****Tuesday, July 11****9:20 AM - 9:40 AM**

2015 SICON Paper Prize Lecture #1

*Room 408*

2017 SICON Paper Prize Lecture #1

*Room 409***9:45 AM - 10:05 AM**

2015 SICON Paper Prize Lecture #2

*Room 408*

2017 SICON Paper Prize Lecture #2

*Room 409*

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**Wednesday, July 12****9:15 AM - 10:00 AM**

SIAG/CST Prize Lecture

**Javad Lavaei**, *University of California, Berkeley, USA**Spirit of Pittsburgh B - 3rd Floor*

## Prizes and Awards Luncheon

The Prizes and Awards Luncheon will be held in the Westin Hotel - Allegheny Ballroom. The Westin is connected to the David Lawrence Convention Center (DLCC) via skywalk. The luncheon begins at 12:30 PM and the awards ceremony shortly thereafter. Please bring the ticket provided in your registration packet.

If you do not have a ticket but wish to attend the luncheon, see a SIAM staff member at the registration desk by noon on Monday, July 10.

The following Prizes and Awards will be recognized:

### **I.E. Block Community Lecture**

**Emily Shuckburgh**, *British Antarctic Survey, United Kingdom*

### **The John von Neumann Lecture**

**Bernard J. Matkowsky**, *Northwestern University, USA*

### **AWM-SIAM Sonia Kovalevsky Lecture**

**Liliana Borcea**, *University of Michigan, USA*

### **W. T. and Idalia Reid Prize in Mathematics**

**Jean-Michel Coron**, *Université Pierre et Marie Curie, France*

### **James H. Wilkinson Prize in Numerical Analysis and Scientific Computing**

**Lek-Heng Lim**, *University of Chicago, USA*

### **Ralph E. Kleinman Prize**

**Emmanuel Candès**, *Stanford University, USA*

### **George Pólya Prize for Mathematical Exposition**

**Nick Trefethen**, *University of Oxford, United Kingdom*

### **SIAM Prize for Distinguished Service to the Profession**

**Ya-xiang Yuan**, *Chinese Academy of Sciences, China*

### **SIAM Outstanding Paper Prizes**

Recipients to be announced

### **SIAM Student Paper Prize**

Recipients to be announced



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Plans for adding more content are on the horizon. Keep an eye out!

The audio, slide, and video presentations are part of SIAM's outreach activities to increase the public's awareness of mathematics and computational science in the real world, and to bring attention to exciting and valuable work being done in the field. Funding from SIAM, the National Science Foundation, and the Department of Energy was used to partially support this project.



New presentations are posted every few months as the program expands with sessions from additional SIAM meetings. Users can search for presentations by category, speaker name, and/or key words.

[www.siam.org/meetings/presents.php](http://www.siam.org/meetings/presents.php)

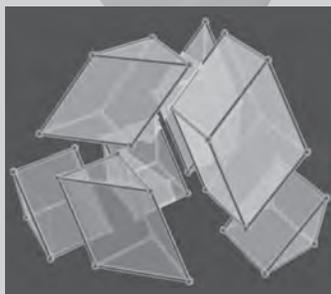
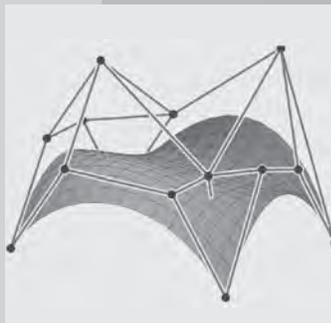


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Gene Golub  
**g2s3** 2018  
 SIAM Summer School

June 17-30, 2018  
 Breckenridge, Colorado, USA

**Inverse Problems: Systematic Integration of Data with Models under Uncertainty**



The ninth Gene Golub SIAM Summer School will take place at the Double Tree by Hilton in Breckenridge, Colorado, USA.

The summer school aims to introduce graduate students to the mathematical and computational aspects of inverse problems, particularly modern developments that emphasize the quantification of uncertainty in the inverse solution within the framework of Bayesian inference. The target audience is PhD and appropriate MS students in mathematics and related fields such as computer science, statistics, engineering, and science.

The central question we address is: How do we learn from data through the lens of models? The summer school will feature an integrated and coherent presentation that begins with ill-posedness and regularization, develops the ideas and tools for deterministic inversion via nonlinear least squares optimization, and elaborates formulations and solution methods for the modern Bayesian perspective, building on several of the deterministic tools. The concepts introduced in the morning lectures will be reinforced and put into practice in afternoon hands-on laboratory sessions using open-source software (hippylib, MUQ) implementing state-of-the-art deterministic and Bayesian inversion methods. Students will work together on projects that will be presented on the last day of the school.

The summer school is being organized by Omar Ghattas (The University of Texas at Austin), Youssef Marzouk (MIT), Matthew Parno (US Army Corps of Engineers), Noemi Petra (University of California, Merced), Georg Stadler (New York University), and Umberto Villa (The University of Texas at Austin).

Applicants selected to participate pay no registration fee. Funding for local accommodations and meal expenses will be available for all participants.

**Application deadline: February 1, 2018**

As information becomes available on how to apply, it will be posted at:

<http://www.siam.org/students/g2s3/>



Aspen Stand, woodcut by Leon Loughridge

*Sponsored by SIAM through an endowment from the estate of Gene Golub.*

*For more information about prior summer schools and Professor Gene Golub go to <http://www.siam.org/students/g2s3/>*

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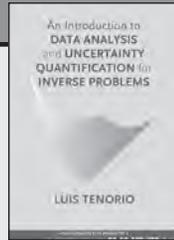
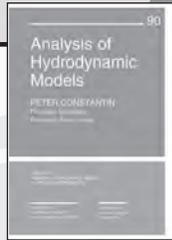
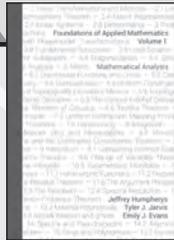
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# AN17 Program

AN17 Program

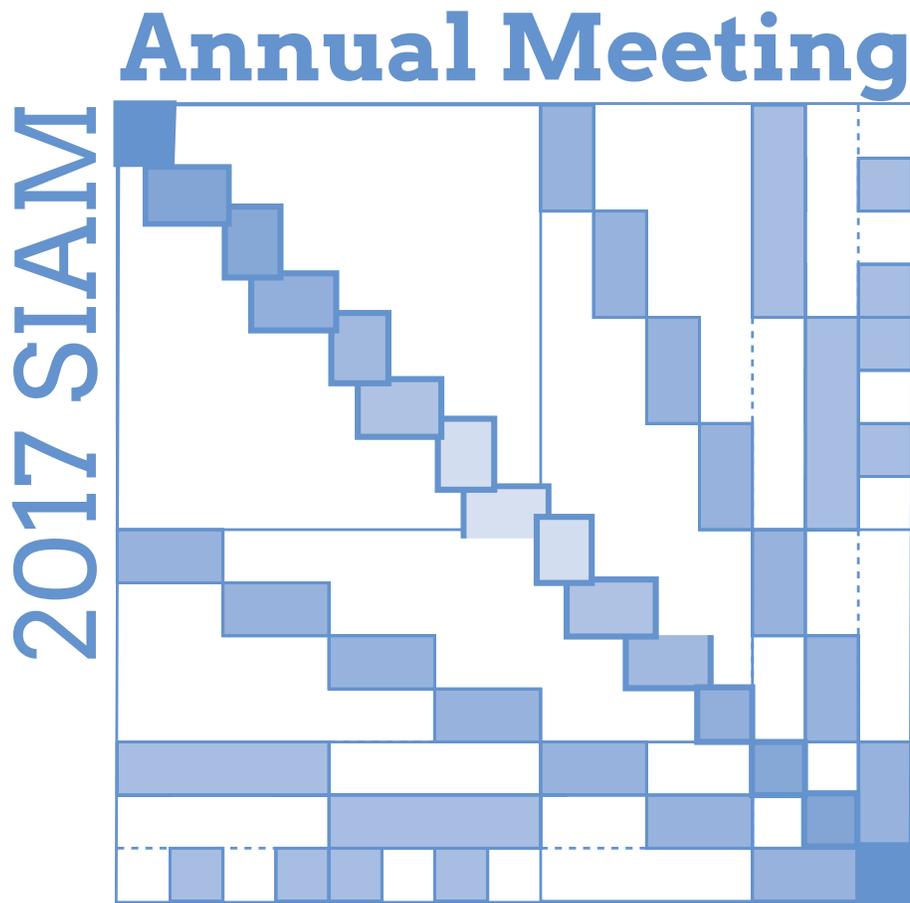


Figure courtesy Yuanzhe Xi, Ruipeng Li and Yousef Saad

**July 10-14, 2017**

David Lawrence Convention Center  
Pittsburgh, Pennsylvania, USA

[www.siam.org/meetings/an17](http://www.siam.org/meetings/an17)

## Sunday, July 9

### Registration

2:00 PM-8:00 PM

Room: Ballroom Gallery - 3rd Floor

### Student Orientation

5:00 PM-6:00 PM

Room: 306 & 307

### Welcome Reception

6:00 PM-8:00 PM

Room: South Terrace - 3rd Floor



## Monday, July 10

### Committee on Committees & Appointments Meeting

7:00 AM-8:30 AM

Room: Westin Hotel - Cambria West

### Diversity Advisory Committee Meeting

7:00 AM-8:30 AM

Room: Westin Hotel - Cambria East

### Registration

7:15 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Opening Remarks

8:15 AM-8:30 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Monday, July 10

## IT1

### Nonlinear Models for Matrix Completion

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Jennifer L. Mueller, Colorado State University, USA

The past decade of research on matrix completion has shown that it is possible to leverage linear dependencies to impute missing values in a low-rank matrix. However, the corresponding assumption that the data lies in or near a low-dimensional linear subspace is not always met in practice. Extending matrix completion theory and algorithms to exploit low-dimensional nonlinear structure in data will allow missing data imputation in a far richer class of problems. In this talk, I will describe several models of low-dimensional nonlinear structure and how these models can be used for matrix completion. In particular, we will explore matrix completion in the context of three different nonlinear models: single index models, in which a latent subspace model is transformed by a nonlinear mapping; unions of subspaces, in which data points lie in or near one of several subspaces; and nonlinear algebraic varieties, a polynomial generalization of classical linear subspaces. In these settings, we will explore novel and efficient algorithms for imputing missing values and new bounds on the amount of missing data that can be accurately imputed. The proposed algorithms are able to recover synthetically generated data up to predicted sample complexity bounds and outperform standard low-rank matrix completion in experiments with real recommender system and motion capture data.

Rebecca Willett

University of Wisconsin, Madison, USA

Monday, July 10

**IT2****Connections in Extremal Combinatorics: Ramsey Theory**

9:15 AM-10:00 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Rachel Levy, Harvey Mudd College, USA

Mathematics provides an abstract framework for connecting apparently unrelated problems. One field, Combinatorics, is simultaneously rich in connections, and also close to many applications in Computer Science. In this context, one often asks for the theoretical limit of how large a certain discrete structure could grow to, reminiscent of the analysis of the worst-case run-time complexity of an algorithm. This talk will open with an innocuous problem: how long of a column of triples of positive integers can you write, such that every integer is between 1 and  $N$  inclusive, and every pair of rows has the property that when the two rows' triples are compared column-by-column, the later row is strictly larger in more than half of the columns? This problem turns out to have rich connections to Combinatorial questions related to voting theory, as well as to Ramsey Theory, and to the very active and still unresolved area of mathematics around Szemerédi's Regularity Lemma.

Po-Shen Loh

Carnegie Mellon University, USA

**Exhibit Hall Open**

9:30 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

**Coffee Break**

10:00 AM-10:30 AM



Room: Ballroom Gallery - 3rd Floor

Monday, July 10

**MS1****Adapting Our Departments to Learn About and Support Diversity in Mathematics**

10:30 AM-12:30 PM

Room: 319

There are many ways in which mathematics faculty can support diversity and inclusion in their departments. The goal of this minisymposium is to give concrete ideas and tools to faculty so they can take these back to their own departments and adapt their offerings. Examples of this are: developing a program that will support STEM degree attainment by low-income students, running a women in math conference, organizing a seminar focused on issues of diversity and inclusion, and running a diversity training. We will focus on lessons learned in working with and for a diverse population.

Organizer: Rosalie Belanger-Rioux

Harvard University, USA

**10:30-10:55 Providing Opportunities for Low-Income Math Students With Academic Promise**

Ron Buckmire, National Science Foundation, USA

**11:00-11:25 Women in Sage: Coding, Collaborating, and Creating Networks for Women in Math**

Anna Haensch, Duquesne University, USA

**11:30-11:55 Promoting Diversity in Mathematics: Bringing the Community into Conversations and Action**

Sunny Xiao, Brown University, USA

**12:00-12:25 Using Case Studies In A Diversity Training**

Rosalie Belanger-Rioux, Harvard University, USA

Monday, July 10

**MS2****Advances Approaches for PDE-Constrained Bayesian Inverse Problems - Part I of II**

10:30 AM-12:30 PM

Room: 318

**For Part 2 see MS10**

Organized by SIAG/UQ

The numerical solution of inverse problems involving complex forward models has become essential to uncertainty quantification in many science and engineering applications. Here, the Bayesian approach provides rigorous characterizations of uncertainty. Yet computational characterisation of the posterior distribution---typically via sampling---remains a computationally challenging task. Challenges include adapting to correlated, concentrated, and non-Gaussian posterior structure; performing real-time estimation from large data streams; handling forward models in a non-intrusive setting; and developing mathematical analysis to illuminate and guide these approaches. This minisymposium presents recent advanced developments in efficient and scalable methods for exploring the posterior. Sampling methods (including MCMC, EnKF, and sparse quadratures in high or infinite-dimensional parameter spaces), fast low rank or reduced-order methods, efficient approximation methods, structure-exploiting methods, advanced polynomial chaos approaches, etc are welcome.

Organizer: Tan Bui-Thanh  
University of Texas at Austin, USA

Monday, July 10

## MS2

### Advances Approaches for PDE-Constrained Bayesian Inverse Problems - Part I of II

10:30 AM-12:30 PM

continued

#### 10:30-10:55 Accelerating Markov Chain Monte Carlo with Active Subspaces

*Paul Constantine* and *Carson Kent*, Colorado School of Mines, USA; *Tan Bui-Thanh*, University of Texas at Austin, USA

#### 11:00-11:25 Numerical Posterior Distribution Error Control and Expected Bayes Factors

*Marcos A. Capistran*, *J. Andrés Christen*, and *Miguel A. Moreles*, CIMAT, Mexico

#### 11:30-11:55 Derivative-Informed Mcmc for Bayesian Calibration of Stochastic Pde Models

*Umberto Villa* and *Omar Ghattas*, University of Texas at Austin, USA

#### 12:00-12:25 Efficient Evaluation of Rare Event Probabilities Using Bayesian Inference

*Siddhant Wahal* and *George Biros*, University of Texas at Austin, USA

Monday, July 10

## MS3

### AWM Workshop: Recent Advances in Numerical Analysis and Scientific Computing -- Part I of II

10:30 AM-12:30 PM

*Room:305*

#### For Part 2 see MS11

This 2-part special session aims at bringing together women mathematicians at various levels, invited from the Women in Numerical Analysis and Scientific Computing (WINASC) Research Network, to share and discuss the recent progress of their research. Topics will include mathematical modeling, high order numerical discretizations (such as spectral methods, discontinuous Galerkin methods, WENO methods), regularization strategies, efficient solvers, and sensitivity analysis, for applications as diverse as in plasma physics, fluid dynamics, solid mechanics, and biology.

Organizer: *Fengyan Li*  
*Rensselaer Polytechnic Institute, USA*

Organizer: *Susanne Brenner*  
*Louisiana State University, USA*

Organizer: *Beatrice Riviere*  
*Rice University, USA*

#### 10:30-10:55 A New Convergence Analysis of Finite Element Methods for Elliptic Distributed Optimal Control Problems with Pointwise State Constraints

*Susanne Brenner*, Louisiana State University, USA

#### 11:00-11:25 Super-convergence of the Asymptotic Approximation of Linear Kinetic Equation with Spectral Methods

*Zheng Chen*, Oak Ridge National Laboratory, USA

#### 11:30-11:55 Numerical Methods for the Chemotaxis Models

*Yekaterina Epshteyn*, University of Utah, USA

#### 12:00-12:25 The Effect of the Sensitivity Parameter in Weighted Essentially Non-oscillatory Methods

*Yulia Hristova*, University of Michigan, Dearborn, USA

Monday, July 10

## MS4

### Career Fair: Alternatives to Academia

10:30 AM-12:30 PM

*Room:302-304*

#### For Part 2 see MS12

The career fair will feature employers from business, industry and government. These representatives will be prepared to discuss with you the opportunities for internships, postdoctoral appointments and full-time jobs at their organizations.

Organizer: *William G. Kolata*  
*SIAM, USA*

The Most Current List of Participating Companies is available at <http://www.siam.org/meetings/AN17/career.php>

Monday, July 10

**MS5****High-Dimensional Dynamical System Inference - Part I of II**

10:30 AM-12:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor***For Part 2 see MS14**

Modern sensors are collecting high-dimensional observations of dynamical systems at unprecedented rates. Such data have the potential to revolutionize our understanding of biological neural networks, finance, healthcare trajectories, astronomy, and social networks. Despite this plethora of data, however, relatively little is known about how to accurately conduct inference in these settings. Recent literature on high-dimensional statistics provides an initial toehold for investigators, but observations of dynamical systems exhibit strong temporal dependencies and other characteristics that preclude straightforward adoption of existing methodology. This minisymposium will explore the current state-of-the-art in inference methods, theoretical guarantees, and novel applications for high-dimensional dynamical systems.

Organizer: Rebecca Willett  
*University of Wisconsin, Madison, USA*

**10:30-10:55 Nonlinear Autoregressive Point Processes**

*Benjamin Mark, University of Wisconsin, Madison, USA*

**11:00-11:25 Learning Influence Structure Among Variables: An Interventional Measurement Approach**

*Negar Kiyavash, University of Illinois at Urbana-Champaign, USA*

**11:30-11:55 Lasso Guarantees for High Time Dimensional Time Series Estimation under Mixing Conditions**

*Ambuj Tewari, University of Michigan, USA*

**12:00-12:25 Rate-Optimal Estimation of High Dimensional Time Series**

*Han Liu, Princeton University, USA*

Monday, July 10

**MS6****Lie and Non-Lie Symmetries: Theory and Applications - Part I of II**

10:30 AM-12:30 PM

*Room: 317***For Part 2 see MS15**

Since the end of 19th century when the prominent Norwegian mathematician Sophus Lie created the theory of Lie algebras and Lie groups and developed the method of their applications for solving differential equations, his theory and method have continuously been in focus of research of many mathematicians and physicists. The minisymposium is devoted to recent developments in symmetry-based methods and their applications for solving physically and biologically motivated equations and models. Participation of leading experts in symmetry-based methods and a wide geographical spread of the minisymposium speakers will guarantee the highest quality of presentations and bring attention of many participants of the SIAM meeting.

Organizer: Danny Arrigo  
*University of Central Arkansas, USA*

Organizer: Roman Cherniha  
*National Academy of Science, Ukraine*

**10:30-10:55 Nonclassical Symmetry Solutions of Useful Nonlinear Reaction-Diffusion Equations in N Dimensions**

*Phil Broadbridge, La Trobe University, Australia*

**11:00-11:25 Conservation Laws and Symmetries of Nonlinear Diffusion-Reaction Equations with Gradient Diffusivity in Multi-Dimensions**

*Stephen Anco, Brock University, Canada*

**11:30-11:55 Generalized Equivalence Transformations For Differential Equations Involving Specific Arbitrary Functions**

*Nicoleta V. Bila, Fayetteville State University, USA*

**12:00-12:25 Lie and Conditional Symmetries of Some Multicomponent Systems of Nonlinear Evolution Equations and Their Application for Constructing Exact Solutions**

*Roman Cherniha, National Academy of Science, Ukraine*

Monday, July 10

**MS7****New Algorithms for Scientific Computing at Exascale - Part I of II**

10:30 AM-12:30 PM

*Room: Spirit of Pittsburgh B - 3rd Floor***For Part 2 see MS16**

Organized by SIAG/SC

Supercomputers are designated to reach exascale performance in the early 2020ies. How will algorithms and applications need to be (re-)designed, updated and implemented to meet the demands of the respective hardware? This minisymposium will present recent work and next steps of eight projects from the various exascale computing initiatives worldwide.

Organizer: Michael Bader  
*Technical University of Munich, Germany*

Organizer: Laura Grigori  
*Inria, France*

**10:30-10:55 Communication Avoiding Iterative Methods and NLAFT Project**

*Laura Grigori, Inria, France*

**11:00-11:25 Inexact Coarse Solvers For Adaptive Preconditioners Using Block Recycled Iterative Methods**

*Pierre Jolivet, CNRS, France*

**11:30-11:55 Asynchronous Iterative Solvers for Extreme-Scale Computing**

*Edmond Chow, Georgia Institute of Technology, USA; Erik G. Boman, Sandia National Laboratories, USA; Jack J. Dongarra, University of Tennessee and Oak Ridge National Laboratory, USA; Daniel B. Szyld, Temple University, USA*

**12:00-12:25 Factorization Based Sparse Solvers and Preconditioners for Exascale**

*Xiaoye S. Li and Pieter Ghysels, Lawrence Berkeley National Laboratory, USA; Christopher Gorman, University of California, Santa Barbara, USA; Francois-Henry Rouet, Livermore Software Technology Corporation, USA*

Monday, July 10

## MS8

### Novel Numerical Methods for PDEs - Part I of II

10:30 AM-12:30 PM

Room:316

#### For Part 2 see MS17

Approximation of the solutions associated with PDEs has been one of the major research interests in the computational/applied science. This is because of the rapid growth of the complexity in engineering/scientific problems involving PDEs in recent years. Thus, to a large extent, a major thrust in these communities has been to improve the collective ability to develop new novel numerical approaches to solve complicated PDEs. Traditionally, a set of PDEs is solved numerically by such approaches as FDM, FEM, FVM, BEM, etc. In this minisymposium, we aim to introduce a few novel numerical methods for solving various kinds of PDEs.

Organizer: Guangming Yao  
Clarkson University, USA

Organizer: L.H. Kuo  
University of West Florida, USA

#### 10:30-10:55 Krylov Subspace Spectral Methods for Navier-Stokes in Cylindrical Geometries

Brianna Bingham and James V. Lambers,  
University of Southern Mississippi, USA

#### 11:00-11:25 A Smoothed Radial Point Interpolation Implicit Method for Heat Conduction Based on the Element-by-Element Technique

Wen Li and Guangming Yao, Clarkson  
University, USA

#### 11:30-11:55 Scalable Computation of Matrix Functions for Time-Dependent Pdes Through Asymptotic Analysis of Block Krylov Projection

Alex Cibotarica, Ivy Tech Community  
College, USA

#### 12:00-12:25 Local Radial Basis Function Method for Quenching Problem

Guangming Yao and Wen Li, Clarkson  
University, USA

Monday, July 10

## MS9

### Student Days: Undergraduate Research Presentations - Part I of II

10:30 AM-12:30 PM

Room:310

#### For Part 2 see MS19

Organized by the SIAM Education  
Committee

This is a two-part session with speakers presenting research done while they were undergraduates. The talks are open to all areas of applied and computational mathematics.

Organizer: Suzanne L. Weekes  
Worcester Polytechnic Institute, USA

Organizer: Luis Melara  
Shippensburg University, USA

Organizer: Sigal Gottlieb  
University of Massachusetts, Dartmouth,  
USA

10:30-10:45 Modeling the Spread of Ebola with SEIR and Optimal Control  
Harout Boujakjian, George Mason  
University, USA

#### 10:50-11:05 Equivalence of n-th Order Difference Equations Under Point Transformations

Jonathan D. Colon, State University of New  
York, New Paltz, USA

#### 11:10-11:25 Numerical Phase Retrieval From Power Spectra of Deterministically Masked Signals

Nicholas Frederick and Sami Merhi,  
Michigan State University, USA

#### 11:30-11:45 A Multicompartment Mathematical Model of Neuroblastoma Tumor Growth

Yixuan He, Dartmouth College, USA

#### 11:50-12:05 Trend to Equilibrium for a Delay Vlasov-Fokker-Planck Equation and Explicit Decay Estimates

Lisa M. Kreusser, University of  
Kaiserslautern, Germany

#### 12:10-12:25 Modeling-Backed Microwave Imaging in Closed Systems: Reconstruction of a Spherical Inhomogeneity

Taylor J. York, Worcester Polytechnic  
Institute, USA

Monday, July 10

## CP1

### Life Sciences - Part I of V

10:30 AM-12:30 PM

Room:306

#### For Part 2 see CP3

Chair: Donald A. Drew, Rensselaer  
Polytechnic Institute, USA

#### 10:30-10:45 Modeling of Retinal Hemodynamics Coupled with Lamina Cribrosa Deformation

Lucia Carichino, Worcester Polytechnic  
Institute, USA; Giovanna Guidoboni,  
Indiana University - Purdue University  
Indianapolis, USA; Alon Harris, Indiana  
University School of Medicine, USA

#### 10:50-11:05 A Mathematical Model for Nutrient Metabolic Chemistry

Donald A. Drew, Rensselaer Polytechnic  
Institute, USA

#### 11:10-11:25 Influence of Autosomal Monoallelic Expression on Signal Transduction Through Network Motifs

Shibin Mathew, Harvard Medical School,  
USA; Alexander Gimelbrant, Dana-Farber  
Cancer Institute, USA; Suzanne Gaudet,  
Harvard Medical School, USA

#### 11:30-11:45 Robust Regulation of Hepatic Pericentral Amination by Glutamate Dehydrogenase Kinetics

Soumen Bera, Central University of  
Rajasthan, India

#### 11:50-12:05 Hydrodynamic Model for Pattern Formation in Tissues

Xueping Zhao, University of South Carolina,  
USA; Qi Wang, University of South  
Carolina, USA and Beijing Computational  
Science Research Center, China

#### 12:10-12:25 Reconstruction of Dynamical Trajectories of Cells Based on Single-Cell Data

Lin Wan, Chinese Academy of Sciences,  
China

Monday, July 10

**CP2****Fluids - Part I of III**

10:30 AM-12:30 PM

Room:307

For Part 2 see CP6

Chair: Kimberly Spayd, Gettysburg College, USA

**10:30-10:45 The Influence of Tear Supply on Tear Film Formation During Upstroke**

Kara L. Maki, Rochester Institute of Technology, USA; William Henshaw, Rensselaer Polytechnic Institute, USA; Alex McManus, Rochester Institute of Technology, USA; Richard Braun and Tobin Driscoll, University of Delaware, USA

**10:50-11:05 Complete Stabilization of Multi-Layer Radial Hele-Shaw Flows Using a Time-Dependent Injection Rate and the Associated Interface Motion**

Craig Gin and Prabir Daripa, Texas A&M University, USA

**11:10-11:25 Generalizing the Modified Buckley-Leverett Equation with Tcat Capillary Pressure**

Kimberly Spayd, Gettysburg College, USA

**11:30-11:45 Non-Classical Dispersive Shock Waves in Shallow Water: Theory and Experiments**

Patrick Sprenger and Mark A. Hoefer, University of Colorado Boulder, USA

**11:50-12:05 Unsteady Flow of Thixotropic Fluid in a Slowly Varying Pipe**

Andrew I. Croudace, David Pritchard, and Stephen Wilson, University of Strathclyde, United Kingdom

**12:10-12:25 The Stationary Navier-Stokes System with No-slip Boundary Condition on Polygons: Corner Singularity and Regularity**

Jae Ryong Kweon, Pohang University of Science and Technology, Korea

Monday, July 10

**Lunch Break**

12:30 PM-2:00 PM

Attendees on their own

**Major Awards Committee Meeting**

12:30 PM-2:00 PM

Room:Westin Hotel - Cambria West

**JP1****Bio-Inspired Dynamics for Multi-Agent Decision-Making**

2:00 PM-2:45 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Fariba Fahroo, Defense Advanced Research Projects Agency, USA

I will present a generalizable framework that uses the singularity theory approach to bifurcation problems, and other tools of nonlinear dynamics, to translate some of the remarkable features of collective animal behavior to an abstract agent-based model. With the abstract model, analysis and design of decision-making between alternatives can be systematically pursued for natural or engineered multi-agent systems. To illustrate, I will apply the framework to explore and extend value-sensitive decision-making dynamics that explain the adaptive and robust behavior of house-hunting honeybees.

Naomi E. Leonard  
Princeton University, USA

Monday, July 10

**SP1****AWM-SIAM Sonia Kovalevsky Lecture: Mitigating Uncertainty in Inverse Wave Scattering**

2:45 PM-3:30 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Ami Radunskaya, Pomona College, USA

Inverse wave scattering is an inverse problem for the wave equation, driven by a broad spectrum of applications. It is an interdisciplinary area that involves mathematical analysis, computational modeling, statistics and signal processing. This lecture will discuss one important challenge due the uncertainty of the model for inversion. Uncertainty is unavoidable in applications, not only because of noise, but because of lack of detailed knowledge of complex media through which the waves propagate.

Liliana Borcea  
University of Michigan, USA

**Coffee Break**

3:30 PM-4:00 PM



Room:Ballroom Gallery - 3rd Floor

Monday, July 10

## MS10

### Advances Approaches for PDE-Constrained Bayesian Inverse Problems - Part II of II

4:00 PM-6:00 PM

Room:318

For Part 1 see MS2

Organized by SIAG/UQ

The numerical solution of inverse problems involving complex forward models has become essential to uncertainty quantification in many science and engineering applications. Here, the Bayesian approach provides rigorous characterizations of uncertainty. Yet computational characterisation of the posterior distribution---typically via sampling---remains a computationally challenging task. Challenges include adapting to correlated, concentrated, and non-Gaussian posterior structure; performing real-time estimation from large data streams; handling forward models in a non-intrusive setting; and developing mathematical analysis to illuminate and guide these approaches. This minisymposium presents recent advanced developments in efficient and scalable methods for exploring the posterior. Sampling methods (including MCMC, EnKF, and sparse quadratures in high or infinite-dimensional parameter spaces), fast low rank or reduced-order methods, efficient approximation methods, structure-exploiting methods, advanced polynomial chaos approaches, etc are welcome.

Organizer: Tan Bui-Thanh  
*University of Texas at Austin, USA*

#### 4:00-4:25 Bayesian Uncertainty Quantification in Numerical Integration

*Briol Francois-Xavier, University of Warwick, United Kingdom*

#### 4:30-4:55 Optimal Parameter Dimension Reduction for Nonlinear Bayesian Inverse Problems

*Olivier Zahm, Massachusetts Institute of Technology, USA*

#### 5:00-5:25 Bayesian Inference for an Estimating Discrepancy Functions in Turbulence Models

*Wouter N. Edeling and Gianluca Iaccarino, Stanford University, USA*

#### 5:30-5:55 QMC with Product Weights for Elliptic PDEs with Coefficients Parametrized in Multifiresolution Representations

*Lukas Herrmann, Robert N. Gantner, and Christoph Schwab, ETH Zürich, Switzerland*

Monday, July 10

## MS11

### AWM Workshop: Recent Advances in Numerical Analysis and Scientific Computing -- Part II of II

4:00 PM-6:00 PM

Room:305

For Part 1 see MS3

This 2-part special session aims at bringing together women mathematicians at various levels, invited from the Women in Numerical Analysis and Scientific Computing (WINASC) Research Network, to share and discuss the recent progress of their research. Topics will include mathematical modeling, high order numerical discretizations (such as spectral methods, discontinuous Galerkin methods, WENO methods), regularization strategies, efficient solvers, and sensitivity analysis, for applications as diverse as in plasma physics, fluid dynamics, solid mechanics, and biology.

Organizer: Fengyan Li

*Rensselaer Polytechnic Institute, USA*

Organizer: Susanne Brenner

*Louisiana State University, USA*

Organizer: Beatrice Riviere

*Rice University, USA*

#### 4:00-4:25 Pseudo-time Adaptive Regularization for Nonmonotone Problems

*Sara Pollock, Wright State University, USA*

#### 4:30-4:55 On the Sensitivity to the Filtering Radius in Leray Models of Incompressible Flow

*Annalisa Quaini, University of Houston, USA*

#### 5:00-5:25 A BDDC Preconditioner for $C^0$ Interior Penalty Methods

*Kening Wang, University of North Florida, USA*

#### 5:30-5:55 A Moving Mesh WENO Method Based on Exponential Polynomials for One-dimensional Conservation Laws

*Yan Jiang, Michigan State University, USA*

*continued in next column*

Monday, July 10

**MS12****Career Fair: Alternatives to Academia**

4:00 PM-6:00 PM

*Room: 302-304***For Part 1 see MS4**

The career fair will feature employers from business, industry and government. These representatives will be prepared to discuss with you the opportunities for internships, postdoctoral appointments and full-time jobs at their organizations.

Organizer: William G. Kolata  
*SIAM, USA*

**The Most Current List of Participating Companies is available at <http://www.siam.org/meetings/AN17/career.php>**

Monday, July 10

**MS13****Discrete Active Systems Sharing Dynamic Media**

4:00 PM-6:00 PM

*Room: 319*

Most mechanical systems operate in contact with solid or fluid media. Interaction with a dynamic medium like a compliant solid substrate or a nonstationary fluid can affect a system's behavior substantially. When multiple systems interact with a shared medium, like the mantel beneath Huygens' pendulum clocks or the water flowing through a school of fish, the resulting dynamic coupling can engender phenomena like attraction, repulsion, or synchronization. This minisymposium presents research concerning both the emergent dynamics of individually actuated devices coupled through shared media and the investigation of the dynamics of shared media by distributed devices under control.

Organizer: Scott D. Kelly

*University of North Carolina, Charlotte, USA*

**4:00-4:25 Dynamics and Interactions of Wheeled Robots on Movable Platforms**

Scott D. Kelly, University of North Carolina, Charlotte, USA

**4:30-4:55 Motion Control and Coordination of Underactuated Bodies in An Ideal Fluid**

Tony Dear, Carnegie Mellon University, USA

**5:00-5:25 Optimizing the Performance of Hydrofoils Coupled Through a Vortical Ideal Fluid**

Michael J. Fairchild and Clarence Rowley, Princeton University, USA; Rakshit Bhansali and Scott D. Kelly, University of North Carolina, Charlotte, USA

**5:30-5:55 Synch Or Swim: Coordinating Robot Teams in Geophysical Flows**

Ani Hsieh, Drexel University, USA; Shibabrat Naik, Virginia Tech, USA; Eric Forgoston, Montclair State University, USA; Herbert Tanner, University of Delaware, USA; Philip Yecko, Montclair State University, USA

Monday, July 10

**MS14****High-Dimensional Dynamical System Inference - Part II of II**

4:00 PM-6:00 PM

*Room: Spirit of Pittsburgh A - 3rd Floor***For Part 1 see MS5**

Modern sensors are collecting high-dimensional observations of dynamical systems at unprecedented rates. Such data have the potential to revolutionize our understanding of biological neural networks, finance, healthcare trajectories, astronomy, and social networks. Despite this plethora of data, however, relatively little is known about how to accurately conduct inference in these settings. Recent literature on high-dimensional statistics provides an initial toehold for investigators, but observations of dynamical systems exhibit strong temporal dependencies and other characteristics that preclude straightforward adoption of existing methodology. This minisymposium will explore the current state-of-the-art in inference methods, theoretical guarantees, and novel applications for high-dimensional dynamical systems.

Organizer: Rebecca Willett

*University of Wisconsin, Madison, USA*

**4:00-4:25 Vector Autoregressive Model Inference with Missing Data**

Amin Jalali and Rebecca Willett, University of Wisconsin, Madison, USA

**4:30-4:55 Network Reconstruction From High-Dimensional Ordinary Differential Equations (ODEs)**

Ali Shojaie, University of Michigan, USA

**5:00-5:25 Network Modeling of High-Dimensional Time Series in the Presence of Factors**

Sumanta Basu, University of Michigan, USA; George Michailidis, University of Florida, USA

**5:30-5:55 Scalable Inference of Neural Dynamical Systems**

Alyson Fletcher, University of California, Los Angeles, USA

**SIAM Presents**

Since 2008, SIAM has recorded many Invited Lectures, Prize Lectures, and selected Minisymposia from various conferences. These are available by visiting SIAM Presents (<http://www.siam.org/meetings/presents.php>).



Monday, July 10

## MS15

### Lie and Non-Lie Symmetries: Theory and Applications - Part II of II

4:00 PM-6:00 PM

Room:317

#### For Part 1 see MS6

Since the end of 19th century when the prominent Norwegian mathematician Sophus Lie created the theory of Lie algebras and Lie groups and developed the method of their applications for solving differential equations, his theory and method have continuously been in focus of research of many mathematicians and physicists. The minisymposium is devoted to recent developments in symmetry-based methods and their applications for solving physically and biologically motivated equations and models. Participation of leading experts in symmetry-based methods and a wide geographical spread of the minisymposium speakers will guarantee the highest quality of presentations and bring attention of many participants of the SIAM meeting.

Organizer: Danny Arrigo

University of Central Arkansas, USA

Organizer: Roman Cherniha

National Academy of Science, Ukraine

#### 4:00-4:25 Analytic Lie Symmetric Solutions of Nonlinear Partial Differential Equations

Barbara Abraham-Shrauner, Washington University, St. Louis, USA

#### 4:30-4:55 Composition of Lie Group Elements from Basis Lie Algebra Elements

George Bluman, University of British Columbia, Canada

#### 5:00-5:25 Lie Point Symmetry Preserving Discretization of the Liouville Equation

Pavel Winternitz, Université de Montréal, Canada

#### 5:30-5:55 You Have a Mathematical Model: What's Next?

Maria Clara Nucci, Università di Perugia, Italy

Monday, July 10

## MS16

### New Algorithms for Scientific Computing at Exascale - Part II of II

4:00 PM-6:00 PM

Room: Spirit of Pittsburgh B - 3rd Floor

#### For Part 1 see MS7

Organized by SIAG/SC

Supercomputers are designated to reach exascale performance in the early 2020ies. How will algorithms and applications need to be (re-)designed, updated and implemented to meet the demands of the respective hardware? This minisymposium will present recent work and next steps of eight projects from the various exascale computing initiatives worldwide.

Organizer: Michael Bader

Technical University of Munich, Germany

Organizer: Laura Grigori

Inria, France

#### 4:00-4:25 Hierarchical Computations on Manycore Architectures: The HiCMA Library

Kadir Akbudak and Ali Charara, King Abdullah University of Science & Technology (KAUST), Saudi Arabia; David E. Keyes, KAUST, Saudi Arabia and Columbia University, USA; Hatem Ltaief and Aleksandr Mikhalev, King Abdullah University of Science & Technology (KAUST), Saudi Arabia; George M Turkiyyah, American University of Beirut, Lebanon and King Abdullah University of Science & Technology (KAUST), Saudi Arabia

#### 4:30-4:55 Towards Exascale in High-Order Computational Fluid Dynamics

Philipp Schlatter, KTH Stockholm, Sweden

#### 5:00-5:25 Experiences with AMR Co-application from the Perspective of an Application using AMR

Anshu Dubey, Argonne National Laboratory, USA

#### 5:30-5:55 It's not an ExaHyPE, yet: ADER-DG on Tree-structured Meshes for an Exascale Hyperbolic PDE Engine

Michael Bader, Technical University of Munich, Germany

Monday, July 10

## MS17

### Novel Numerical Methods for PDEs - Part II of II

4:00 PM-6:00 PM

Room:316

#### For Part 1 see MS8

Approximation of the solutions associated with PDEs has been one of the major research interests in the computational/applied science. This is because of the rapid growth of the complexity in engineering/scientific problems involving PDEs in recent years. Thus, to a large extent, a major thrust in these communities has been to improve the collective ability to develop new novel numerical approaches to solve complicated PDEs. Traditionally, a set of PDEs is solved numerically by such approaches as FDM, FEM, FVM, BEM, etc. In this minisymposium, we aim to introduce a few novel numerical methods for solving various kinds of PDEs.

Organizer: Guangming Yao

Clarkson University, USA

Organizer: L.H. Kuo

University of West Florida, USA

#### 4:00-4:25 Discrete Convolution Methods for Solving Differential Equations

Joseph Kolibal, University of New Haven, USA

#### 4:30-4:55 A New Adaptive Method Modified Knot Insertion for RBF Approximation

L.H. Kuo, University of West Florida, USA

#### 5:00-5:25 Wavelet Regularized Solution of Laplace Equation in an Arbitrary Shaped Domain

Vani Cheruvu, University of Toledo, USA

#### 5:30-5:55 Rapid Modification of Orthogonal Polynomials for Pdes in Polar and Cylindrical Geometries

Amber C. Sumner and James V. Lambers, University of Southern Mississippi, USA

Monday, July 10

**MS18****Panel: Celebrating Diversity in Mathematical Sciences**

4:00 PM-6:00 PM

Room:406

The purpose of the Panel is to learn and share about historic perspectives, policy issues and program initiatives in mathematical sciences to improve the preparation, increase the participation and ensure the contribution of members from underrepresented groups. The panel will consist of distinguished members whose work has impacted nationally to address equity and inclusion-related challenges and opportunities in mathematics. Participants will have the opportunity to learn from these experts about policies and procedures that can help identify ways to facilitate careers in mathematics for traditionally underrepresented groups. They will also learn about successful examples across the country that has helped to create sustainable projects and programs for diversity, inclusion, and broadening participation in mathematics. The panel will be moderated by Dr. Padmanabhan Seshaiyer who is the current chair of the SIAM Diversity Advisory Committee.

Organizer: Padmanabhan Seshaiyer

*George Mason University, USA*

**Panelists**

**Ami Radunskaya**

Pomona College, USA

**Richard A. Tapia**

Rice University, USA

**Carlos Castillo-Chavez**

Arizona State University, USA

**Cristina Villalobos**

University of Texas, Rio Grande Valley

Monday, July 10

**MS19****Student Days: Undergraduate Research Presentations - Part II of II**

4:00 PM-6:00 PM

Room:310

**For Part 1 see MS9**

Organized by the SIAM Education Committee

This is a two-part session with speakers presenting research done while they were undergraduates. The talks are open to all areas of applied and computational mathematics.

Organizer: Suzanne L. Weekes  
*Worcester Polytechnic Institute, USA*

Organizer: Luis Melara  
*Shippensburg University, USA*

Organizer: Sigal Gottlieb  
*University of Massachusetts, Dartmouth, USA*

**4:00-4:15 Optimization of Power Output in a Magnetohydrodynamic Generator**

*Michael T. Redle, Oregon State University, USA*

**4:20-4:35 Efficiency of Water Distribution in Water Poor Areas of the World**

*Mitchell E. Sailsbery, Brigham Young University, USA*

**4:40-4:55 A Study of Parallel Simulation Procedures for the Taylor-Green Vortex Problem Using PETSc**

*Nicholas W. Stegmeier, South Dakota State University, USA*

**5:00-5:15 The Behavior of the Phase Response Curve Near Bifurcations in a Neuronal Model**

*Vighnesh Viswanathan and Michael Block, University of Pittsburgh, USA*

**5:20-5:35 Modeling Over-the-Counter Derivative Trading with and without Central Clearing Parties**

*Natalie S. Wellen, Worcester Polytechnic Institute, USA*

**5:40-5:55 Recovery Time of Backed up Traffic**

*Ryan L. Reading, The Ohio State University, USA*

Monday, July 10

**CP3****Life Sciences - Part II of V**

4:00 PM-6:00 PM

Room:306

**For Part 1 see CP1****For Part 3 see CP12**

*Chair: Alvaro A. Ortiz Lugo, University of Cincinnati, USA*

**4:00-4:15 Observation, Modeling and Computation of Algal Swimming and Photosynthesis**

*Louis F. Rossi, University of Delaware, USA*

**4:20-4:35 Modeling Stripe Formation on the Body and Fins of Zebrafish**

*Alexandria Volkening and Bjorn Sandstede, Brown University, USA*

**4:40-4:55 Mathematical Modeling of Plants under Multiple Stressors**

*Maria Leite, University of South Florida, St. Petersburg, USA; Benito Chen-Charpentier, University of Texas at Arlington, USA; Orou Gaoue, University of Hawaii, Manoa, USA; Folashade Augusto, University of Kansas, USA*

**5:00-5:15 Modeling the Evolution of Visual Female Sexual Signaling**

*Kelly Rooker and Sergey Gavrillets, University of Tennessee, Knoxville, USA*

**5:20-5:35 Mathematical Model of Pathogen Dynamics in a Water Distribution Network under Time-Constant Flow Conditions**

*Benjamin L. Vaughan, Sadiqah Al Marzooq, and Alvaro Ortiz-Lugo, University of Cincinnati, USA*

**5:40-5:55 Analysis of a Mathematical Model of Pathogen Dynamics in Water Distribution Networks With Time Periodic and Aperiodic Flows**

*Alvaro A. Ortiz Lugo, University of Cincinnati, USA*

Monday, July 10

## CP4

### Numerical PDE - Part I of III

4:00 PM-6:00 PM

Room:307

For Part 2 see CP20

Chair: Todd Arbogast, University of Texas at Austin, USA

#### 4:00-4:15 A Semi-Lagrangian Finite Difference Weno Scheme for Scalar Nonlinear Conservation Laws

Todd Arbogast, University of Texas at Austin, USA; Chieh-Sen Huang, National Sun Yat-Sen University, Taiwan; Chen-Hui Hung, Air Force Academy, USA

#### 4:20-4:35 High Order Monotone LPS Scheme Based on Bernstein-Bezier Finite Elements for Nonlinear Hyperbolic Systems

Sibusiso Mabuza and John N. Shadid, Sandia National Laboratories, USA; Dmitri Kuzmin and Christoph Lohmann, Dortmund University of Technology, Germany

#### 4:40-4:55 A Numerical Study on the Time Parallel Approach for the Semi-Linear Wave and Dirac Equations

Jung-Han Kimn, South Dakota State University, USA; Hyun Lim, Brigham Young University, USA; Nicholas W. Stegmeier, South Dakota State University, USA

#### 5:00-5:15 Direct Fem Simulation of Multi-Phase Turbulent Flow

Margarida Moragues Ginard, Tania Bakhos, and Daniel Castañón, Basque Center for Applied Mathematics, Spain; Johan Hoffman, Royal Institute of Technology, Stockholm, Sweden; Johan Jansson, KTH Royal Institute of Technology, Sweden; Ezhilmathi Krishnasamy and Massimiliano Leoni, Basque Center for Applied Mathematics, Spain; Laura Saavedra, Polytechnic University of Madrid, Spain

#### 5:20-5:35 The Semi-Lagrangian Discontinuous Galerkin Method on Modern Computer Architectures

Lukas Einkemmer, University of Innsbruck, Austria

#### 5:40-5:55 An Approximate Inverse Preconditioner for Spatial Fractional Diffusion Equations with Piecewise Continuous Coefficients

Zhi-Wei Fang, Hai-Wei Sun, and Hui-Qin Wei, University of Macau, China

## Intermission

6:00 PM-6:15 PM

Monday, July 10

### Workshop Celebrating Diversity (WCD) Meet-and-Greet

6:15 PM-7:15 PM

Room:South Terrace - 3rd Floor

## PD1

### Student Careers in Business, Industry and Government (BIG)

6:15 PM-7:15 PM

Room:Spirit of Pittsburgh A - 3rd Floor

Chair: William G. Kolata, SIAM, USA

Chair: Rachel Levy, Harvey Mudd College, USA

It is worth investigating BIG career opportunities. Mathematics and computational science play a pivotal role in many industry and government. Applied mathematics and computation is widely used in various aspects of research, engineering, manufacturing and technical services. This panel will feature individuals with experience in industry or government. Following short introductions, the moderator will lead a discussion on how students interested in BIG careers can broaden their educational experience and prepare for careers in industry or government.

#### Panelists:

**Susan Sohler Everingham**  
Rand Corporation, USA

**Andrew Knyazev**  
Mitsubishi Electric Research Laboratories, USA

**Bonita V. Saunders**  
National Institute of Standards and Technology, USA

Monday, July 10

### Career Fair, Graduate Student and Industry Reception

7:15 PM-9:15 PM

Room:302-304



### Membership Committee Meeting

7:15 PM-9:15 PM

Room:Westin Hotel - Cambria West

### Communication Doctors

7:15 PM-9:15 PM

Room:302-304

Stop by this booth and chat with representing mathematicians, science communicators and educators about how to turn your complex research into a story that appeals to the public. "Doctors" will offer feedback and advice on how to craft an effective message about your research for future employers, outreach events, or the press. Stop by with a short pitch or summary of your work and let's make it media ready!

### SIREV Editorial Board Dinner Meeting

7:30 PM-9:30 PM

Room:Westin Hotel - Westmoreland Central

## Tuesday, July 11

### Student Days: Chapter Breakfast with SIAM Leadership (by invitation)

7:00 AM-8:15 AM

Room: Westin Hotel - Allegheny I

### Mathematics in Industry Book Series Editorial Board meeting

7:00 AM-8:15 AM

Room: Westin Hotel - Butler East

### Registration

7:30 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Remarks

8:20 AM-8:30 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Tuesday, July 11

## IT3

### Model-Based Learning in Imaging

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Jennifer Mueller, Colorado State University, USA

One of the most successful approaches to solve inverse problems in imaging is to cast the problem as a variational model. The key to the success of the variational approach is to define the variational energy such that its minimiser reflects the structural properties of the imaging problem in terms of regularisation and data consistency. Variational models constitute mathematically rigorous inversion models with stability and approximation guarantees as well as a control on qualitative and physical properties of the solution. On the negative side, these methods are rigid in a sense that they can be adapted to data only to a certain extent. Hence researchers started to apply machine learning techniques to “learn” more expressible variational models. The basic principle is to consider a bilevel optimization problem, where the variational model appears as the lower-level problem and the higher-level problem is the minimization over a loss function that measures the reconstruction error for the solution of the variational model. In this talk we discuss bilevel optimisation, its analysis and numerical treatment, and show applications to regularisation learning, learning of noise models and of sampling patterns in MRI. This talk includes joint work with M. Benning, L. Calatroni, C. Chung, J. C. De Los Reyes, M. Ehrhardt, G. Maierhofer, F. Sherry, T. Valkonen, and V. Vladic.

Carola Bibiane Schoenlieb  
University of Cambridge, United Kingdom

Tuesday, July 11

## IT4

### Homogenization for Sea Ice and the Climate System

9:15 AM-10:00 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Kody Law, Oak Ridge National Laboratory, USA

The precipitous decline of Arctic sea ice has outpaced the predictions of most global climate models. I will discuss how we are using statistical physics and homogenization for composite materials to help understand multiscale sea ice structures and processes. In particular, percolation, network, and Ising models have been developed to describe key processes such as fluid flow through the porous brine microstructure and the evolution of surface melt ponds. Powerful integral representations for effective parameters have been developed to study the electromagnetic and thermal properties of sea ice, its polycrystalline structure, advection diffusion processes, and the propagation of ocean waves through the sea ice pack. Computations of the spectral measures in these representations has led to a close connection with random matrix theory, and the discovery of an Anderson transition in classical transport phenomena near a percolation threshold. Our work is helping to advance how sea ice is represented in climate models and improve projections of the fate of Earth’s ice packs and the ecosystems they support.

Kenneth M. Golden  
University of Utah, USA

### Exhibit Hall Open

9:30 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Coffee Break

10:00 AM-10:30 AM

Room: Ballroom Gallery - 3rd Floor



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– Juan C. Meza, Dean, School of Natural Sciences, University of California Merced; Chair, SIAM SIAG on Optimization; Associate Editor, *SIAM Review*

Tuesday, July 11

## MT1

### Practical Ideas to Connect Academic Departments with Business, Industry and Government

10:30 AM-12:30 PM

Room:317

Chair: Rachel Levy, Harvey Mudd College, USA

This minitutorial is designed for department chairs, directors of graduate studies, faculty and graduate students interested in connecting their department with Business, Industry and Government. Participants of industrial study groups, data science preparation programs and internships are welcome. We hope conference participants from Business, Industry and Government will bring their experience in mentoring interns and hiring employees. Many undergraduate and graduate students trained in the mathematical sciences will enter the workforce in a rich array of business, industry and government (BIG) careers. Departments can have tremendous impact by raising awareness of the skills and experience required in today's job market. In this workshop we will (a) discuss impactful initiatives (b) exchange ideas about successful departmental programs (c) identify departmental needs and (d) prioritize achievable action items. Participants will leave with an individualized institutional plan. The workshop was developed by The BIG Math Network ([bigmathnetwork.wordpress.com](http://bigmathnetwork.wordpress.com)), a collaborative effort among math societies, institutes, and industry partners to increase awareness of internships, training, mentoring and jobs.

**Speakers:**  
**Rachel Levy,**  
 Harvey Mudd College, USA

**Amr El-Bakry,**  
 ExxonMobil Upstream Research Company,  
 USA

**Donna LaLonde,**  
 American Statistical Society, USA

**Suzanne L. Weekes,**  
 Worcester Polytechnic Institute, USA

Tuesday, July 11

## MS20

### A Mathematical View of the Different Biological Scales: From the genomic level to the human interaction level

10:30 AM-12:30 PM

Room:304

Part of the SIAM Workshop Celebrating Diversity

In this session we highlight the applied mathematics work of early career mathematicians from diverse parts of the United States. This will be a look at the application of mathematics of the different biological scales of the human body, from DNA to person interaction.

Organizer: Candice Price  
 University of San Diego, USA

#### 10:30-10:55 Dna Topology: An Application of Knot Theory to Biochemistry

Candice Price, University of San Diego,  
 USA

#### 11:00-11:25 Interactions of Elastic Cilia Driven by a Geometric Switch

Amy Buchmann, Tulane University, USA

#### 11:30-11:55 Modeling Hormone Regulation to Examine the Effects of Insulin-Mediated Testosterone Production on Ovulatory Function

Erica J. Graham, Bryn Mawr College, USA;  
 James F. Selgrade, North Carolina State University, USA

#### 12:00-12:25 The Effects of Risk Perceptions on An Sis Model

Kamuela Yong, University of Hawaii, West Oahu, USA

#### SIAM Presents

Since 2008, SIAM has recorded many Invited Lectures, Prize Lectures, and selected Minisymposia from various conferences. These are available by visiting SIAM Presents (<http://www.siam.org/meetings/presents.php>).



continued in next column

Tuesday, July 11

**MS21****Data Assimilation and Nonlinear Filtering - Part I of II**

10:30 AM-12:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor***For Part 2 see MS33**

Organized by SIAG/UQ

Filtering describes the solution of a sequence inverse problems, in which the data arrives in an online fashion. The subject of filtering has enjoyed a long standing symbiosis between classical and probabilistic approaches. Data assimilation can be viewed as a bridge between these approaches, built out of the necessity to obtain solutions to the filtering problem quickly for very high dimensional, turbulent, nonlinear forecast models, with notable applications in atmospheric and oceanographic science. This minisymposium aims to bring together experts interested in nonlinear filtering, data assimilation and applications, to share their latest research.

Organizer: Kody Law

*Oak Ridge National Laboratory, USA***10:30-10:55 What the Collapse of the Ensemble Kalman Filter Can Tell Us About Localization of Particle Filters**

*Matthias Morzfeld*, University of Arizona, USA; *Chris Snyder*, National Center for Atmospheric Research, USA; *Daniel Hodyss*, Naval Research Laboratory, USA

**11:00-11:25 Coherent Structure Approaches for Lagrangian Data Assimilation**

*John MacLean*, University of North Carolina, USA; *Chris Jones*, University of North Carolina at Chapel Hill, USA; *Naratip Santitissadeekorn*, University of Surrey, United Kingdom

**11:30-11:55 Clustered Particle Filtering for High-Dimensional Non-Gaussian Systems**

*Yoonsang Lee* and *Majda Andrew*, Courant Institute of Mathematical Sciences, New York University, USA

**12:00-12:25 Importance Sampling and Data Assimilation**

*Daniel Sanz-Alonso*, Brown University, USA

Tuesday, July 11

**MS22****Fractional Partial Differential Equations: Modeling, Simulation, Application, and Analysis - Part I of II**

10:30 AM-12:30 PM

*Room:302***For Part 2 see MS34**

FPDEs are emerging as a powerful tool for modeling challenging multiscale phenomena including overlapping microscopic and by integer-order differential equations. However, these problems raise new modeling, computational, mathematical macroscopic scales, anomalous transport, and long range time memory or spatial interactions, which cannot be modeled accurately, and numerical difficulties that have not been encountered in the context of integer-order differential equations. The aim of this minisymposium is to cover the recent development in modeling, simulation, application, and analysis in this field.

Organizer: Hong Wang

*University of South Carolina, USA*

Organizer: George Em

Karniadakis

*Brown University, USA***10:30-10:55 Perturbation Theory for Fractional Differential Equations**

*Renato Spigler*, Università degli Studi Roma Tre, Italy

**11:00-11:25 On Efficient Algorithms for Fractional PDEs Arising from Image Restoration and Co-Registration Models**

*Ke Chen*, University of Liverpool, United Kingdom

**11:30-11:55 Numerical Methods for Stochastic FPDEs Subject to Uncertain Orders and Random Noise**

*Mohsen Zayernouri*, Michigan State University, USA

**12:00-12:25 Fast Numerical Methods for Space-Time Fractional PDEs**

*Hong Wang*, University of South Carolina, USA

Tuesday, July 11

**MS23****Geometry and Computational Challenges in Data Science - Part I of II**

10:30 AM-12:30 PM

*Room: Spirit of Pittsburgh B - 3rd Floor***For Part 2 see MS35**

The mathematics of data science, propelled by the unprecedented power of data acquisition, storage, and processing, brings in new challenges in understanding complex, massive, and often high-dimensional datasets: theoretically, the information in large datasets are often obscured by their complicated geometric structures; practically, gaining insights into these datasets would be impossible without delicate design and analysis of fast, scalable algorithms. In recent years, tools and methodologies from many fields in geometry and topology (e.g. differential geometry, representation theory, and algebraic topology) have been introduced into or adapted for data science problems; topological data analysis and manifold learning are typical examples. Though fast algorithms developed for problems in data science (e.g. empirical mode decomposition, shape analysis, and medical imaging) can benefit significantly from better understandings of the underlying geometric structure, extra efforts are almost always required to incorporate the deep mathematical techniques into contexts of application. This minisymposium aims at bringing together active data science researchers with diverse backgrounds ranging from computer science and applied harmonic analysis to differential geometry, algebraic geometry, and algebraic topology; the talks constitute a concise exposition of the collaborative, multifaceted nature of data science.

Organizer: Tingran Gao

*Duke University, USA**continued on next page*

Tuesday, July 11

## MS23

### Geometry and Computational Challenges in Data Science - Part I of II

10:30 AM-12:30 PM

continued

#### 10:30-10:55 Diffusion Geometry and Manifold Learning on Fibre Bundles

*Tingran Gao*, Duke University, USA

#### 11:00-11:25 Sheaves of Probability Distributions

*Sanjeevi Krishnan*, Ohio State University, USA

#### 11:30-11:55 Synchronization over Cartan Motion Groups Via Contraction

*Onur Ozyesil*, Princeton University and INTECH LLC, USA; *Nir Sharon* and *Amit Singer*, Princeton University, USA

#### 12:00-12:25 A Variational Approach to Consistency of Graph-Based Methods for Data Clustering and Dimensionality Reduction

*Nicolas Garcia Trillos*, Brown University, USA

Tuesday, July 11

## MS24

### High Performance Computing and Data Science in Molecular Engineering - Part I of II

10:30 AM-12:30 PM

*Room:319*

#### For Part 2 see MS36

Organized by SIAG/SC

The importance of molecular modeling and simulation for engineering applications increases rapidly due to improvements in the numerical accuracy and the accessible length and time scales. Reaching quantitative agreement with the available data, and predicting properties where experimental data are absent, molecular engineering transforms engineering data science. The major challenge today consists in integrating various levels, including molecular simulation codes, reliable molecular models, equations of state, mesoscopic methods, property databases, and process models, to a coherent framework. This requires a collaboration between chemical and process engineering, scientific computing, and applied mathematics. In this interdisciplinary minisymposium, engineers and HPC experts meet to discuss a variety of perspectives. For simulations which are carried out on huge core counts, resilience becomes a major issue, while communication and I/O efforts need to be limited. Load balancing needs to deal with performance fluctuations. Concurrency theory becomes increasingly relevant for problems which can be decomposed into a large number of tasks, such as model optimization and problems with high-dimensional order parameter spaces. Moreover, molecular-continuum methods have attracted much interest, since they significantly reduce the computational load. Accordingly, efforts to develop rigorous spatio-temporal multiscale simulation methods are becoming more relevant.

Organizer: *Martin T. Horsch*  
*University of Kaiserslautern, Germany*

Organizer: *Philipp Neumann*  
*University of Hamburg, Germany*

Organizer: *Hans-Joachim Bungartz*

*Technical University of Munich, Germany*

#### 10:30-10:55 HPC and Data Science in Molecular Engineering: An Overview on Molecular and Multiscale Simulation and Analysis

*Martin T. Horsch*, University of Kaiserslautern, Germany; *Philipp Neumann*, University of Hamburg, Germany

#### 11:00-11:25 Large-Scale Molecular Dynamics Simulations at the Argonne Leadership Computing Facility

*Silvio Rizzi* and *Joseph Insley*, Argonne National Laboratory, USA

#### 11:30-11:55 Simulating Human Red Blood Cells at Protein Resolution with the Openbc Molecular Dynamics Package

*Yu-Hang Tang*, *Lu Lu*, and *He Li*, Brown University, USA; *Constantinos Evangelinos*, IBM T.J. Watson Research Center, USA; *Leopold Grinberg*, IBM Corporation, USA; *Vipin Sachdeva*, IBM T.J. Watson Research Center, USA; *George E. Karniadakis*, Brown University, USA

#### 12:00-12:25 Gleaning Insights from Analytics on High Throughput Molecular Simulation Data

*Colin W. Glass*, High Performance Computing Center Stuttgart, Germany

Tuesday, July 11

**MS25****Mathematical Advances in Electrical Impedance Tomography - Part I of II**

10:30 AM-12:30 PM

Room:301

**For Part 2 see MS37**

Electrical impedance tomography (EIT) is a relatively new medical imaging modality in which mathematics plays a key role in image reconstruction, hardware design, and clinical data analysis. The reconstruction problem in EIT is a severely ill-posed nonlinear inverse problem in which the internal conductivity of the body is reconstructed from boundary measurements of the electric field arising from applied currents on electrodes. This minisymposium encompasses recent mathematical developments in EIT having impacts in reconstruction algorithms, system design, and clinical problems.

Organizer: Peter A. Muller  
Colorado State University, USA

Organizer: Jennifer L. Mueller  
Colorado State University, USA

**10:30-10:55 Problems in Electromagnetic Imaging**

David Isaacson, Rensselaer Polytechnic Institute, USA

**11:00-11:25 Recent Development in Anisotropic Electrical Impedance Tomography Using Bayesian Framework**

Rashmi Murthy and Jennifer L. Mueller, Colorado State University, USA

**11:30-11:55 Measuring Conductivity and Validation Using Current Density Imaging**

Nahla M. Elsaid, University of Maryland, USA; Adrian Nachman, University of Toronto, Canada; Weijing Ma, Sheridan College, Canada; Michael Joy, University of Toronto, Canada

**12:00-12:25 Stroke Classification and Monitoring Using Electrical Impedance Tomography**

Minh N. Mach, Samuli Siltanen, and Andreas Hauptmann, University of Helsinki, Finland

Tuesday, July 11

**MS26****New Developments in Population Dynamics and Epidemiology - Part I of II**

10:30 AM-12:30 PM

Room:303

**For Part 2 see MS38**

This special session will bring together researchers, who are experts in mathematical biology to share ideas and methods for mathematical modeling, analysis, and simulations related to population dynamics. It will allow for discussion of pressing topics and exchange of novel ideas. It is expected that the session will lead to the development of mathematical theory for biological dynamics. Potential topics of interest include population dynamics, immune responses, and infectious diseases

Organizer: Necibe Tuncer  
Florida Atlantic University, USA

Organizer: Maia Martcheva  
University of Florida, USA

**10:30-10:55 Backward Bifurcation and Oscillations in a Nested Immuno-Eco-Epidemiological Model**

Maia Martcheva and Michael Barfield, University of Florida, USA; Necibe Tuncer, Florida Atlantic University, USA; Robert Holt, University of Florida, USA

**11:00-11:25 A Periodically Forced Matrix Model for the Dynamics of a Seasonally Reproducing Population**

Jim M. Cushing, University of Arizona, USA

**11:30-11:55 Modeling Bumble Bee Population Dynamics with Delay Differential Equations**

H. T. Banks, North Carolina State University, USA

**12:00-12:25 The Dynamic Consequences of Evolution in Response to Environmental Disturbances**

Azmy S. Ackleh, University of Louisiana, Lafayette, USA

Tuesday, July 11

**MS27****Sentiment and Stability: Mathematical Modeling of Financial Markets**

10:30 AM-12:30 PM

Room:315

Market sentiment can be quantified and analyzed for its impact on stock prices. For stocks for which valuation is not very clear-cut, or arbitrage not readily possible, sentiment has the greatest impact. Sentiment is one of the causes of significant movements without a corresponding change in underlying fundamentals. When there is an abrupt change in the absence of a corresponding change in valuation, classical theory offers little insight beyond the conclusion that it was an unusual event. The mathematical problems posed involve modeling of the behavioral motivations, statistical studies and the study of stability and bifurcation in ODEs.

Organizer: Gunduz Caginalp  
University of Pittsburgh, USA

Organizer: Mark DeSantis  
Chapman University, USA

**10:30-10:55 Investor Sentiment in the Stock Market**

Jeffrey Wurgler, Stern School of Business, New York University, USA

**11:00-11:25 Analysis of Market Stability Through Experiments, Statistical Studies and Mathematical Modeling**

Gunduz Caginalp, University of Pittsburgh, USA

**11:30-11:55 Slow-Fast Analysis of a Multi-Group Asset Flow Model with Implications for the Dynamics of Wealth**

Mark DeSantis, Chapman University, USA

**12:00-12:25 Bifurcation Analysis of a Single Group Asset Flow Model**

Huseyin Merdan, TOBB University of Economics and Technology, Turkey

Tuesday, July 11

## MS28

### Student Days: Student Chapter Presentations - Part I of II

10:30 AM-12:30 PM

Room:310

#### For Part 2 see MS41

Organized by the SIAM Education Committee

Presentations by students from SIAM Student Chapters.

Organizer: Suzanne L. Weekes  
*Worcester Polytechnic Institute, USA*

Organizer: Joseph M. Gaone  
*Worcester Polytechnic Institute, USA*

Organizer: Son Van  
*Carnegie Mellon University, USA*

#### 10:30-10:45 Correcting the Biasedness of the Value-at-Risk and Conditional Tail Expectation

*Nuzulia Fajri Rahmi and Dumaria R. Tampubolon, Institut Teknologi Bandung, Indonesia*

#### 10:50-11:05 PDE Constrained Optimization with Multiscale Methods

*Samy Wu Fung, Emory University, USA*

**11:10-11:25 Prediction of Valuable Customers**  
*Chirag Girdhar and Janpreet Singh, Indian School of Mines, India*

**11:30-11:45 Relaxation in BH of Second Order Structured Deformations**  
*Adrian Hagerty, Carnegie Mellon University, USA*

**11:50-12:05 Simulation of Phase Transitions in Gene-gene Interaction Networks**  
*Jeyashree Krishnan, RWTH Aachen University, Germany*

Tuesday, July 11

## MS29

### Applications and Analysis of Piecewise Smooth Dynamical Systems - Part I of II

10:30 AM-12:30 PM

Room:316

#### For Part 2 see MS30

Piecewise smooth dynamical systems occur in many engineered and naturally occurring systems, and exhibit a wide range of phenomena compared with smooth systems of similar dimension. This minisymposium will showcase recent advance in the analysis and application of piecewise smooth systems (including Filippov systems) including new results on emergent behavior in threshold linear networks, models of biological motor control systems, analysis of limit cycles and phase response curves in piecewise smooth dynamical systems, pattern formation in neural networks with nonsmooth firing rate dynamics, regularization of piecewise smooth dynamical systems, and temporal indeterminacy in piecewise smooth systems.

Organizer: Peter J. Thomas  
*Case Western Reserve University, USA*

Organizer: Bard Ermentrout  
*University of Pittsburgh, USA*

**10:30-10:55 Emergent Dynamics from Network Connectivity: A Minimal Model**  
*Katherine Morrison, University of Northern Colorado, USA*

**11:00-11:25 Phase Response Curves for Limit Cycles in Filippov Systems**  
*Youngmin Park, University of Pittsburgh, USA; Kendrick Shaw, Hillel Chiel, and Peter J. Thomas, Case Western Reserve University, USA*

**11:30-11:55 Piecewise Smooth Models of a Biological Motor Control System**  
*Yangyang Wang, Ohio State University, USA; Jeff Gill, Hillel Chiel, and Peter J. Thomas, Case Western Reserve University, USA*

**12:00-12:25 Pattern Formation in Networks of (Nonsmooth) Firing Equations**  
*Jeremy D. Harris, University of Pittsburgh, USA*

Tuesday, July 11

## CP5

### Computer Science - Part I of II

10:30 AM-12:30 PM

Room:306

#### For Part 2 see CP8

*Chair: Preston Donovan, University of Maryland, Baltimore County, USA*

#### 10:30-10:45 An Algorithm for Creating Synthetic, Differentially Private Database Tables from Large Database Tables

*Jeffrey S. Saltzman, Cottonwood Analytics, USA*

#### 10:50-11:05 Minor Set Covers of Biclique Graphs

*Kathleen Hamilton and Travis Humble, Oak Ridge National Laboratory, USA*

#### 11:10-11:25 Graph Representations of Fracture Networks for Predicting Flow and Propagation

*Gowri Srinivasan, Hari Viswanathan, Aric Hagberg, Jeffrey Hyman, Daniel O'Malley, Satish Karra, Esteban Rougier, Bryan Moore, and Maruti Mudunuru, Los Alamos National Laboratory, USA*

#### 11:30-11:45 Spectral Clustering of Signed Graphs Revisited

*Andrew Knyazev, Mitsubishi Electric Research Laboratories, USA*

#### 11:50-12:05 Discrete Homogenization Theory for Random Walks on Graphs Embedded in the Euclidean Space

*Preston Donovan and Muruhan Rathinam, University of Maryland, Baltimore County, USA*

#### 12:10-12:25 Topological Methods and Classification of Complex Patterns

*Rachel Neville and Patrick Shipman, Colorado State University, USA*

Tuesday, July 11

**CP6****Fluids - Part II of III**

10:30 AM-12:30 PM

Room:307

For Part 1 see CP2

For Part 3 see CP9

*Chair: Prabir Daripa, Texas A&M University, USA***10:30-10:45 On the Modeling of Displacement of Non-Newtonian Fluids in Porous Media Flows***Prabir Daripa, Texas A&M University, USA***10:50-11:05 A Stable Semi-Implicit Finite Element Method for a Dynamic Interface Problem on An Unfitted Mesh***Kyle G. Dunn, Worcester Polytechnic Institute, USA; Marcus Sarkis, Worcester Polytechnic Institute, USA, and Instituto de Matematica Pura e Aplicada (IMPA), Brazil; Roger Lui, Worcester Polytechnic Institute, USA***11:10-11:25 Recent Studies on Vortex Dynamics and Its Applications to Biological Problems***Ling Xu, University of Michigan, Ann Arbor, USA***11:30-11:45 Numerical Investigation on the MVG Controlled Shock Wave Vortex Rings Interaction***Yinlin Dong and Chaoqun Liu, University of Texas at Arlington, USA***11:50-12:05 How Boundaries Shape Chemical Delivery in Microfluidics***Francesca Bernardi, Manuchehr Aminian, and Roberto Camassa, University of North Carolina, USA; Daniel Harris and Richard McLaughlin, University of North Carolina at Chapel Hill, USA***12:10-12:25 The Kirchoff-Plateau Problem***Giulio G. Giusteri, Okinawa Institute of Science and Technology, Japan; Luca Lussardi, Politecnico di Torino, Italy; Eliot Fried, Okinawa Institute of Science and Technology, Japan*

Tuesday, July 11

**CP7****Materials Science - Part I of II**

10:30 AM-12:30 PM

Room:311

For Part 2 see CP10

*Chair: Rajah P. Varatharajah, North Carolina A&T State University, USA***10:30-10:45 Instability and Patterns of Active Suspensions of Liquid Crystals***Robert A. Williams and Ruhai Zhou, Old Dominion University, USA***10:50-11:05 Dynamic Optimization of Polymer Grade Transitions with Molecular Weight Distribution Models***Yannan Ma, Carnegie Mellon University, USA; Xi Chen, Zhejiang University, China; Lorenz Biegler, Carnegie Mellon University, USA***11:10-11:25 Mathematical Analysis and Simulation of Electromagnetic Cloaks of Arbitrary Shapes***Jichun Li, University of Nevada, Las Vegas, USA***11:30-11:45 Optical Beams Interaction at the Interface of Two Nonlinear Optical Media***Rajah P. Varatharajah, North Carolina A&T State University, USA***11:50-12:05 Mathematical Modeling of Nanofluid Based Solar Collectors***Gary J. O'Keeffe and Sarah Mitchell, University of Limerick, Ireland; Tim G. Myers and Vincent Cregan, Centre de Recerca Matemàtica, Spain***12:10-12:25 Modelling and Design of Nano-Structures: Multilayer Nanoplasmonics Configurations:***Harun Kurkcu, Gulf University for Science and Technology, Kuwait***Prizes and Awards Luncheon***(Offsite at the connected Westin Hotel)*

12:30 PM-2:30 PM

*Room:Westin Hotel - Allegheny Ballroom**(Ticket required)*

Tuesday, July 11

**SP2****The John von Neumann Lecture: Singular Perturbations in Noisy Dynamical Systems**

2:30 PM-3:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Nicholas J. Higham, University of Manchester, United Kingdom*

Consider a deterministic dynamical system in a domain containing a stable equilibrium, e.g., a particle in a potential well. The particle, independent of initial conditions eventually reaches the bottom of the well. If however, a particle is subjected to white noise, due, e.g., to collisions with a population of smaller, lighter particles comprising the medium through which the Brownian particle travels, a dramatic difference in the behavior of the Brownian particle occurs. The particle can exit the well. The natural questions then are: how long will it take for it to exit and from where on the boundary of the domain of attraction of the equilibrium will it exit. We compute the mean first passage time to the boundary and the probability distribution of boundary points being exit points. When the noise is small each quantity satisfies a singularly perturbed deterministic boundary value problem. We treat the problem by the method of matched asymptotic expansions (MAE) and generalizations thereof. MAE has been used successfully to solve problems in many applications. However, there exist problems for which MAE does not suffice. Among these are problems exhibiting boundary layer resonance, which led some to conclude that this was "the failure of MAE". We present a physical argument and four mathematical arguments to modify MAE to make it successful. Finally, we discuss applications of the theory.

*Bernard Matkowsky  
Northwestern University, USA***Coffee Break**

3:30 PM-4:00 PM

*Room:Ballroom Gallery - 3rd Floor*

Tuesday, July 11

## MS30

### Applications and Analysis of Piecewise Smooth Dynamical Systems - Part II of II

4:00 PM-5:30 PM

Room:316

#### For Part 1 see MS29

Piecewise smooth dynamical systems occur in many engineered and naturally occurring systems, and exhibit a wide range of phenomena compared with smooth systems of similar dimension. This minisymposium will showcase recent advance in the analysis and application of piecewise smooth systems (including Filippov systems) including new results on emergent behavior in threshold linear networks, models of biological motor control systems, analysis of limit cycles and phase response curves in piecewise smooth dynamical systems, pattern formation in neural networks with nonsmooth firing rate dynamics, regularization of piecewise smooth dynamical systems, and temporal indeterminacy in piecewise smooth systems.

Organizer: Peter J. Thomas  
Case Western Reserve University, USA

Organizer: Bard Ermentrout  
University of Pittsburgh, USA

#### 4:00-4:25 Regularisation of Piecewise Smooth Dynamical Systems, with Application to the Painlevé Paradox

John Hogan, Bristol Centre for Applied Nonlinear Mathematics and University of Bristol, United Kingdom

#### 4:30-4:55 On Temporal Indeterminacy in Piecewise Smooth Systems

Simon C. Webber, University of Bristol, United Kingdom; Paul Glendinning, University of Manchester, United Kingdom; Mike R. Jeffrey, University of Bristol, United Kingdom

#### 5:00-5:25 Zeno Breaking, the 'Contact' Effect, and Sensitive Behaviour in Piecewise Linear Systems

Roderick Edwards, University of Victoria, Canada

Tuesday, July 11

## MS31

### AWM Workshop: Career Panel: Perspectives from Women in Research

4:00 PM-6:00 PM

Room:305

Well prepared and educated women continue today to face challenges at work and many of them strive to break through the glass ceiling. The panel will consider the factors that lead to a successful career in academia or industry, and the obstacles that women can face.

Organizer: Beatrice Riviere  
Rice University, USA

Organizer: Laura Ellwein  
Virginia Commonwealth University, USA

Organizer: Megan Owen  
Lehman College, CUNY, USA

#### Panelists To Be Announced

Tuesday, July 11

## MS32

### Contributions of Black Mathematicians to Current Research Problems

4:00 PM-6:00 PM

Room:304

Part of the SIAM Workshop Celebrating Diversity

The need for diversity in the scientific community is becoming increasingly recognized and appreciated as we work to tackle the world's largest challenges. Research teams encompassing members from multiple educational disciplines, genders, generations, races, ethnicities, nationalities, etc. often offer diverse and innovative perspectives on and approaches to scientific problems. Black Americans are 13% of the US population, but continue to be underrepresented in STEM fields. In this session, four black mathematicians at various career stages will discuss the broad range of problems they investigate with applied mathematics.

Organizer: Talea Mayo  
University of Central Florida, USA

Organizer: Erica J. Graham  
Bryn Mawr College, USA

Organizer: Higgins Raegan  
Texas Tech University, USA

Organizer: Shelby Wilson  
Morehouse College, USA

#### 4:00-4:25 Branch Decompositions and Imaging

Illya Hicks, Rice University, USA

#### 4:30-4:55 Stochastic Optimization Using Parametric Cost Function Approximations

Raymond Perkins, Princeton University, USA

#### 5:00-5:25 A Bayesian Approach to Value of Information: Exploring the Value of Waiting During a Trial of Labor

Karen T. Hicklin, University of North Carolina, Chapel Hill, USA; Julie Ivy and Fay Cobb Payton, North Carolina State University, USA; Meera Viswanathan, RTI International, USA; Evan Myers, Duke University, USA

#### 5:30-5:55 Hurricane Uncertainty Propagation for Real-Time Storm Surge Forecasting

Talea Mayo, University of Central Florida, USA

Tuesday, July 11

**MS33****Data Assimilation and Nonlinear Filtering - Part II of II**

4:00 PM-6:00 PM

*Room: Spirit of Pittsburgh A - 3rd Floor***For Part 1 see MS21**

Organized by SIAG/UQ

Filtering describes the solution of a sequence inverse problems, in which the data arrives in an online fashion. The subject of filtering has enjoyed a long standing symbiosis between classical and probabilistic approaches. Data assimilation can be viewed as a bridge between these approaches, built out of the necessity to obtain solutions to the filtering problem quickly for very high dimensional, turbulent, nonlinear forecast models, with notable applications in atmospheric and oceanographic science. This minisymposium aims to bring together experts interested in nonlinear filtering, data assimilation and applications, to share their latest research.

Organizer: Matthias Morzfeld

*University of Arizona, USA***4:00-4:25 Correcting Biased Observation Model Error in Data Assimilation***John Harlim, Pennsylvania State University, USA***4:30-4:55 Accuracy of a Class of Nonlinear Filters for Quasi-linear Dynamics in the Presence of Model Error***Michal Branicki, University of Edinburgh, United Kingdom***5:00-5:25 Analysis of a Nudging-Based Algorithm for Data Assimilation***Cecilia F. Mondaini and Ciprian Foias, Texas A&M University, USA; Edriss S. Titi, Texas A&M University, USA and Weizmann Institute of Science, Israel***5:30-5:55 Projected Data Assimilation***Eric Van Vleck, University of Kansas, USA*

Tuesday, July 11

**MS34****Fractional Partial Differential Equations: Modeling, Simulation, Application, and Analysis - Part II of II**

4:00 PM-6:00 PM

*Room: 302***For Part 1 see MS22**

FPDEs are emerging as a powerful tool for modeling challenging multiscale phenomena including overlapping microscopic and by integer-order differential equations. However, these problems raise new modeling, computational, mathematical macroscopic scales, anomalous transport, and long range time memory or spatial interactions, which cannot be modeled accurately, and numerical difficulties that have not been encountered in the context of integer-order differential equations. The aim of this minisymposium is to cover the recent development in modeling, simulation, application, and analysis in this field.

Organizer: Hong Wang

*University of South Carolina, USA*

Organizer: George Em Karniadakis

*Brown University, USA***4:00-4:25 An Efficient Spectral Method for Fractional PDEs on Unbounded Domains***Jie Shen, Purdue University, USA***4:30-4:55 Modeling and Simulation for Tempered Anomalous Dynamics***Weihua Deng, Lanzhou University, China***5:00-5:25 A Petro-Galerkin Method of Linear Complexity and Exponential Convergence for the 1-D Diffusion Equation with Two-Sided Fractional Derivatives***Zhiping Mao and George Em Karniadakis, Brown University, USA***5:30-5:55 A Universal Fractional Model for Wall Turbulence***Fangying Song and George Em Karniadakis, Brown University, USA*

Tuesday, July 11

**MS35****Geometry and Computational Challenges in Data Science - Part II of II**

4:00 PM-6:00 PM

*Room: Spirit of Pittsburgh B - 3rd Floor***For Part 1 see MS23**

The mathematics of data science, propelled by the unprecedented power of data acquisition, storage, and processing, brings in new challenges in understanding complex, massive, and often high-dimensional datasets: theoretically, the information in large datasets are often obscured by their complicated geometric structures; practically, gaining insights into these datasets would be impossible without delicate design and analysis of fast, scalable algorithms. In recent years, tools and methodologies from many fields in geometry and topology (e.g. differential geometry, representation theory, and algebraic topology) have been introduced into or adapted for data science problems; topological data analysis and manifold learning are typical examples. Though fast algorithms developed for problems in data science (e.g. empirical mode decomposition, shape analysis, and medical imaging) can benefit significantly from better understandings of the underlying geometric structure, extra efforts are almost always required to incorporate the deep mathematical techniques into contexts of application. This minisymposium aims at bringing together active data science researchers with diverse backgrounds ranging from computer science and applied harmonic analysis to differential geometry, algebraic geometry, and algebraic topology; the talks constitute a concise exposition of the collaborative, multifaceted nature of data science.

Organizer: Tingran Gao

*Duke University, USA*

Tuesday, July 11

## MS35

### Geometry and Computational Challenges in Data Science - Part II of II

4:00 PM-6:00 PM

continued

#### 4:00-4:25 On the Convergence of Recursive Schemes for Wave Shape Functions

Haizhao Yang, Duke University, USA

#### 4:30-4:55 A Polynomial-Time Relaxation of the Gromov-Hausdorff Distance

Soledad Villar, University of Texas at Austin, USA; Afonso S. Bandeira, Massachusetts Institute of Technology, USA; Andrew Blumberg, University of Texas, USA; Rachel Ward, University of Texas at Austin, USA

#### 5:00-5:25 Multiscale Fast Algorithm for STORM Imaging

Yingzhou Li, Stanford University, USA

#### 5:30-5:55 Optimization on Flag Manifolds

Ke Ye, Chicago State University, USA; Lek-Heng Lim and Ken Sze-Wa

i Wong, University of Chicago, USA

Tuesday, July 11

## MS36

### High Performance Computing and Data Science in Molecular Engineering - Part II of II

4:00 PM-6:00 PM

Room:319

#### For Part 1 see MS24

Organized by SIAG/SC

The importance of molecular modeling and simulation for engineering applications increases rapidly due to improvements in the numerical accuracy and the accessible length and time scales. Reaching quantitative agreement with the available data, and predicting properties where experimental data are absent, molecular engineering transforms engineering data science.

The major challenge today consists in integrating various levels, including molecular simulation codes, reliable molecular models, equations of state, mesoscopic methods, property databases, and process models, to a coherent framework. This requires a collaboration between chemical and process engineering, scientific computing, and applied mathematics. In this interdisciplinary minisymposium, engineers and HPC experts meet to discuss a variety of perspectives. For simulations which are carried out on huge core counts, resilience becomes a major issue, while communication and I/O efforts need to be limited. Load balancing needs to deal with performance fluctuations. Concurrency theory becomes increasingly relevant for problems which can be decomposed into a large number of tasks, such as model optimization and problems with high-dimensional order parameter spaces. Moreover, molecular-continuum methods have attracted much interest, since they significantly reduce the computational load. Accordingly, efforts to develop rigorous spatio-temporal multiscale simulation methods are becoming more relevant.

continued in next column

Organizer: Martin T. Horsch  
University of Kaiserslautern, Germany

Organizer: Philipp Neumann  
University of Hamburg, Germany

Organizer: Hans-Joachim Bungartz  
Technical University of Munich, Germany

#### 4:00-4:25 The NIST Standard Reference Simulation Website: Reference Calculations and Evaluated Thermodynamic Properties to Aid Molecular Simulation Users

Harold Hatch, William Kreckelberg, Raymond Mountain, Vincent Shen, and Daniel Siderius, National Institute of Standards and Technology, USA

#### 4:30-4:55 Molecular Simulation and Correlation of Thermodynamic Data

Rolf Lustig, Cleveland State University, USA

#### 5:00-5:25 How to Validate Your Molecular Model (and Why You Should Do It!)

Ahmed E. Ismail, West Virginia University, USA; Christoph Klein, Janos Sallai, and Christopher Iacovella, Vanderbilt University, USA

#### 5:30-5:55 Code Users Versus Code Developers: A Fake Distinction?

Gareth A. Tribello, Queen's University, Belfast, United Kingdom

#### SIAM Presents

Since 2008, SIAM has recorded many Invited Lectures, Prize Lectures, and selected Minisymposia from various conferences. These are available by visiting SIAM Presents (<http://www.siam.org/meetings/presents.php>).



Tuesday, July 11

**MS37****Mathematical Advances in Electrical Impedance Tomography - Part II of II**  
4:00 PM-6:00 PM*Room:301***For Part 1 see MS25**

Electrical impedance tomography (EIT) is a relatively new medical imaging modality in which mathematics plays a key role in image reconstruction, hardware design, and clinical data analysis. The reconstruction problem in EIT is a severely ill-posed nonlinear inverse problem in which the internal conductivity of the body is reconstructed from boundary measurements of the electric field arising from applied currents on electrodes. This minisymposium encompasses recent mathematical developments in EIT having impacts in reconstruction algorithms, system design, and clinical problems.

Organizer: Peter A. Muller  
*Colorado State University, USA*

Organizer: Jennifer L. Mueller  
*Colorado State University, USA*

**4:00-4:25 Adapting Calderón's Method for Real-Time, Patient-Specific Imaging**

*Peter A. Muller and Jennifer L. Mueller, Colorado State University, USA; Michelle Mellenthin, University of Colorado, Denver, USA*

**4:30-4:55 Polynomial Surrogates for Electrical Impedance Tomography**  
*Nuutti Hyvonen, Aalto University, Finland***5:00-5:25 Novel Algorithms for the Development of a Combined Ultrasound and EIT Breast Imaging System**

*Ethan K. Murphy, Dartmouth College, USA*

**5:30-5:55 Directional Observability for Electrical Impedance Tomography**

*Raul G. Lima, Olavo L. Silva, Fernando S. Moura, and Erick Camargo, University of Sao Paulo, Brazil*

Tuesday, July 11

**MS38****New Developments in Population Dynamics and Epidemiology - Part II of II**  
4:00 PM-6:00 PM*Room:303***For Part 1 see MS26**

This special session will bring together researchers, who are experts in mathematical biology to share ideas and methods for mathematical modeling, analysis, and simulations related to population dynamics. It will allow for discussion of pressing topics and exchange of novel ideas. It is expected that the session will lead to the development of mathematical theory for biological dynamics. Potential topics of interest include population dynamics, immune responses, and infectious diseases

Organizer: Necibe Tuncer  
*Florida Atlantic University, USA*

Organizer: Maia Martcheva  
*University of Florida, USA*

**4:00-4:25 Title Not Available At Time Of Publication**

*Necibe Tuncer, Florida Atlantic University, USA*

**4:30-4:55 Multistage Models in HIV Infection and Treatment**

*Libin Rong, Oakland University, USA*

**5:00-5:25 Disease Spread on Networks: Integrating Structure and Dynamics through a Generalized Inverse**

*Joseph Tien, The Ohio State University, USA*

**5:30-5:55 Examining the Affect of Sexual Transmission on the Dynamics of Zika Infection**

*Lauren Childs, Virginia Polytechnic Institute and State University, USA*

Tuesday, July 11

**MS39****Phylogenetic Trees: Theory and Algorithms**  
4:00 PM-6:00 PM*Room:315*

Organized by SIAG/DM

This minisymposium will examine the mathematics of phylogenetic inference, i.e., evolutionary tree building. Phylogenetics is a long-standing topic in computational biology, but one that has seen new life due to dramatic advances in our understanding of molecular evolution and ability to gather genomic data by which to reconstruct it, leading to a proliferation of new mathematical models, problems, and algorithms. The availability of vast quantities of genomic data has simultaneously led to reconstruction on much larger scales than ever before, further driving new models and algorithms and in new problems in characterizing uncertainty in solution spaces. These same technological advances have also led to an explosion of new applications of phylogenetic inference for understanding evolutionary phenomena on scales from classic species tree evolution, to evolution within populations, to evolution of single cells in individual organisms or ecosystems. This minisymposium will examine some emerging topics in modern phylogenetic inference with a focus on the combinatorics of phylogeny inference across scales and applications. This will include current directions in fundamental mathematical models and algorithms for tree fitting and reconciliation, combinatorial problems in characterizing tree spaces, and emerging problems in evolution of single-cell populations. This minisymposium is part of the SIAM DM track.

Organizer: Russell Schwartz  
*Carnegie Mellon University, USA*

Tuesday, July 11

## MS39

### Phylogenetic Trees: Theory and Algorithms

4:00 PM-6:00 PM

continued

#### 4:00-4:25 Phylogenetic Inference at the Single-Cell Level

*Russell Schwartz*, Carnegie Mellon University, USA

#### 4:30-4:55 So Many Maximum Parsimony Tree Reconciliations! How Can We Find a Small Set of Representative Solutions?

*Ran Libeskind-Hadas*, Harvey Mudd College, USA

#### 5:00-5:25 Adventures in Tree-Fitting

*Dannie Durand*, Carnegie Mellon University, USA

#### 5:30-5:55 Predicting Ecological Function in the Microbiome Using Spectral Properties of Interacting Clades

*Russell Y. Neches*, University of California, Davis, USA

Tuesday, July 11

## MS40

### Resilient Computation in Large Scale Scientific Computing - Part I of II

4:00 PM-6:00 PM

Room:320

#### For Part 2 see MS51

Organized by SIAG/SC

As semiconductor technology reaches its physical limit, the performance improvement of high performance computing systems no longer follows the predictions by Moore's law. One of the viable approaches to address this stagnation is to relax the reliability of computing systems, and leave the application users to manage it. However, computing system vendors have been discouraged to provide such unreliable systems due to a lack of alternative use models in practice. Recently, this lack of the model has seen addressed through interdisciplinary effort where applied/computational math plays an important role upon the effort in hardware and system software. This minisymposium opens an opportunity for exchanging the ideas/needs in computational science research to address the emerging topics on application resiliency in large simulations. Additionally, we discuss the reliability and failure behavior of the recent supercomputing systems that will help us to prepare for Exascale computing.

Organizer: Keita Teranishi

*Sandia National Laboratories, USA*

Organizer: Luc Giraud

*Inria, France*

Organizer: Emmanuel Agullo

*Inria, France*

#### 4:00-4:25 Toward Resilient Asynchronous Many Task Programming Model

*Keita Teranishi* and *Nicole Slattengren*, Sandia National Laboratories, USA

#### 4:30-4:55 Evaluating Parallel Application Resiliency with the Software Fault Injector, PFSEFI

*Nathan A. DeBardeleben*, Los Alamos National Laboratory, USA

#### 5:00-5:25 Checkpoint/Restart: Why You Should Delegate it to a Specialized Library

*Franck Cappello*, Argonne National Laboratory, USA

#### 5:30-5:55 A Catalog of Faults, Errors, and Failures in Extreme-Scale Systems

*Christian Engelmann*, Oak Ridge National Laboratory, USA

Tuesday, July 11

## MS41

### Student Days: Student Chapter Presentations - Part II of II

4:00 PM-6:00 PM

Room:310

#### For Part 1 see MS28

Organized by the SIAM Education Committee

Presentations by students from SIAM Student Chapters.

Organizer: Suzanne L. Weekes  
Worcester Polytechnic Institute, USA

Organizer: Joseph M. Gaone  
Worcester Polytechnic Institute, USA

Organizer: Son Van  
Carnegie Mellon University, USA

#### 4:00-4:15 Structure-preserving Finite Elements for Perfect Fluids

Andrea Natale and Colin J. Cotter, Imperial College London, United Kingdom

#### 4:20-4:35 Hypersurface Model of the Fracture for Nonlinear Fluid Flows

Pushpi J. Paranamana, Eugenio Aulisa, Magdalena Toda, and Akif Ibragimov, Texas Tech University, USA

#### 4:40-4:55 Recent Advances on Riccati-Feedback Control of Complex Flows with Moving Interfaces

Björn Baran, Peter Benner, Jan Heiland, and Jens Saak, Max Planck Institute for Dynamics of Complex Technical Systems, Germany

#### 5:00-5:15 Macro Stokes Elements on Quadrilaterals

Duygu Sap and Michael J. Neilan, University of Pittsburgh, USA

#### 5:20-5:35 Numerical Analysis of a Velocity-vorticity Method for the 2D Navier-Stokes Equations

Camille Zerfas and Leo Rebholz, Clemson University, USA; Mine Akbas, Middle East Technical University, Turkey

#### 5:40-5:55 Geometry of Synchronization in Oscillatory Networks

Wei Zhang and Jr-Shin Li, Washington University in St. Louis, USA

Tuesday, July 11

## CP8

### Computer Science - Part II of II

4:00 PM-5:20 PM

Room:306

#### For Part 1 see CP5

Chair: Salimeh Yasaei Sekeh, University of Michigan, USA

#### 4:00-4:15 A Global Nonlinear Dimensionality Reduction Framework Using Smooth Geodesics

Kelum D. Gajamannage and Randy Paffenroth, Worcester Polytechnic Institute, USA; Erik Bollt, Clarkson University, USA

#### 4:20-4:35 Price of Non-lidness and Minimax Coincidence

Michael Spece, Carnegie Mellon University, USA

#### 4:40-4:55 Permutation Complexity Measures for Time-Series Data

Daryl R. Deford and Katherine Moore, Dartmouth College, USA

#### 5:00-5:15 Estimation of Henze-Penrose Divergence Measures

Salimeh Yasaei Sekeh, The University of Michigan, Ann Arbor, USA; Morteza Noshad, University of Michigan, Ann Arbor, USA; Kevin Moon, Yale University, USA; Alfred Hero, University of Michigan, USA

Tuesday, July 11

## CP9

### Fluids - Part III of III

4:00 PM-6:00 PM

Room:307

#### For Part 2 see CP6

Chair: Brian J. Spencer, University of Buffalo, USA

#### 4:00-4:15 Corner Wetting and Drop Geometry During the Vapor-Liquid-Solid Growth of Faceted Nanowires

Brian J. Spencer, State University of New York at Buffalo, USA

#### 4:20-4:35 Coupling Effects Between An Applied Electric Field and Thermal Fluctuations in Dilute Electrolyte Solutions

Jean-Philippe M. Peraud, Andy Nonaka, and John B. Bell, Lawrence Berkeley National Laboratory, USA; Aleksandar Donev, Courant Institute of Mathematical Sciences, New York University, USA; Alejandro Garcia, San Jose State University, USA

#### 4:40-4:55 Inferring Clogging Mechanisms from the Spreading of a Particle-Laden Fluid on a Porous Membrane

Armin U. Krupp, Ian Griffiths, and Colin Please, University of Oxford, United Kingdom

#### 5:00-5:15 Fouling of a Filter Membrane with Complex Microstructure: A Simplified Mathematical Model

Pejman Sanaei and Linda Cummings, New Jersey Institute of Technology, USA

#### 5:20-5:35 Traffic Flow with Lane Changing

Jiah Song and Smadar Karni, University of Michigan, USA

#### 5:40-5:55 Stability of Oscillatory Rotating Boundary Layers

Scott N. Morgan, Cardiff University, United Kingdom

Tuesday, July 11

## CP10

### Materials Science - Part II of II

4:00 PM-6:00 PM

Room:311

#### For Part 1 see CP7

Chair: Chong Wang, George Washington University, USA

#### 4:00-4:15 Pattern Formation – on the Modeling of Multi-Constituent Inhibitory Systems

Chong Wang, Yanxiang Zhao, and Xiaofeng Ren, George Washington University, USA

#### 4:20-4:35 Modeling Impact in a Damped 1-D Continuum

Scott Hansen and Feifei Wang, Iowa State University, USA

#### 4:40-4:55 On An Adaptive Finite Element Phase-Field Dynamic Fracture Model: Anti-Plane Shear Crack.

Mallikarjunaiah S. Muddamallappa, Texas A&M University, USA; Christopher Larsen, Worcester Polytechnic Institute, USA; Marcus Sarkis, Worcester Polytechnic Institute, USA, and Instituto de Matematica Pura e Aplicada (IMPA), Brazil

#### 5:00-5:15 Membrane Thinning during Deformation

Paul Greaney, Martin Meere, and Giuseppe Zurlo, National University of Ireland, Galway, Ireland

#### 5:20-5:35 Transformation Groups and Discrete Structures in Continuum Description of Defective Crystals

Maxim Zyskin, University of Nottingham, United Kingdom

#### 5:40-5:55 Boundary Value Problems in the Theory of Elasticity of Materials with a Triple Porosity Structure

Merab Svanadze, Iliia State University, Georgia

## Intermission

6:00 PM-6:15 PM

Tuesday, July 11

## SIAM Business Meeting and 2017 Fellows Recognition

6:15 PM-7:00 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Complimentary beer and wine will be served



## Fellows Reception

7:00 PM-7:30 PM

Room: South Terrace - 3rd Floor



## PD2

### Hidden Figures

7:00 PM-8:00 PM

Room:406

Chair: Carla Cotwright-Williams, Social Security Administration, USA

Christine Darden was one of the human computers included in the book “Hidden Figures” by Margot Lee Shetterly that was recently featured as a Hollywood movie. Dr. Darden will share some of the work she and other African American women did at NASA’s mathematics-intensive aerospace program and during the era of segregation. We will also feature “Modern Figures” who will share their mathematical work as well as personal insights of how to support and encourage diversity. This event is sponsored by the Association for Women in Mathematics, Enhancing Diversity in Graduate Education, IBM, the National Association of Mathematicians, Inc., and the Society for Industrial and Applied Mathematics.

#### Christine Darden

Retired from NASA

#### Erica Graham

Bryn Mawr College, USA

#### Talitha Washington

Howard University, USA

#### Shelby Wilson

Morehouse College, USA

Tuesday, July 11

## PP1

### Poster and Dessert Reception

8:00 PM-10:00 PM

Room: West Atrium - 3rd Floor



#### A Review of the Poincare-Bendixson Theorem and Its Extensions

Nazila Akhavan Kharazian and Felicia Magpantay, University of Manitoba, Canada

#### A Comparison of Existing Measles Models

Clifford Allotey and Felicia Magpantay, University of Manitoba, Canada

#### Nonlinear Phenomena in a Piecewise Linear Model of Airflow in Birds’ Lungs

Alona Ben-Tal, Massey University, New Zealand; Emily Harvey, Market Economics, New Zealand

#### Bootstrapping and Cross-Validating Generalized PIs Regressions Using Gpu

Frederic Bertrand and Myriam Maumy, University of Strasbourg, France

#### The Reduced Collocation Method for Nonlinear Steady-State PDEs

Chris Bresten and Yanlai Chen, University of Massachusetts, Dartmouth, USA

#### Modeling the Effect of Calcium Coupling on Sperm Motility

Lucia Carichino and Sarah D. Olson, Worcester Polytechnic Institute, USA

#### Mathematical Modeling of Tissue Engineered Articular Cartilage

Simone Cassani and Sarah D. Olson, Worcester Polytechnic Institute, USA

#### A Posteriori Analysis of the Poisson-Boltzmann Equation

Jehanzeb H. Chaudhry, University of New Mexico, USA

#### A Three-Sensor Assignment Method for Multiple Target Tracking

Cesar Contreras, John Langford, Larry Ammann, and John Zweck, University of Texas at Dallas, USA

#### Corrupted Blood: A Mathematical Analysis

Kyle Cook and Anthanasios Gentimis, Florida Polytechnic University, USA

continued in next column

### Modeling and Simulation of Phytoplankton Blooms in the Ocean

*Seth Cowall*, University of Delaware, USA

### Numerical Reservoir Simulation of CO<sub>2</sub> Enhanced Oil Recovery in Shale Oil Reservoirs

*Christian Dalton*, Mary Broussard, and Watheq J. Al-Mudhafar, Louisiana State University, USA

### A New Algorithm for Community Detection in Large Social Networks

*Natalia Y. Dibbern*, Student; Thomas Laurent, Loyola Marymount University, USA

### Open-Source Python Package for Easy and Flexible Shape Optimization and Analysis

*Gunay Dogan*, National Institute of Standards and Technology, USA

### Numerical Study of Flow and Transport in EOR Processes

*Sourav Dutta* and Prabir Daritya, Texas A&M University, USA

### Parameter Identifiability and Sensitivity in a Wound Healing Mathematical Model

*Rachel N. French*, Rachel Turner, and Jacob Menix, Western Kentucky University, USA

### A Mathematical Model of Microwave Heating a Dielectric Layer for Channel Flow Energy Collection

*Joseph M. Gaone*, Burt S. Tilley, and Vadim Yakovlev, Worcester Polytechnic Institute, USA

### Assessing the Growth of Ung Family: A Logistic Approach

*Elizabeth M. Gilman* and Bikash Das, University of North Georgia, USA

### Discovering Brain Networks Using Tensor Decompositions

*Koby B. Hayashi*, Grey Ballard, and Michael Tobia, Wake Forest University, USA

### Seismogram Classification Using Learned Convolutional-Filter Dictionaries

*Kyle S. Hickmann* and Gowri Srinivasan, Los Alamos National Laboratory, USA

### A Simple Direct-forcing Immersed-boundary Projection Method with Prediction-correction for Fluid-structure-interaction Problems

*Tzzy-Leng Horng*, Feng Chia University, Taichung, Taiwan

*continued in next column*

### A Tensor Field Mumford-Shah Segmentation of Neural Pathways in Diffusion Weighted MRI Images

*Bebart Janbek*, Brian Booth, and Ghassan Hamarneh, Simon Fraser University, Canada

### Yield to the Resistance: The Impact of Nematode Resistant Varieties on Alfalfa Yield

*Scott G. Jordan* and Luis Gordillo, Utah State University, USA

### Identifying Optimal Sampling Distributions for Individual Patients with Diabetic Foot Ulcers

*Nigar Karimli*, Ayush Prasad, and Richard Schugart, Western Kentucky University, USA

### Sufficient Conditions for Existence of Stationary Distributions of Stochastic Reaction Networks and Mixing Times

*Jinsu Kim* and David F. Anderson, University of Wisconsin, Madison, USA

### Implementing Parallel Numerical Procedures for 3+1 Fluid Flow Simulations Using Petsc

Jung-Han Kimn, *Nicholas Stegmeier*, and Jeffrey Doom, South Dakota State University, USA

### Matrices, Moments, Quadrature and Pdes

*James V. Lambers*, University of Southern Mississippi, USA

### The Influence of a Lipid Reservoir on the Tear Film Dynamics

*Kara L. Maki* and Gregory Barron, Rochester Institute of Technology, USA; Richard Braun, University of Delaware, USA

### Heat Transfer and Flow of a Non-Linear Fluid

*Mehrdad Massoudi*, National Energy Technology Laboratory, USA; Wei-Tao Wu, Carnegie Mellon University, USA

### Interactive Visualization for the Reading and the Pattern Identification of the Electrocardiogram Using R Shiny

*William Mateus*, Marco Paluszny, and Freddy Hernande, Universidad Nacional de Colombia, Colombia

### Gpu-Based Approximate Bayesian Computation Algorithms for Network Reverse-Engineering

*Myriam Maumy-Bertrand* and Frederic Bertrand, University of Strasbourg, France

### Finding Circles in High Dimensional Data

*Brad Nelson*, Stanford University, USA; Geoffrey D. Sanders, Lawrence Livermore National Laboratory, USA

*continued in next column*

### A Distributed and Incremental SVD Algorithm for Agglomerative Data Analysis on Large Networks

*Benjamin W. Ong*, Michigan Technological University, USA; Mark Iwen, Michigan State University, USA

### Multiscale Plasma Modeling: Coupling the Vlasov-BGK Equation and Molecular Dynamics

*Jacob Price*, University of Washington, USA; Gil Shohet, Stanford University, USA; Jeffrey Haack and Mathieu Marciante, Los Alamos National Laboratory, USA; Michael Murillo, Michigan State University, USA

### Eulerian Versus Lagrangian Data Assimilation

*Diego A. Rios*, New Jersey Institute of Technology, USA

### A Conservative Lagrangian-Eulerian Finite Volume Approximation Method for Balance Law Problems

*John Alexander P. Sepulveda*, ITM-Institución Universitaria, Colombia; Eduardo Abreu and Arthur Santo, University of Campinas, Brazil

### Black-Box Kernel-Level Performance Modeling for Tuning DG on GPUs

*James Stevens* and Andreas Kloeckner, University of Illinois, USA

### Application in the Shiny Library of R for the Estimation of the Linear Mixed Model to Longitudinal Data

*Johanna T. Trochez Gonzalez*, Juan Carlos Salazar, and Freddy Hernandez, Universidad Nacional de Colombia, Colombia; Marisol Valencia, Tecnológico de Antioquia, Colombia

### Discrete Data Analytic Study of the Traffic Light Problem

*Mathew K. Tucker*, Student; Bikash Das, University of North Georgia, USA; Amrita Acharyya, University of Toledo, USA

### Extend Levelt's Propositions to Multistable Binocular Rivalry

*Yunjiao Wang*, Texas Southern University, USA; Alain Jacot-Guillarmod, Lausanne University Hospital, Switzerland; Claudia Pedroza, University of Texas, USA; Haluk Ogmen, University of Denver, USA; Zackary Kilpatrick, University of Colorado, USA; Kresimir Josic, University of Houston, USA

*continued on page 63*



#### SUBMISSION DEADLINES

January 10, 2018:

Minisymposium proposal submissions

January 31, 2018:

Contributed Lecture, Minisymposia,  
Poster and Minisymposia Presentation  
Abstracts

#### INVITED SPEAKERS

Danielle S. Bassett, University of Pennsylvania, USA

Craig B. Gentry, IBM Research, USA

Martin Hairer, University of Warwick, United Kingdom

Bruce Hendrickson, Lawrence Livermore National Laboratory, USA

Jeff Humpherys, Brigham Young University, USA

Robert V. Kohn, NYU, Courant Institute of Mathematical Sciences, USA

Jelani Nelson, Harvard University, USA

Björn Sandstede, Brown University, USA

Guillermo Sapiro, Duke University, USA

William W. Symes, Rice University, USA

Rekha R. Thomas, University of Washington, USA

Mariel Vazquez, University of California, Davis, USA

Barbara Wohlmuth, Technische Universität München, Germany



**siam**

**SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS**

Tuesday, July 11

**PP1****Poster and Dessert Reception**

8:00 PM-10:00 PM

continued

**Double-Exposure Epidemiological Model***Haley Yaple* and Kerry Stapf, Carthage College, USA**Modeling Shape Dependent Mott Oxidation of Nanosized Metal Particles***Maxim Zyskin*, University of Nottingham, United Kingdom; *Karen Martirosyan*, University of Texas, Rio Grande Valley**PP2****Minisymposium: AWM Posters**

8:00 PM-10:00 PM

Room: West Atrium - 3rd Floor

**AWM Workshop - Tailoring Tails in Taylor Dispersion: How Boundaries Shape Chemical Deliveries in Microfluidics***Francesca Bernardi*, University of North Carolina, USA**AWM Workshop - A New Goal-Oriented A Posteriori Error Estimation for 2D and 3D Saddle Point Problems in Hp Adaptive Fem***Arezou Ghesmati*, Texas A&M University, USA**AWM Workshop - Sobolev Discontinuous Galerkin (dG) Methods***Adeline Kornelus*, University of New Mexico, USA**AWM Workshop - An AMG Approach in Solving Graph Laplacians of Protein Networks Based on Diffusion State Distance Metrics***Junyuan Lin*, Tufts University, USA**AWM Workshop - Hyperspectral Image Classification Using Parallellized Graph Clustering Methods***Zhaoyi Meng*, University of California, Los Angeles, USA**AWM Workshop - A Reaction-Diffusion Model for Cell Polarization in Yeast***Marissa Renardy*, Ohio State University, USA**AWM Workshop - An Invariant-Region-Preserving Limiter for DG Method to Compressible Euler Equations***Yi Jiang* and *Hailiang Liu*, Iowa State University, USA**AWM Workshop - Band-Edge Solitons in the NIs Equation with Periodic Pt-Symmetric Potentials***Jessica Taylor*, University of California, Merced, USA**AWM Workshop - Polynomial Preconditioned Arnoldi for Eigenvalues***Jennifer A. Loe* and *Ron Morgan*, Baylor University, USA; *Mark Embree*, Virginia Tech, USA**AWM Workshop - Almost Sure Convergence of Particle Swarm Optimization Using Pure Adaptive Search Method***Ganesh Weerasinghe*, Auburn University, USA**AWM Workshop - Blending Peridynamics and Classical Elasticity to Model Material Behavior***Kileen Berry*, University of Tennessee, USA**AWM Workshop - Computational Approaches for Linear Goal-Oriented Bayesian Inverse Problems***Karina Koval*, Courant Institute of Mathematical Sciences, New York University, USA

Tuesday, July 11

**PP3****Minisymposium: Active Subspaces**

8:00 PM-10:00 PM

Room: West Atrium - 3rd Floor

*Paul Constantine*, Colorado School of Mines, USA**How Many Dimensions Is High Dimensions?***Izabel P. Aguiar* and *Jessica R. Deters*, Colorado School of Mines, USA**Active Subspaces: Emerging Ideas in Dimension Reduction for Parameter Studies***Paul Constantine*, Colorado School of Mines, USA**Inverse Regression for Ridge Recovery***Andrew Glaws* and *Paul Constantine*, Colorado School of Mines, USA; *Dennis Cook*, University of Minnesota, USA**Parameterization-Independent Active Subspaces of Engineering Geometries***Zach Grey* and *Paul Constantine*, Colorado School of Mines, USA**Data-Driven Polynomial Ridge Approximation Using Variable Projection***Jeffrey M. Hokanson* and *Paul Constantine*, Colorado School of Mines, USA

Tuesday, July 11

## PP4



### Minisymposium: Student Chapter Presentations

8:00 PM-10:00 PM

Room: West Atrium - 3rd Floor

Suzanne L. Weekes, Worcester Polytechnic Institute, USA

Presentations by students from SIAM Student Chapters.

#### Using Parameter Estimation Techniques to Analyze a Mathematical Wound Healing Model

Rachel N. French, Rachel Turner, and Jacob Menix, Western Kentucky University, USA

#### Patterns in the Starch-Iodine Reaction

Derek Handwerk, Colorado State University, USA

#### Offline-Enhanced Reduced Basis Method through Adaptive Construction of the Surrogate Parameter Domain

Jiahua Jiang and Yanlai Chen, University of Massachusetts, Dartmouth, USA; Akil Narayan, University of Utah, USA

#### A Parametric Level-set Method for Partially Discrete Tomography

Ajinkya Kadu and Tristan van Leeuwen, Utrecht University, The Netherlands; K. Joost Batenburg, Centrum voor Wiskunde en Informatica (CWI), Netherlands

#### Pattern Formation of a Nonlocal, Anisotropic Interaction Model

Lisa Maria Kreusser, University of Cambridge, United Kingdom; Martin Burger, University of Münster, Germany; Bertram Düring, University of Sussex, United Kingdom; Peter A. Markowich and Carola-Bibiane Schönlieb, University of Cambridge, United Kingdom

#### Mathematical and Computational Modelling of Compressible Non-isothermal Viscoelastic Flow

Alex Mackay, Cardiff University, United Kingdom

#### Modelling a District Heating Network, Gas Network and Power Grid as an Integrated System

Anne S. Markensteijn, Delft University of Technology, Netherlands

#### A Sharp Interface Model and its Numerical Approximation of Solid-state Dewetting in Three Dimensions

Zhao Quan and Bao Weizhu, National University of Singapore, Singapore; Wei Jiang, Wuhan University, China; David J. Srolovitz, University of Pennsylvania, USA

#### Kernel-based Reconstruction of Spatially Embedded Complex Networks

Fernando J. Quevedo, Erik Bollt, and Jie Sun, Clarkson University, USA

#### A Decision Tree Classification Model to Identify Flight Delay Patterns of U.S. Airlines

Nandini Rakala, James Williams, Willa Huddleston, and Munever Subasi, Florida Institute of Technology, USA

#### Generic Steady State Bifurcations in Homogeneous Coupled Cell Networks

Sören Schwenker, Universität Hamburg, Germany

#### Global Recurrence Relations of Epidemiological Cellular Automata

Michael Yereniuk, Worcester Polytechnic Institute, USA

Tuesday, July 11

## PP5



### Minisymposium: Undergraduate Student Presentations

8:00 PM-10:00 PM

Room: West Atrium - 3rd Floor

Suzanne L. Weekes, Worcester Polytechnic Institute, USA

Luis Melara, Shippensburg University, USA

Sigal Gottlieb, University of Massachusetts, Dartmouth, USA

This minisymposium includes undergraduate student posters.

#### Creating Art with Mathematical Symmetries

Carmen Acosta-Alonzo and Kenyona Bethea, Bennett College For Women, USA

#### The Amensiac Lookback Option and Intercontinental Option

Ho-Chun Herbert Chang, Kevin Li, and Bat-Amgalan Zorigt, Dartmouth College, USA

#### Why Do They Not Believe?: The Network Dynamics of Opinion

Tucker E. Evans, Dartmouth College, USA

#### Construction of 3D Representations for Small-Sized, Detailed Objects With Perspective Limitations: A Case Study

Hae In Lee, University of Washington, USA

## Wednesday, July 12

### Programs & Conferences Committee Meeting

7:00 AM-8:30 AM

Room: Westin Hotel - Cambria East

### Book Committee Meeting

7:00 AM-8:15 AM

Room: Westin Hotel - Butler East

### Registration

8:00 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Remarks

8:20 AM-8:30 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Wednesday, July 12

## IT5

### Connecting Model-Based Predictions to Reality

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Nick Trefethen, University of Oxford,  
United Kingdom

The common use of computational models, in combination with physical observations, has expanded our understanding and ability to anticipate behaviors in a variety of physical systems. With relevant physical observations, it is possible to calibrate a computational model, and even estimate systematic discrepancies between the model reality reality. Estimating and quantifying the uncertainty in this model discrepancy can lead to reliable prediction uncertainties - so long as this prediction is "similar" to the available physical observations. Exactly how to define "similar" has proven difficult in many applications. Clearly it depends on how well the computational model captures the relevant physics in the system, as well as the portability of the model discrepancy in moving from the available physical data to the prediction. This talk will discuss these concepts using computational models ranging from simple to complex.

David M. Higdon  
Virginia Tech, USA

Wednesday, July 12

## IT6

### Computational Methods for Personalized Medicine in Cardiovascular Disease

9:15 AM-10:00 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Paul Constantine, Colorado School  
of Mines, USA

Cardiovascular disease is the leading cause of death worldwide, with nearly 1 in 4 deaths caused by heart disease alone. In children, congenital heart disease affects 1 in 100 infants, and is the leading cause of infant mortality in the US. Patient-specific modeling based on medical image data increasingly enables personalized medicine and individualized treatment planning in cardiovascular disease patients, providing key links between the mechanical environment and subsequent disease progression. We will discuss recent methodological advances in cardiovascular simulations, including (1) optimization algorithms enabling customized treatments for individual patients, (2) uncertainty quantification tools to compute confidence in simulation predictions, and (3) multiscale modeling with fluid structure interaction that couple local hemodynamics to circulatory physiology and wall mechanobiology. Clinical application of these methods will be demonstrated in two applications: 1) coronary bypass graft surgery and the biomechanics of vein graft failure, and 2) prediction of right ventricular failure in pediatric patients with pulmonary hypertension. We will provide an overview of our open source SimVascular project, which makes our tools available to the scientific community ([www.simvascular.org](http://www.simvascular.org)). Finally, we will provide an outlook on recent successes and challenges of translating modeling tools to the clinic.

Alison Marsden  
Stanford University, USA

Wednesday, July 12

## Exhibit Hall Open

9:30 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

## Coffee Break

10:00 AM-10:30 AM



Room: Ballroom Gallery - 3rd Floor

## MT2

### Mathematics for Crime Prediction and Prevention

10:30 AM-12:30 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Martin Short, Georgia Institute of Technology, USA

This minitutorial will focus on a specific application where mathematics has made some recent progress - predicting and preventing crime. We will cover the topic from a fundamental mathematical level, to the results of experiments, up through implementation in the field. On the crime prediction side, we will discuss self-exciting point processes, including their mathematical properties, how they may be fit to data, and their link with crime. For prevention, we will discuss the Stackelberg Security Game framework, giving an overview, possible pitfalls, and details of formulations meant to address everyday crime. We hope to include an opportunity for the audience to directly engage in some pseudo-experiments during the talk to illustrate some of the ideas presented.

#### Speakers:

**Martin Short**

Georgia Institute of Technology, USA

**George Mohler**

Indiana University - Purdue University Indianapolis, USA

Wednesday, July 12

## MS42

### Discrete Methods in Molecular Biology - Part I of II

10:30 AM-12:30 PM

Room: Spirit of Pittsburgh B - 3rd Floor

For Part 2 see MS55

Organized by SIAG/DM

This minisymposium will focus on the importance of algebraic, combinatorial, geometric, and topological methods in mathematical biology, with applications ranging from phylogenetic trees and RNA folding to systems biology and molecular computation. This invited minisymposium is part of the SIAM DM track.

Organizer: Christine Heitsch

Georgia Institute of Technology, USA

#### 10:30-10:55 RNA Profiling: Extracting Structural Signals from Noisy Distributions

Emily Rogers and Christine Heitsch, Georgia Institute of Technology, USA

#### 11:00-11:25 When is it Surprising that All Gene Trees are Unique? An Application of the Generalized Birthday Problem

Ruth E. Davidson, University of Illinois at Urbana-Champaign, USA; James H. Degan, University of Canterbury, New Zealand

#### 11:30-11:55 A Near-Optimal Control for Stochastic Gene Regulatory Networks

David Murrugarra, University of Kentucky, USA

#### 12:00-12:25 Discrete Mathematical Models in Synthetic Biology

Laurie Heyer, Davidson College, USA

Wednesday, July 12

## MS43

### Identifying Computational Methods for Early Benefit from Quantum Computing

10:30 AM-12:30 PM

Room: 305

With increased scale, quantum computers (QCs) are approaching relevance for leading-edge computational scientists. QCs are markedly different from classical von Neumann computers, with the largest-scale implementations appearing best suited to solving optimization problems and sampling from statistical distributions. This minisymposium aims to a) identify, as specifically as practical, computational methods that are likely to benefit from QCs in the next 5 years, b) share the experiences of early QC application developers, and c) focus attention on the tools needed for fastest progress. No background in quantum physics is expected.

Organizer: Steve P. Reinhardt

D-Wave Systems, Inc., USA

Organizer: Scott Pakin

Los Alamos National Laboratory, USA

#### 10:30-10:55 Current Opportunities for Quantum Computers: Basics, Performance, Interfaces, and Community

Steve P. Reinhardt, D-Wave Systems, Inc., USA; Scott Pakin, Los Alamos National Laboratory, USA

#### 11:00-11:25 Graph Partitioning Using the D-Wave for Electronic Structure Problems

Susan Mniszewski, Hayato Ushijima-Mwesigwa, and Christian Negre, Los Alamos National Laboratory, USA

#### 11:30-11:55 Applications of Quantum Annealing in Computational Finance

Phil Goddard, IQBit, Canada

#### 12:00-12:25 Quantum Annealing for Traffic Flow Optimization

Florian Neukart, Volkswagen, Germany

Wednesday, July 12

**MS44****Interface Dynamics and Microstructural Evolution: Emergent Topology, Geometry & Symmetries**

10:30 AM-12:00 PM

Room:302

The statistical physics governing phase-ordering following a symmetry-breaking first-order quench remains largely unknown, unlike the mature theory that has been developed for critical phenomena associated with second-order phase-transitions. Indeed, beyond the Dynamic Scaling Hypothesis, which presumes that power-laws control the growth in time of the characteristic size of domains, with a concomitant scale-invariance of any associated length distributions, little is known. Indeed, the identification of universal principles governing such textural evolutions presents deep mathematical and computational challenges, which clearly lie at the fringe, if not beyond, our current conceptual frames and computational capabilities. This minisymposium highlights recent theoretical and data-driven developments that point to principles beyond the Dynamic Scaling Hypothesis that are likely to be of general import, or at least point the way, in the development of a statistical theory of such coarsening systems.

Organizer: Stephen J. Watson  
*University of Glasgow, Scotland, UK*

**10:30-10:55 Hidden Lorentzian Symmetry Predicts Universality Beyond Power Laws**

*Stephen J. Watson, University of Glasgow, Scotland, UK*

**11:00-11:25 A Gradient Flow for Microstructure**

*David Kinderlehrer, Carnegie Mellon University, USA*

**11:30-11:55 Equations of Motion for Grain Boundaries**

*David J. Srolovitz, University of Pennsylvania, USA*

Wednesday, July 12

**MS45****Kinetic Models with Applications in Biology**

10:30 AM-12:30 PM

Room:315

Kinetic theory arose from the need to model the dynamics of gas molecules in a rigorous way, but has evolved to provide insight into complex dynamical systems throughout physics, materials science, and biology. Recently, scientists have introduced kinetic models for large systems in order to make them amenable to mathematical analysis. In this minisymposium we focus on development, analysis, and simulation of kinetic models used in biology (e.g., medicine, flocking, social insect behavior, pattern formation, etc.). In particular, we present novel kinetic models used to study biological systems while outlining potential areas for future investigation.

Organizer: Shawn D. Ryan  
*Cleveland State University, USA*

Organizer: Alethea Barbaro  
*Case Western Reserve University, USA*

**10:30-10:55 Kinetic Models for Active Biosystems**

*Shawn D. Ryan, Cleveland State University, USA*

**11:00-11:25 Estimating the Division Rate and Kernel in the Fragmentation Equation**

*Magali Tournus, Institut de Mathématiques de Marseille, France*

**11:30-11:55 A Kinetic Approach for Computation of Correlations in Many Particle Systems**

*Mykhailo Potomkin, Pennsylvania State University, USA*

**12:00-12:25 Kinetic Equations for Utility Sharing**

*Kirk Kayser and Dieter Armbruster, Arizona State University, USA; Michael Herty, RWTH-Aachen, Germany; Christian Ringhofer, Arizona State University, USA*

Wednesday, July 12

**MS46****Matrix Computations for Image Processing and Inverse Problems**

10:30 AM-12:30 PM

Room:303

Large scale inverse problems, including those arising from image processing, generate significant computational challenges. In many cases the key issues can be cast in terms of problems in matrix computation. This minisymposium will consider a range of issues arising in this field. Tools to be discussed will range from deep learning convolutional autoencoders, Bayesian reconstruction algorithms, Hadamard bases, Dirichlet-to-Neumann maps, regularization, linear sampling, single shot parameter assessment and dimension reduction. The presentations will include illustrations on realistic data sets.

Organizer: Catherine F. Higham

*University of Glasgow, Scotland, UK*

**10:30-10:55 Achieving Video Rate for Single-Pixel Cameras Using Deep Learning**

*Catherine F. Higham, Roderick Murray-Smith, Matthew P. Edgar, and Miles J. Padgett, University of Glasgow, Scotland, UK*

**11:00-11:25 Computation and Modeling in Ultrasound Tomography Reconstructions**

*Jennifer L. Mueller, Colorado State University, USA; Sergio Furuie and Raul G. Lima, University of Sao Paulo, Brazil*

**11:30-11:55 Direct Methods for Reconstructing Impenetrable Inclusions from Electrostatic Data**

*Isaac Harris and William Rundell, Texas A&M University, USA*

**12:00-12:25 Second Order Approximation of the MRI Signal for Single Shot Parameter Assessment**

*Rodrigo B. Platte, Arizona State University, USA*

Wednesday, July 12

## MS47

### Modeling and Simulation of Nanostructures and 2D Materials - Part I of II

10:30 AM-12:30 PM

Room:301

#### For Part 2 see MS60

Nanomaterials, nanostructures, and related 2D materials like graphene are currently the focus of intense research because of their unique physical, mechanical, electrical, and chemical properties. Applied mathematics plays a fundamental role when developing models that describe the synthesis, structure, and properties of these new materials. Much of this work is driven by the need to understand formation and evolution of surface and line defects and other important surface effects. This minisymposium will bring together applied mathematicians, materials scientists, physicists, and chemists engaged in the multiscale modeling of nanomaterials and 2D materials.

Organizer: Malena I. Espanol  
*University of Akron, USA*

Organizer: J. Patrick Wilber  
*University of Akron, USA*

#### 10:30-10:55 Shape-Selective Growth of Nanoscale Materials: Insights from Multi-Scale Theory and Simulation

*Kristen Fichthorn, Pennsylvania State University, USA*

#### 11:00-11:25 Discrete-to-Continuum Modeling of Supported Graphene and Lattice Mismatch

*J. Patrick Wilber, Malena I. Espanol, and Dmitry Golovaty, University of Akron, USA*

#### 11:30-11:55 A Structural Phase Field Crystal Approach for Studying Defects in Multilayer Graphene

*Rachel V. Zucker and Mark Asta, University of California, Berkeley, USA*

#### 12:00-12:25 Multiscale and Hybrid Approaches in 2D-Materials Growth: Kinetic Monte Carlo, Markov Chains, and Phase Field Modeling

*Henry Yu, Ksenia Bets, Nitant Gupta, Ming Luo, and Boris Yakobson, Rice University, USA*

Wednesday, July 12

## MS48

### Numerical Algorithms for Data Assimilation and Nonlinear Filtering

10:30 AM-12:00 PM

Room:318

Organized by SIAG/UQ

Filtering describes the solution of a sequence inverse problems, in which the data arrives in an online fashion. The subject of filtering has enjoyed a long standing symbiosis between classical and probabilistic approaches. Data assimilation can be viewed as a bridge between these approaches, built out of the necessity to obtain solutions to the filtering problem quickly for very high dimensional, turbulent, nonlinear forecast models, with notable applications in atmospheric and oceanographic science. This minisymposium aims to bring together experts interested in numerical algorithms for nonlinear filtering and data assimilation, to share their latest research.

Organizer: Matthias Morzfeld  
*University of Arizona, USA*

Organizer: Kody Law  
*Oak Ridge National Laboratory, USA*

#### 10:30-10:55 An Automated Measure Transport Framework for Online Non-linear Filtering and Smoothing

*Daniele Bigoni and Alessio Spantini, Massachusetts Institute of Technology, USA; Youssef M. Marzouk, Massachusetts Institute of Technology, USA*

#### 11:00-11:25 Multilevel Ensemble Kalman Filtering for Spatially Extended Models

*Håkon Hoel, EPFL, Switzerland*

#### 11:30-11:55 Data Assimilation Algorithm Based on Feedback Control Theory

*Evelyn Lunasin, United States Naval Academy, USA*

Wednesday, July 12

## MS49

### Optimal Control and Applications

10:30 AM-12:30 PM

Room:304

*Part of the SIAM Workshop Celebrating Diversity*

Advances in the theory and application of optimal control in the context of Nonsmooth Analysis.

Organizer: Norma Ortiz-Robinson

*Virginia Commonwealth University, USA*

#### 10:30-10:55 Qualitative Properties of the Reachable Set for Delayed Differential Inclusions

*Norma Ortiz-Robinson, Virginia Commonwealth University, USA*

#### 11:00-11:25 Optimal Control Problems with Symmetry Breaking Cost Functions

*Rohit Gupta, University of Minnesota, USA; Tomoki Ohsawa, University of Texas at Dallas, USA; Leonardo J. Colombo and Anthony M. Bloch, University of Michigan, USA*

#### 11:30-11:55 Optimization and Control in Free Boundary Fluid-Structure Interactions

*Lorena Bociu, North Carolina State University, USA*

#### 12:00-12:25 Discrete-Time Geometric Maximum Principle

*Robert Kipka, Kent State University, USA; Rohit Gupta, University of Minnesota, USA*

Wednesday, July 12

## MS50

### Panel: MSC Codes

10:30 AM-12:30 PM

Room:406

Math Reviews classification codes and the representation of applied mathematics.

Organizer: Edward Dunne

*American Mathematical Society, USA*

### Discussion with SIAM Members about Math Subject Classification (MSC) Codes

*Edward Dunne and Dean Carlson, American Mathematical Society, USA*

Wednesday, July 12

## MS51

### Resilient Computation in Large Scale Scientific Computing - Part II of II

10:30 AM-12:30 PM

Room:320

For Part 1 see MS40

Organized by SIAG/SC

As semiconductor technology reaches its physical limit, the performance improvement of high performance computing systems no longer follows the predictions by Moore's law. One of the viable approaches to address this stagnation is to relax the reliability of computing systems, and leave the application users to manage it. However, computing system vendors have been discouraged to provide unreliable systems due to a lack of alternative resilience. This makes the resilience an interdisciplinary topic where applied/computational math should play an important role upon the effort in hardware and system software. This minisymposium opens an opportunity for exchanging the ideas/needs in computational science research to address the emerging topics on application resiliency in large simulations. Additionally, we discuss the reliability and failure behavior of the recent supercomputing systems that will help us to prepare for Exascale computing.

Organizer: Keita Teranishi

*Sandia National Laboratories, USA*

Organizer: Luc Giraud

*Inria, France*

Organizer: Emmanuel Agullo

*Inria, France*

### 10:30-10:55 Soft Error in Classical PCG and its Variants: Sensitivity, Numerical Defections and Possible Recovery Policies

*Emmanuel Agullo, Inria, France; Siegfried Cools, University of Antwerp, Belgium; Emrullah F. Yetkin, Istanbul Technical University, Turkey; Luc Giraud, Inria, France; Wim I. Vanroose, University of Antwerp, Belgium*

### 11:00-11:25 The Resiliency of Multilevel Methods on Next Generation Computing Platforms: Probabilistic Model and Its Analysis

*Christian Glusa and Mark Ainsworth, Brown University, USA*

### 11:30-11:55 Resilience for Parallel Multigrid

*Ulrich J. Ruede, University of Erlangen-Nuremberg, Germany; Markus Huber and Barbara Wohlmuth, Technische Universität München, Germany*

### 12:00-12:25 Bosilca & Bouteiller

*George Bosilca, University of Tennessee, Knoxville, USA*

#### SIAM Presents

Since 2008, SIAM has recorded many Invited Lectures, Prize Lectures, and selected Minisymposia from various conferences. These are available by visiting SIAM Presents (<http://www.siam.org/meetings/presents.php>).



Wednesday, July 12

## MS52

### Stochastic Models in Mathematical Biology - Part I of II

10:30 AM-12:30 PM

Room:317

#### For Part 2 see MS63

Stochasticity is present in almost all levels of all biological systems. However, the effects and the potential functional roles of various sources of randomness in biological systems have only recently been investigated in a rigorous, mathematical manner. In this minisymposium, we propose to present a collection of mathematical biology problems centered around the theme of stochastic models. There has been a flowering of ideas from probability and stochastic processes in this field, and we believe there would be great benefit in assembling several examples of new research directions in one place. The topics to be discussed in the minisymposium include stochastic differential equations applied to cell biology, evolution of resistance to chemotherapies, neuroscience, and data assimilation in biological networks.

Organizer: Thomas Fai

Harvard University, USA

Organizer: Calvin Zhang

University of Arizona, USA

#### 10:30-10:55 Stochastic Model of Flagellar Length Control

Thomas Fai and Ariel Amir, Harvard University, USA

#### 11:00-11:25 Noisy Coupled Oscillators of the Suprachiasmatic Nucleus

Adam Stinchcombe, University of Michigan, USA

#### 11:30-11:55 Glioblastoma Recurrence and Resistance to Temozolomide

Kathleen Storey, Jasmine Foo, and Kevin Leder, University of Minnesota, USA; Russell Rockne, Beckman Research Institute, USA; Atique Ahmed, Northwestern University, USA; Andrea Hawkins-Daarud, Mayo Clinic, USA

#### 12:00-12:25 Using Computation to Understand Insect Embryogenesis

Jordan Hoffmann, Harvard University, USA

Wednesday, July 12

## MS53

### Student Days: Student Paper Prize Winner Presentations

10:30 AM-12:30 PM

Room:310

Organized by the SIAM Education Committee

The SIAM Student Paper Prize(s) are awarded every year to the student author(s) of the most outstanding paper(s) submitted to the SIAM Student Paper Competition. This award is based solely on the merit and content of the student's contribution to the submitted paper. The purpose of the Student Paper Prizes is to recognize outstanding scholarship by students in applied mathematics or computing.

#### Speakers To Be Announced

Wednesday, July 12

## CP11

### Geophysical Science - Part I of II

10:30 AM-12:30 PM

Room:311

#### For Part 2 see CP14

Chair: Sourav Dutta, Texas A&M University, USA

#### 10:30-10:45 Structure-Preserving Finite Elements for Atmospheric Flows

Andrea Natale and Colin J. Cotter, Imperial College London, United Kingdom

#### 10:50-11:05 Modeling and Simulation of Multicomponent, Multiphase Porous Media Flows Using a New Hybrid Method

Sourav Dutta and Prabir Daripa, Texas A&M University, USA

#### 11:10-11:25 Fire, Ice, Water and Dirt: A Simple Climate Model. An Adventure in Mathematical Modeling

John E. Kroll, Old Dominion University, USA

#### 11:30-11:45 Efficient Numerical Ice-Sheet Simulations over Long Time Spans

Gong Cheng, Lina von Sydow, and Per Lötstedt, Uppsala University, Sweden

#### 11:50-12:05 Web-Based Software for Surrogate Modeling and Parameter Estimation of Environmental Models Using Clusters of Distributed Computers

Shawn L. Matott, University of Buffalo, USA; Eva Wu, Sentient Science, USA; Ramin Bostanabad, Northwestern University, USA

#### 12:10-12:25 Organization of Biogeochemical Nitrogen Pathways with Switch-Like Adjustment in Fluctuating Soil Redox Conditions

Mubasher Rather, University of Rajasthan, India; Claudia Acquisti, West Virginia University, USA; Amit Chakraborty, University of Rajasthan, India

Wednesday, July 12

**CP12****Life Sciences - Part III of V**

10:30 AM-12:30 PM

Room:306

For Part 2 see CP3

For Part 4 see CP15

*Chair: Cammey Cole Manning, Meredith College, USA***10:30-10:45 A Mathematical Model of Zika Virus Spread Including Human-Human Transmission***Daniel L. Kern and Kelsea Livingstone, Florida Gulf Coast University, USA***10:50-11:05 Modeling Ertapenem: The Impact of Body Mass Index on Distribution of the Antibiotic in the Body***Cammey Cole Manning, Meredith College, USA; Michele Joyner, East Tennessee State University, USA***11:10-11:25 Modeling the Mitigation of Mosquito-borne Diseases by Infecting Mosquitoes with Wolbachia Bacteria***Zhuolin Qu, Tulane University, USA; Ling Xue, University of Manitoba, Canada; James Hyman, Tulane University, USA***11:30-11:45 Tree Hydraulics: from Leaves Transpiration to Trunk Sap Flow and Vice Versa***Bebart Janbek and John Stockie, Simon Fraser University, Canada***11:50-12:05 A Model for Cell Migration in Non-Isotropic Fibrin Networks with An Application to Pancreatic Tumor Islets***Jiao Chen, Delft University of Technology, Netherlands; Daphne Weihs, Technion - Israel Institute of Technology, Israel; Fred J. Vermolen, Delft University of Technology, Netherlands***12:10-12:25 Glucose and Urinary Bladder Smooth Muscle Excitability: Role of ATP-Sensitive Potassium Channels***Chitaranjan Mahapatra and Rohit Manchanda, Indian Institute of Technology Bombay, India*

Wednesday, July 12

**CP13****Simulation, Modeling and Applications**

10:30 AM-12:50 PM

Room:307

*Chair: Michael Fundator, National Academy of Sciences, USA***10:30-10:45 A Novel Renormalized Mori-Zwanzig Method for Model Reduction***Jacob Price, University of Washington, USA***10:50-11:05 Model Reduction Methods Using Koopman Operators for Data Assimilation***Humberto C. Godinez and Nicholas Hengartner, Los Alamos National Laboratory, USA***11:10-11:25 Model Reduction of Chemical Reaction Networks Using L1-Regularization***Qian Yang, Stanford University, USA; Carlos Sing-Long, Pontificia Universidad Católica de Chile, Chile; Evan Reed, Stanford University, USA***11:30-11:45 Hierarchical Coarse-Graining of Operators for Md***Berend C. Rinderspacher, Army Research Laboratory, USA; Jaydeep Bardhan, Northeastern University, USA; Ahmed E. Ismail, West Virginia University, USA***11:50-12:05 Structure-Preserving Model Reduction for Marginally Stable LTI Systems***Liqian Peng, Kevin T. Carlberg, and Mohan Sarovar, Sandia National Laboratories, USA***12:10-12:25 Various Extensions of Original Born-Kramers-Slater Model for Reactions Kinetics Based on Brownian Motion and Fokker-Plank Equation Including 1D, 2D, 3D, and Multi-dimensional Approaches***Michael Fundator, National Academy of Sciences, USA***12:30-12:45 Modeling Adsorption in Functionalized Membranes***Anastasia B. Wilson, Augusta University, USA; Eleanor Jenkins, Clemson University, USA*

Wednesday, July 12

**Workshop Celebrating Diversity (WCD) Luncheon (by invitation only)**

12:30 PM-2:00 PM

Room:316

**Lunch Break**

12:30 PM-2:00 PM

*Attendees on their own***Fundamentals of Algorithms Book Series Editorial Board Meeting**

12:30 PM-2:00 PM

*Room: Westin Hotel - Butler East***Industry Committee Meeting**

12:30 PM-2:00 PM

*Room: Westin Hotel - Cambria East***Journal Committee Meeting**

12:30 PM-2:00 PM

*Room: Westin Hotel - Cambria West*

Wednesday, July 12

**SP3****Past President's Address:  
The Future of SIAM: Looking  
to the Mathematicians of  
Tomorrow**

2:00 PM-3:00 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Nicholas J. Higham, University of  
Manchester, United Kingdom*

During my tenure as SIAM president, I sought to emphasize that the 'S' in SIAM stands for students by focusing on boosting our global presence and cultivating the next generation of mathematicians. To all the long-time SIAM members, can you guess how many new international chapters we've added since 2012? To all the new SIAM student members we've welcomed in that period, can you name all the ways SIAM can help you grow your careers? At the 2017 SIAM Annual Meeting I will invite our Student Chapters to use their own words to answer these important questions through a series of videos spanning several continents. The advances we've made should make us all proud. Of course, there's always more that SIAM can do as it continues to push ahead in order to remain at the vanguard of the scientific community.

Irene Fonseca  
*Carnegie Mellon University, USA*

Wednesday, July 12

**SP4****James H. Wilkinson  
Numerical Analysis and  
Scientific Computing  
Prize Lecture: Tensors  
in Computational  
Mathematics**

3:00 PM-3:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Nicholas J. Higham, University of  
Manchester, United Kingdom*

We show that in many instances, one would find a higher-order tensor, usually of order three, at the core of an important problem in computational mathematics. The resolution of the problem depends crucially on determining certain properties of its corresponding tensor. We will draw examples from (i) numerical linear algebra: fastest/stablest algorithms for matrix product, matrix inversion, or structured matrix computations; (ii) numerical optimization: SDP-relaxations of NP-hard problems, self-concordance, higher-order KKT conditions; and, if time permits, (iii) numerical PDEs: tensor network ranks. This talk is based on joint works with Ke Ye, with Shenglong Hu, and with Shmuel Friedland.

Lek-Heng Lim  
*University of Chicago, USA*

**Coffee Break**

3:30 PM-4:00 PM

*Room: Ballroom Gallery - 3rd Floor***SIAM Presents**

Since 2008, SIAM has recorded many Invited Lectures, Prize Lectures, and selected Minisymposia from various conferences. These are available by visiting SIAM Presents  
(<http://www.siam.org/meetings/presents.php>).



Wednesday, July 12

**MS54****Advances in Mathematics  
of Large-Scale and Higher-  
Order Networks - Part I of II**

4:00 PM-6:00 PM

*Room: 302***For Part 2 see MS66**

Network science is a rapidly growing and highly interdisciplinary field. The ability of handling large-scale problems is crucial when analyzing the huge amount of data we are exposed to in today's world. Furthermore, more and more often, the data at our disposal encode multi-dimensional or time-dependant features. This pushes toward the introduction of higher-order models, opening to new mathematical challenges to derive rigorous theory and develop efficient numerical methods. The talks in this minisymposium sample some recent advances and contributions from relatively diversified fields - from network science to spectral theory, matrix analysis and machine learning - with a focus on mathematical and numerical tools to treat graphs and networks.

Organizer: Francesco Tudisco  
*University of Padua, Italy*

Organizer: Francesca Arrigo  
*University of Strathclyde, United Kingdom*

**4:00-4:25 Centrality Measures  
for Multiplex Networks Based on  
Eigenvectors of Multi-Homogeneous  
Maps**

*Francesca Arrigo, University of Strathclyde,  
United Kingdom; Antoine Gautier, Saarland  
University, Germany; Francesco Tudisco,  
University of Padua, Italy*

**4:30-4:55 Methods for Analyzing  
Higher-Order Structures in Networks**

*David F. Gleich, Purdue University, USA;  
Austin Benson, Stanford University, USA*

continued on next page

**5:00-5:25 Generative Model for Mesoscale Structure in Multilayer Networks**

*Marya Bazzi*, University of Oxford, United Kingdom; *Lucas Jeub*, Indiana University, USA; *Sam Howison*, Oxford University, United Kingdom; *Alex Arenas*, Universidad Rovira i Virgili, Spain; *Mason A. Porter*, University of Oxford, United Kingdom

**5:30-5:55 Detectability of Community Structure in Multilayer and Temporal Networks Undergoing Layer Aggregation**

*Dane Taylor*, University of North Carolina at Chapel Hill, USA; *Rajmonda Caceres*, Massachusetts Institute of Technology, USA; *Peter J. Mucha*, University of North Carolina at Chapel Hill, USA

Wednesday, July 12

**MS55**

**Discrete Methods in Molecular Biology - Part II of II**

4:00 PM-6:00 PM

*Room: Spirit of Pittsburgh B - 3rd Floor*

**For Part I see MS42**  
Organized by SIAG/DM

This minisymposium will focus on the importance of algebraic, combinatorial, geometric, and topological methods in mathematical biology, with applications ranging from phylogenetic trees and RNA folding to systems biology and molecular computation. This invited minisymposium is part of the SIAM DM track.

Organizer: *Christine Heitsch*  
*Georgia Institute of Technology, USA*

**4:00-4:25 Recovering the Treelike Trend of Evolution Despite Extensive Lateral Genetic Transfer**

*Constantinos Daskalakis*, Massachusetts Institute of Technology, USA; *Sebastien Roch*, University of Wisconsin, Madison, USA

**4:30-4:55 Branching Polytopes for RNA Sequences**

*Fidel Barrera-Cruz* and *Christine Heitsch*, Georgia Institute of Technology, USA; *Svetlana Poznanovikj*, Clemson University, USA

**5:00-5:25 The Geometry of Sloppiness**

*Emilie Dufresne* and *Heather Harrington*, University of Oxford, United Kingdom; *Dhruva Raman*, University of Cambridge, United Kingdom

**5:30-5:55 Detecting Reoccurring Patterns of Scrambled Genes**

*Natasha Jonoska* and *Masahico Saito*, University of South Florida, USA

Wednesday, July 12

**MS56**

**Fractional Models: Computation and Applications**

4:00 PM-6:00 PM

*Room: 304*

Fractional derivative models have been playing an increasingly important role nowadays in economics, finance, biological systems, mechanics, and industrial simulations. As a result, there is a tremendous amount of demands for efficient computational techniques that takes into account the complexity in these models due to the non-locality. Invited presentations in this minisymposium will address several interesting issues in applications, such as fractional models in financial trading and transactions, and how the non-locality in combustion will explain some anomalous behaviors. The latest research results from the study of fractional partial differential equation models in finance, and optics involving multi-dimensional nonlinear Schrödinger equations will also be presented.

Organizer: *Khaled Furati*  
*King Fahd University of Petroleum and Minerals, Saudia Arabia*

Organizer: *Abdul Qayyum M. Khaliq*  
*Middle Tennessee State University, USA*

Organizer: *Qin Sheng*  
*Baylor University, USA*

**4:00-4:25 Efficient Numerical Methods for Multi-dimensional Space Fractional Semi-linear Partial Differential Equations**

*Abdul Qayyum M. Khaliq*, Middle Tennessee State University, USA

Wednesday, July 12

## MS56

### Fractional Models: Computation and Applications

4:00 PM-6:00 PM

continued

#### 4:30-4:55 An Efficient Probabilistic Numerical Method Based on Fourier-Cosine Series for Fractional Laplacian Equations

Guannan Zhang, Oak Ridge National Laboratory, USA

#### 5:00-5:25 An Exploration of Quenching-Combustion Via Globalized Fractional Models

Joshua Padgett and Qin Sheng, Baylor University, USA

#### 5:30-5:55 Finite Element Approximations for Fractional Fokker Planck Equations

Kassem Mustapha, King Fahd University of Petroleum and Minerals, Saudi Arabia; William McLean and Kim Ngan Le, University of New South Wales, Australia

Wednesday, July 12

## MS57

### High Performance Simulations of Cardiac and Other Mathematical Models in Real-Time Using Graphic Cards

4:00 PM-6:00 PM

Room:303

The need for computational power has been increasing over the years as the problems that we try to tackle become more and more complex. However, CPU speeds has been increasing slowly as a result of physical limitations on increasing speeds in CPUs. Nowadays, we see CPUs with multiple cores to introduce a small level of parallelization in personal computers and when even that is not enough scientists use clusters for parallel computing. However, clusters are expensive, hard to maintain, and running your codes usually requires staying in user queues for your turn to run your program. Nowadays, graphic cards, or more precisely Graphic Processing Units (GPUs) come with hundreds to thousands of computational cores. Each core, is usually slower than a typical CPU core, but the sheer number of the cores makes the computational power of GPUs one to two orders of magnitude larger than traditional CPUs. In this minisymposium, we will showcase the leading research examples that are made possible by utilizing the computational power of GPUs, which if GPUs were not utilized would require modern supercomputers to tackle.

Organizer: Abouzar Kaboudian  
Georgia Institute of Technology, USA

#### 4:00-4:25 GPU-Accelerated Stochastic Models of Cardiac Myocytes to Understand Genetically-Based Arrhythmia

Mohsin S. Jafri, George Mason University, USA

#### 4:30-4:55 Near Real-Time Interactive Cardiac Simulations in Tissue Using WebGL

Abouzar Kaboudian and Flavio H. Fenton, Georgia Institute of Technology, USA

#### 5:00-5:25 CindyGL: Automatic Translation of a High-level Programming Language to a GPU Shader Language -- Theory and Application

Aaron Montag and Jürgen Richter-Gebert, Technical University of Munich, Germany

#### 5:30-5:55 Studying the Instabilities of Spiral Waves Due to Their Chirality in Anisotropic Cardiac Tissue using CUDA

Hector Augusto Velasco Perez, Abouzar Kaboudian, and Flavio H. Fenton, Georgia Institute of Technology, USA

Wednesday, July 12

## MS58

### High Performance Tensor Computations - Part I of II

4:00 PM-6:00 PM

Room:319

For Part 2 see MS69

Organized by SIAG/SU

Tensor decompositions are increasingly useful in data science. We consider tensor decompositions such as CANDECOMP/PARAFAC (CP), Tucker, as well as coupled decompositions. This minisymposium focuses especially on effective algorithms for data science problems as well as considering high performance implementations for key tensor computations.

Organizer: Grey Ballard

Wake Forest University, USA

Organizer: Tamara G. Kolda

Sandia National Laboratories, USA

### 4:00-4:25 Model-Driven Sparse CP Decomposition for Higher-Order Tensors

Jiajia Li, Georgia Institute of Technology, USA; Jee Choi, IBM T.J. Watson Research Center, USA; Ioakeim Perros, Jimeng Sun, and Richard Vuduc, Georgia Institute of Technology, USA

### 4:30-4:55 Fusion of Multi-Modal Neuroimaging Data using Coupled Matrix and Tensor Factorizations

Evrin Acar, University of Copenhagen, Denmark; Yuri Levin-Schwartz and Tulay Adali, University of Maryland, Baltimore County, USA; Vince Calhoun, University of New Mexico, USA

### 5:00-5:25 Portability and Scalability of Sparse Tensor Decompositions on CPU/MIC/GPU Architectures

Christopher J. Forster, Keita Teranishi, Greg Mackey, Daniel M. Dunlavy, and Tamara G. Kolda, Sandia National Laboratories, USA

### 5:30-5:55 Blocking Optimization Strategies for Sparse Tensor Computation

Jee Choi, IBM T.J. Watson Research Center, USA

Wednesday, July 12

## MS59

### Model Error Quantification in Computational Physical Models

4:00 PM-6:00 PM

Room:318

Organized by SIAG/UQ

There is growing interest in the quantification of model error or structural uncertainty in computational science and engineering. In the context of statistical model calibration, model error representation and quantification faces significant challenges, particularly for physical models. For example, it is difficult to properly disambiguate data noise from model errors, or to extrapolate towards the prediction of arbitrary model outputs of interest. This minisymposium will highlight the challenges and present novel methods for model error assessment, aiming to contribute towards improving predictive fidelity of computational physical models across a range of disciplines.

Organizer: Khachik Sargsyan

Sandia National Laboratories, USA

Organizer: Xun Huan

Sandia National Laboratories, USA

Organizer: Habib N. Najm

Sandia National Laboratories, USA

### 4:00-4:25 A Non-Intrusive Embedding Approach for Statistical Characterization of Model Error

Xun Huan, Khachik Sargsyan, and Habib N. Najm, Sandia National Laboratories, USA

### 4:30-4:55 Approximate Bayesian Inference for Intractable Likelihood Functions Due to Modeling Errors

Gabriel Terejanu, University of South Carolina, USA

### 5:00-5:25 Uncertainty Quantification and Discrepancy for Complex Multiscale Systems

K. Sham Bhat, Los Alamos National Laboratory, USA; David S. Mebane, West Virginia University, USA; Troy Holland and Peter W. Marcy, Los Alamos National Laboratory, USA; Priyadarshi Mahapatra, National Energy Technology Laboratory, USA; Curtis Storlie, Mayo Clinic, USA

### 5:30-5:55 Towards Accounting for Model Error in CO2 Retrievals from the OCO-2 Satellite

Jenny Brynjarsdottir, Case Western Reserve University, USA; Jonathan Hobbs and Amy Braverman, Jet Propulsion Laboratory, California Institute of Technology

continued in next column

Wednesday, July 12

## MS60

### Modeling and Simulation of Nanostructures and 2D Materials - Part II of II

4:00 PM-6:00 PM

Room:301

#### For Part 1 see MS47

Nanomaterials, nanostructures, and related 2D materials like graphene are currently the focus of intense research because of their unique physical, mechanical, electrical, and chemical properties. Applied mathematics plays a fundamental role when developing models that describe the synthesis, structure, and properties of these new materials. Much of this work is driven by the need to understand formation and evolution of surface and line defects and other important surface effects. This minisymposium will bring together applied mathematicians, materials scientists, physicists, and chemists engaged in the multiscale modeling of nanomaterials and 2D materials.

Organizer: Malena I. Espanol  
University of Akron, USA

Organizer: J. Patrick Wilber  
University of Akron, USA

#### 4:00-4:25 Steric Hindrance of Crystal Growth: Nonlinear Mesoscale Model in 1+1 Dimensions

Dionisios Margetis, University of Maryland, College Park, USA

#### 4:30-4:55 Surface Elasticity in Steigmann-Ogden Form in Modeling of Fracture

Anna Zemlyanova, Kansas State University, USA

#### 5:00-5:25 The Role of Topology in Microstructure-property Relationships: A 2D DEM Based Study

Katerine Saleme Ruiz and Maria Emelianenko, George Mason University, USA

#### 5:30-5:55 High-throughput Identification and Characterization of Two-dimensional Materials using Density Functional Theory

Kamal Choudhary, NIST, USA

Wednesday, July 12

## MS61

### Numerical Libraries: Foundations of Community Software Ecosystems

4:00 PM-6:00 PM

Room:305

Numerical libraries have proven effective in providing widely reusable software that is robust, efficient, and scalable---delivering advanced algorithms and data structures that enable scientific discovery for a broad range of applications. As we collectively address more advanced modeling, simulation, and analysis, the developers of open-source numerical libraries are increasingly encouraging community contributions to their software, and at the same time considering more effective strategies for connections with external packages that provide complementary functionality. The speakers in this session will discuss strategies for numerical library design and development that promote extensibility and community contributions. We will also discuss challenges and opportunities in working toward broader community scientific software ecosystems.

Organizer: Lois Curfman McInnes

Argonne National Laboratory, USA

Organizer: Michael Heroux  
Sandia National Laboratories, USA

#### 4:00-4:25 Numerical Libraries: Community Achievements, Challenges, and Opportunities

Lois Curfman McInnes, Argonne National Laboratory, USA; Michael Heroux, Sandia National Laboratories, USA

#### 4:30-4:55 Clawpack: Building An Open Source Ecosystem for Solving Hyperbolic PDEs

Kyle T. Mandli, Columbia University, USA

#### 5:00-5:25 deal.II: Perspectives from a Modular and Community-Driven Finite-Element Library

Matthias Maier, University of Minnesota, Twin Cities, USA

#### 5:30-5:55 Experiences with Library Interoperability in the xSDK

Alicia M. Klinvex, Sandia National Laboratories, USA

Wednesday, July 12

## MS62

### Panel: Implicit Bias, Stereotyping and Prejudice in STEM

4:00 PM-5:30 PM

Room:406

Implicit bias in judgment and/or behavior results from subtle cognitive processes, e.g., attitudes and/or stereotypes, that operate below conscious awareness and without intentional control. This minisymposium and panel discussion addresses these phenomena insofar as they impact the academic and scholarly evaluation procedures in science, technology, engineering, and mathematics (STEM) fields. University of Michigan Professor Denise Sekaquaptewa, an experimental social psychologist, will discuss current research on stereotyping, implicit bias, and the experiences of women and underrepresented minorities in STEM fields. Former UC Berkeley Vice Provost for Academic Personnel Nicholas P. Jewell will discuss gender issues including the impact of implicit bias in appointments, promotions, peer review and leadership opportunities. National Science Foundation (NSF) Program Director Ron Buckmire will discuss what NSF tells proposal reviewers about implicit bias and summarize what effect NSF feels it has on the proposal review process.

Organizer: Charles R. Doering  
University of Michigan, Ann Arbor, USA

#### 4:00-4:25 Stereotyping, Implicit Bias, and Experiences of Women and Underrepresented Minorities in STEM Fields

Denise Sekaquaptewa, University of Michigan, Ann Arbor, USA

#### 4:30-4:55 Gender Issues and the Impact of Implicit Bias in Appointments, Promotions, Peer Review and Leadership Opportunities

Nicholas P. Jewell, University of California, Berkeley, USA

#### 5:00-5:25 Implicit Bias Its Impact on the Proposal Review Process: The View from NSF

Ron Buckmire, National Science Foundation, USA

Wednesday, July 12

## MS63

### Stochastic Models in Mathematical Biology - Part II of II

4:00 PM-6:00 PM

Room:317

#### For Part 1 see MS52

Stochasticity is present in almost all levels of all biological systems. However, the effects and the potential functional roles of various sources of randomness in biological systems have only recently been investigated in a rigorous, mathematical manner. In this minisymposium, we propose to present a collection of mathematical biology problems centered around the theme of stochastic models. There has been a flowering of ideas from probability and stochastic processes in this field, and we believe there would be great benefit in assembling several examples of new research directions in one place. The topics to be discussed in the minisymposium include stochastic differential equations applied to cell biology, evolution of resistance to chemotherapies, neuroscience, and data assimilation in biological networks.

Organizer: Thomas Fai  
*Harvard University, USA*

Organizer: Calvin Zhang  
*University of Arizona, USA*

#### 4:00-4:25 A Benefit of Noise in Synaptic Vesicle Release

*Calvin Zhang, University of Arizona, USA;*  
Charles S. Peskin, Courant Institute of Mathematical Sciences, New York University, USA

#### 4:30-4:55 Stochasticity in Vesicle Exocytosis Downstream of Ca<sup>2+</sup> Channel Gating: A Computational Study

*Victor Matveev, New Jersey Institute of Technology, USA*

#### 5:00-5:25 Complexity Reduction for Ion Channel Models Via Stochastic Shielding

*Deena Schmidt, University of Nevada, Reno, USA; Roberto F. Galan and Peter J. Thomas, Case Western Reserve University, USA*

#### 5:30-5:55 A Data Assimilation Approach to Completing Models of Pattern-generating Networks

*Eve Armstrong, University of California, San Diego, USA*

Wednesday, July 12

## MS64

### Student Days: An Informal Meeting with the Co-chairs and Invited Speakers

4:00 PM-6:00 PM

Room:310

Student Days session organized by the Annual Meeting Organizing Committee Co-Chairs. This informal session provides opportunities for students to meet invited speakers. This is your chance to ask research or career questions, or listen to advice provided by the experts.

Organizer: Des Higham  
*University of Strathclyde, United Kingdom*

Organizer: Jennifer L. Mueller  
*Colorado State University, USA*

#### Participating Invited Speakers

**Charlie Catlett**  
Argonne National Laboratory, USA

**Kenneth M. Golden**  
University of Utah, USA  
**David M. Higdon**  
Virginia Tech, USA

**Mark Lewis**  
University of Alberta, Canada

**Alison Marsden**  
Stanford University, USA

**Carola Bibiane Schoenlieb**  
University of Cambridge, United Kingdom

**Mary Silber**  
University of Chicago, USA

**Barbara Wagner**  
Weierstrass Institute, Germany

Wednesday, July 12

## MS65

### Variational Methods and Optimization for Image and Data Analysis

4:00 PM-6:00 PM

Room: Spirit of Pittsburgh A - 3rd Floor

We live in a data-rich era. Images, measurements, signals are being generated and recorded continuously, and there is a critical need for sophisticated algorithms to improve and enhance this data, and then to interpret it and turn it into meaningful representations. This minisymposium will showcase a selection of recent state-of-the-art approaches to accomplish these tasks using variational methods and optimization.

Organizer: Gunay Dogan

National Institute of Standards and Technology, USA

#### 4:00-4:25 Bayesian Uncertainty Quantification in the Classification of High Dimensional Data

Andrea L. Bertozzi, University of California, Los Angeles, USA

#### 4:30-4:55 Density Based Clustering Applied to Image Segmentation

Marilyn Vazquez, George Mason University, USA

#### 5:00-5:25 A Learning Approach for Computing Regularization Parameters for General-Form Tikhonov Regularization

Malena I. Espanol, University of Akron, USA; Julianne Chung, Virginia Tech, USA

#### 5:30-5:55 A Fast Relaxed Normal Two Split Method And An Effective Weighted Tv Approach For Euler's Elastica Image Inpainting

Sung Ha Kang, Georgia Institute of Technology, USA

Wednesday, July 12

## CP14

### Geophysical Science - Part II of II

4:00 PM-6:00 PM

Room: 311

For Part 1 see CP11

Chair: David L. Coulliette, Asbury University, USA

#### 4:00-4:15 Design of Experiments-Based Geological Uncertainty Quantification of Co<sub>2</sub>-Based Gas Assisted Gravity Drainage (GAGD) Process

Watheq J. Al-Mudhafar, Louisiana State University, USA

#### 4:20-4:35 Modelling and Uncertainty Quantification in Biot's Poro-Elasticity with Pulsating and Oscillatory Boundary Conditions

Menel Rahrah and Fred J. Vermolen, Delft University of Technology, Netherlands

#### 4:40-4:55 Field Scale Modeling of Rate-Limited Sorption in Production Transport Codes

David L. Coulliette, Kenneth Rietz, and Andrew Ward, Asbury University, USA

#### 5:00-5:15 Joint Reconstruction with Parametric Level-Set Full-Waveform Inversion

Ajinkya Kadu and Tristan van Leeuwen, Utrecht University, The Netherlands; Wim Mulder, Delft University of Technology and Shell International Exploration and Production, Netherlands

#### 5:20-5:35 Seismic Imaging and Correlation Analysis of Statistical Fault Zone Model

Dmitriy Kolyukhin, Vadim Lisitsa, and Maxim Protasov, Trofimuk Institute of Petroleum Geology and Geophysics of SB RAS, Russia; Dongfang Qu, Uni Research CIPR, Norway; Vladimir Tcheverda, Trofimuk Institute of Petroleum Geology and Geophysics of SB RAS, Russia; Jan Tveranger, Centre for Integrated Petroleum Research, Norway; Dmitry Vishnevsky, Trofimuk Institute of Petroleum Geology and Geophysics of SB RAS, Russia

#### 5:40-5:55 Calculation of Seismic Depth Migration Before Summation Based on the Asymptotic Solutions of the Telegraph Equation in Parametric Global Coordinate System

Ilya Smirnov, Lomonosov Moscow State University, Russia

Wednesday, July 12

## CP15

### Life Sciences - Part IV of V

4:00 PM-6:00 PM

Room: 306

For Part 3 see CP12

For Part 5 see CP19

Chair: Simone Cassani, Worcester Polytechnic Institute, USA

#### 4:00-4:15 Establishing a Theoretical Framework for the Ultradian Forced Desynchrony Protocol

Nora Stack, Colorado School of Mines, USA; Mary Carskadon and David Barker, Brown University, USA; Cecilia Diniz Behn, Colorado School of Mines, USA

#### 4:20-4:35 On a Diffusion Based Model for Parkinsonian Tremors

Pratik Worah, Google Research, USA

#### 4:40-4:55 Activity Patterns in Lateral-Inhibition Type Neural Fields with Asymmetric Excitatory Distal Components

Alex Onderdonk, Myles Akin, and Yixin Guo, Drexel University, USA

#### 5:00-5:15 Mathematical Modeling of Retinal Hemodynamics and Its Relevance in Glaucoma

Simone Cassani, Worcester Polytechnic Institute, USA; Giovanna Guidoboni and Julia Arciero, Indiana University - Purdue University Indianapolis, USA; Alon Harris, Indiana University School of Medicine, USA

#### 5:20-5:35 On the Computation of Point Spread Functions for the Eye after Contact Lens Motion with Application

Sanjeeva S. Karunarathna and Ram V. Iyer, Texas Tech University, USA; Steven Mathews, West Texas Eye Associates, USA

#### 5:40-5:55 Evaluating Dosimetric Changes Caused by Positional Errors of the Savi Applicator Used for Breast Cancer Treatment

Abbas M. Jammali, Ball State University, USA; Andrew Bergan, Ball Memorial Hospital, USA

Wednesday, July 12

**CP16****Ordinary Differential Equations**

4:00 PM-6:00 PM

Room:315

Chair: John Gemmer, Wake Forest University, USA

**4:00-4:15 Least Action Methods and Noise Induced Transitions in Periodically Forced Systems**

John Gemmer, Wake Forest University, USA; Yuxin Chen, Northwestern University, USA; Alexandria Volkening, Brown University, USA; Mary Silber, University of Chicago, USA

**4:20-4:35 What Is a Random Smooth Function?**

Nick Trefethen, University of Oxford, United Kingdom

**4:40-4:55 Practical Issues Concerning Parameter Estimation in Distributed Delay Systems**

Karyn L. Sutton, University of Louisiana, USA

**5:00-5:15 On the Periodic Doubling and Neimark-Sacker Bifurcations in a Discrete Larch Budmoth Model**

Mihiri M. De Silva and Sophia Jang, Texas Tech University, USA

**5:20-5:35 Symbolic Iterative Solution of Boundary Value Problems**

Hamid Semiyari, American University, USA

**5:40-5:55 Stable Foliations Near a Traveling Front for Reaction Diffusion Systems**

Xinyao Yang, Xi'an Jiaotong - Liverpool University, China; Yuri Latushkin, University of Missouri, Columbia, USA; Roland Schnaubelt, Karlsruhe Institute of Technology, Germany

Wednesday, July 12

**SP5****I.E. Block Community Lecture: From Flatland to Our Land: A Mathematician's Journey through Our Changing Planet**

6:15 PM-7:15 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Nicholas J. Higham, University of Manchester, United Kingdom

Mathematics is central to our understanding of the world around us. We live in a vast dynamical system, the many dimensions of which can be interrogated with mathematical tools. In this talk I will consider our changing climate. I will describe the scientific evidence that tells us how and why our climate is changing, and what the future may hold. In this journey I will pause at various waypoints to describe in more detail some of the insight different branches of mathematics are providing. Diverse examples will include applying ideas from dynamical systems research to create novel strategies for measuring the ocean mixing processes that are critical to the flow of heat and carbon through the Earth system, through to employing statistical learning techniques to improve future predictions of Arctic sea ice, currently in perilous decline. Climate change is one of the greatest challenges facing humanity. Responding to the challenge requires robust scientific evidence to inform policies. Opportunities for mathematicians to contribute to this important issue abound.

Emily Shuckburgh  
British Antarctic Survey, United Kingdom**Community Reception**

7:15 PM-8:15 PM

Room: North Terrace - 4th Floor

**Thursday, July 13****Education Committee Meeting**

7:00 AM-8:30 AM

Room: Westin Hotel - Cambria East

**Registration**

8:00 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

**Remarks**

8:20 AM-8:30 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Thursday, July 13

**IT7****Creating New Sources of Data and Embedded Systems to Understand Cities**

8:30 AM-9:15 AM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Des Higham, University of Strathclyde, United Kingdom*

The availability of urban data has increased over the past few years, in particular through open data initiatives, creating new opportunities for collaboration between academia and local government in areas ranging from scalable data infrastructure to tools for data analytics, along with challenges such as replicability of solutions between cities, integrating and validating data for scientific investigation, and protecting privacy. For many urban questions, however, new data sources will be required with greater spatial and/or temporal resolution, driving innovation in the use of sensors in mobile devices as well as embedding intelligent sensing infrastructure in the built environment. Collectively these data sources also hold promise to begin to integrate computational models associated with individual urban sectors such as transportation, building energy use, or climate. Catlett will discuss the work that Argonne National Laboratory and the University of Chicago are doing in partnership with the City of Chicago and other cities through the Urban Center for Computation and Data, focusing in particular on new opportunities related to embedded systems and integrated data platforms.

Charlie Catlett

*Argonne National Laboratory, USA*

Thursday, July 13

**IT8****Highly Accurate Numerical Methods and Error Estimates for Evaluation of Nearly Singular Integrals in Integral Equations**

8:30 AM-9:15 AM

*Room: Spirit of Pittsburgh B - 3rd Floor**Chair: Erica J. Graham, Bryn Mawr College, USA*

Near singularities arise from Green's functions as single and double layer potentials are evaluated close to boundaries and interfaces in an integral equation based method. The quadrature error for this integral evaluation increases exponentially as the boundary is approached if a regular quadrature rule is used. Starting in 2D, we present very precise estimates for the quadrature errors, that are derived using a technique based on contour integration and calculus of residues. These estimates can determine when the regular quadrature fails to keep the error below a set tolerance. Quadrature by expansion (QBX) is a new specialized quadrature method that can evaluate nearly singular integrals very accurately. There are however several parameters to choose for this method. Estimates can be derived also for the error in the coefficients of the expansion underlying QBX, and this can be used to create an adaptive QBX method that self-selects parameters, given an error tolerance. The performance of this method is discussed for Laplace and Helmholtz equations in 2D. We also discuss QBX in three dimensions for Stokes flow. We show how to extend the error estimates to integrals over surfaces in 3 dimensions. We discuss a QBX method for solid ellipsoids and rigid walls, where precomputations are made using geometric symmetries to reduce computations and storage. Finally, a target-specific QBX method for deformable drops is introduced, where all computations are made on the fly.

Anna-Karin Tornberg

*KTH Royal Institute of Technology, Sweden*

Thursday, July 13

**IP1****Genetic Consequences of Range Expansion Under Climate Change**

9:15 AM-10:00 AM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Bard Ermentrout, University of Pittsburgh, USA*

Range expansion is a crucial population response to climate change. Genetic consequences are coupled to ecological dynamics that, in turn, are driven by shifting climate conditions. We model a population with a reaction-diffusion system, coupled to a heterogeneous environment that shifts with time due to climate change. We decompose the resulting traveling wave solution into neutral genetic components to analyze the spatio-temporal dynamics of its genetic structure. Our analysis shows that range expansion under slow climate change preserves genetic diversity. However, diversity is diminished when climate change occurs too quickly. We show that populations with intermediate dispersal ability are best for maintaining genetic diversity. Our study also provides new insight regarding traveling wave solutions in heterogeneous environments. This is joint with Jimmy Garnier (CNRS).

Mark Lewis

*University of Alberta, Canada***Exhibit Hall Open**

9:30 AM-4:30 PM

*Room: Ballroom Gallery - 3rd Floor***Coffee Break**

10:00 AM-10:30 AM

*Room: Ballroom Gallery - 3rd Floor*

Thursday, July 13

**MS66****Advances in Mathematics of Large-Scale and Higher-Order Networks - Part II of II**

10:30 AM-12:30 PM

Room:302

**For Part 1 see MS54**

Network science is a rapidly growing and highly interdisciplinary field. The ability of handling large-scale problems is crucial when analyzing the huge amount of data we are exposed to in today's world. Furthermore, more and more often, the data at our disposal encode multi-dimensional or time-dependant features. This pushes toward the introduction of higher-order models, opening to new mathematical challenges to derive rigorous theory and develop efficient numerical methods. The talks in this minisymposium sample some recent advances and contributions from relatively diversified fields—from network science to spectral theory, matrix analysis and machine learning—with a focus on mathematical and numerical tools to treat graphs and networks.

Organizer: Francesco Tudisco  
*University of Padua, Italy*

Organizer: Francesca Arrigo  
*University of Strathclyde, United Kingdom*

**10:30-10:55 Walk This Way**

*Desmond J. Higham* and Francesca Arrigo, University of Strathclyde, United Kingdom; Peter Grindrod, University of Oxford, United Kingdom; Vanni Noferini, University of Essex, United Kingdom

**11:00-11:25 Detecting Changes in Node Importance in Time-Evolving Networks**

*Christine Klymko*, Lawrence Livermore National Laboratory, USA; Olivia Simpson, University of California, San Diego, USA

**11:30-11:55 Community Detection Via Nonlinear Modularity Eigenvectors**

*Pedro Mercado*, Saarland University, Germany; Francesco Tudisco, University of Padua, Italy; Matthias Hein, Saarland University, Germany

**12:00-12:25 Locating the Vertices in a Three-Dimensional Space for Building a Large-Scale Visual Search Engine**

*Weijian Zhang*, Jonathan Deakin, and Nicholas J. Higham, University of Manchester, United Kingdom

Thursday, July 13

**MS67****Boosting and Learning in Mathematical Imaging Algorithms - Part I of II**

10:30 AM-12:30 PM

Room: Spirit of Pittsburgh A - 3rd Floor

**For Part 2 see MS75**

Existing algorithms for processing image data have covered the gamut of mathematical techniques over the past several decades. In fact, they have become so good that recent research has found that in lieu of creating completely new approaches, great advances can be made by either boosting or introducing advanced learning techniques into existing algorithms/frameworks. In this minisymposium we will explore some recent state-of-the-art work in this area.

Organizer: Stacey E. Levine  
*Duquesne University, USA*

Organizer: Marcelo Bertalmío  
*Universitat Pompeu Fabra, Spain*

**10:30-10:55 How to Improve Your Denoising Result Without Changing Your Denoising Algorithm**

*Marcelo Bertalmío*, Thomas Batard, and Gabriela Ghimpeteanu, Universitat Pompeu Fabra, Spain; Stacey E. Levine, Duquesne University, USA

**11:00-11:25 The Little Engine That Could: Regularization by Denoising (RED)**

*Yaniv Romano* and Michael Elad, Technion Israel Institute of Technology, Israel; Peyman Milanfar, Google Research, USA

**11:30-11:55 Learning with Privileged Information and Its Application in Medical Informatics**

*Keyvan Najarian* and Harm Derksen, University of Michigan, USA

**12:00-12:25 NIR-VIS Face Recognition Via Cross-spectral Hallucination and Low-Rank Embedding**

*Jose Lezama*, *Qiang Qiu*, and Guillermo Sapiro, Duke University, USA

*continued in next column*

## GRADUATING? EARNING YOUR FINAL DEGREE?



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— Necibe Tuncer,  
Florida Atlantic  
University

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# Notes

Thursday, July 13

## MS68

### Efficient Graph Algorithms

10:30 AM-12:30 PM

Room: Spirit of Pittsburgh B - 3rd Floor

Organized by SIAG/DM

Graphs are a powerful modeling tool backed by many efficient algorithms. The talks in this minisymposium consider fundamental complexity and practical performance of graph algorithms in new settings or for new/evolving high-performance architectures. The talks consider parallel or distributed graph algorithms, the relationship between graph algorithm and quantum algorithms, or illustrate the value of polyhedral combinatorics and graph methods in logistics and optimization. This minisymposium is part of the SIAM DM track.

Organizer: Cynthia Phillips

Sandia National Laboratories, USA

### 10:30-10:55 Cooperative Computing for Autonomous Data Centers

Jonathan Berry, Sandia National Laboratories, USA; Michael Collins, Christopher Newport University, USA; Aaron Kearns, KBRwyle, USA; Cynthia Phillips, Sandia National Laboratories, USA; Jared Saia, University of New Mexico, USA; Randy Smith, Sandia National Laboratories, USA

### 11:00-11:25 Parallel Graph Algorithms: Simple, Efficient and Scalable

Laxman Dhulipala, Carnegie Mellon University, USA; Julian Shun, University of California, Berkeley, USA; Guy Blelloch, Carnegie Mellon University, USA

### 11:30-11:55 Quantum Approximation Algorithms

Ojas Parekh, Emory University, USA

### 12:00-12:25 Approximation Algorithms for Inventory Routing on Line Metrics

Yang Jiao and R. Ravi, Carnegie Mellon University, USA

Thursday, July 13

## MS69

### High Performance Tensor Computations - Part II of II

10:30 AM-12:30 PM

Room: 319

For Part 1 see MS58

Organized by SIAG/SC

Tensor decompositions are increasingly useful in data science. We consider tensor decompositions such as CANDECOMP/PARAFAC (CP), Tucker, as well as coupled decompositions. This minisymposium focuses especially on effective algorithms for data science problems as well as considering high performance implementations for key tensor computations.

Organizer: Grey Ballard

Wake Forest University, USA

Organizer: Tamara G. Kolda

Sandia National Laboratories, USA

### 10:30-10:55 Generalized Canonical Tensor Factorization for Binary, Count, Nonnegative, or Real-Valued Data

Tamara G. Kolda, Sandia National Laboratories, USA

### 11:00-11:25 Optimizing Distributed Tucker Decomposition

Venkatesan Chakaravarthy, IBM Corporation, USA; Jee Choi, IBM T.J. Watson Research Center, USA; Douglas Joseph and Xing Liu, IBM Corporation, USA; Prakash Murali, Yogish Sabharwal, and Dheeraj Sreedhar, IBM Research, India

### 11:30-11:55 Decomposing Large-Scale Tensors into Rank-1 Terms Using Randomized Block Sampling

Nico Vervliet and Lieven De Lathauwer, KU Leuven, Belgium

### 12:00-12:25 A Practical Randomized CP Tensor Decomposition

Casey Battaglino, Georgia Institute of Technology, USA

Thursday, July 13

## MS70

### Mathematical Modeling of Nano-Composites - Part I of II

10:30 AM-12:30 PM

Room: 301

For Part 2 see MS78

It is well known that surface energy becomes significant for physical processes occurring at nano-scales. Examples of such processes include behavior of composites reinforced by nano-dots, nano-rods or 2D-materials, and biological processes. Moreover, taking into account surface energy introduces a length-scale into problems, thus, allowing to explain experimentally observed size-dependency of the results. The minisymposium aims to bring together researchers working in the continuum modeling of solids with surface energy on the boundary. The presentations at the minisymposium will address different theories of surface-stressed solids with prominent place dedicated to renowned Gurtin-Murdoch theory which is frequently used for modeling of nano-objects. Steigmann-Ogden surface elasticity which builds upon Gurtin-Murdoch theory and additionally allows for curvature-dependence of the surface stress will be considered as well. The minisymposium will facilitate discussions, exchange of ideas, and collaborations among researchers working within continuum modeling of processes at nano-scales. A variety of analytical and numerical techniques for solving problems of this type will be discussed including analysis of partial differential equations, variational methods, methods of integral equations, and numerical methods.

Organizer: Anna Zemlyanova  
Kansas State University, USA

Organizer: Sofia Mogilevskaya  
University of Minnesota, USA

continued on next page

**10:30-10:55 The Use of Layer Potentials in Solving Elasticity Problems with Surface Effects**

*Vladislav Mantic*, University of Sevilla, Spain; *Sofia Mogilevskaia*, University of Minnesota, USA

**11:00-11:25 Equivalent Inclusions in Effective Thermo-Elastic Properties of Nanocomposites Incorporating Interface Energy**

*Zhuping Huang*, Peking University, China

**11:30-11:55 Neutral Nano-Inhomogeneities in Hyperelastic Materials with a Hyperelastic Interface Model**

*Peter Schiavone*, University of Alberta, Canada

**12:00-12:25 A Chemo-Mechanics Framework for Elastic Solids with Surface Stress**

*Jianmin Qu* and *Xiang Gao*, Tufts University, USA; *Daining Fang*, Peking University, China

Thursday, July 13

## MS71

### Modeling and Computation with Fractional PDEs

10:30 AM-12:30 PM

Room:303

Fractional derivative models have been playing an increasingly important role nowadays in economics, finance, biological systems, mechanics, and industrial simulations. As a result, there is a tremendous amount of demands for efficient computational techniques that takes into account the complexity in these models due to the non-locality. Invited presentations in this minisymposium will address several interesting issues in applications, such as fractional models in financial trading and transactions, and how the non-locality in combustion will explain some anomalous behaviors. The latest research results from the study of fractional partial differential equation models in finance, and optics involving multi-dimensional nonlinear Schrödinger equations will also be presented.

Organizer: *Khaled Furati*

*King Fahd University of Petroleum and Minerals, Saudia Arabia*

Organizer: *Abdul Qayyum M. Khaliq*

*Middle Tennessee State University, USA*

Organizer: *Qin Sheng*

*Baylor University, USA*

**10:30-10:55 Particle Methods for Fractional Diffusion Equations**

*Samer Allouch* and *Marco Lucchesi*, King Abdullah University of Science & Technology (KAUST), Saudi Arabia; *Olivier Le Maitre*, LIMSI-CNRS, France; *Kassem Mustapha*, King Fahd University of Petroleum and Minerals, Saudia Arabia; *Omar Knio*, King Abdullah University of Science & Technology (KAUST), Saudi Arabia

**11:00-11:25 The Finite Difference Method for Fractional Parabolic Equation with Fractional Laplacian**

*Changpin Li*, Shanghai University, China

**11:30-11:55 Pricing of Options Issued on Assets Following a CGMY-Process by Solving a Forward Kolmogorov Equation**

*Lina von Sydow*, *Josef Höök*, and *Gustav Ludvigsson*, Uppsala University, Sweden

**12:00-12:25 Fractional-Order Models for Biological Systems With Memory**

*Fathalla A. Rihan*, United Arab Emirates University, United Arab Emirates

Thursday, July 13

## MS72

### Multifidelity Approaches in Uncertainty Quantification - Part I of II

10:30 AM-12:30 PM

Room:318

For Part 2 see MS79

Organized by SIAG/UQ

A persistent challenge in uncertainty quantification is the multifidelity problem: make efficient and robust predictions given several competing models, each having its own degree of trust. The abstract concept of “fidelity” -- faithfulness to physics, experimental observations, and/or idealized mathematical formulations -- arises because different simulation suites utilize different discretization types and scales, can be sampled at different cost, and make dissimilar simplifications of underlying physics. This minisymposium aims to highlight recent advances in algorithms that make optimal use of models with differing fidelities. The challenges include resource distribution among models, identification and learning of model hierarchy, and efficient synthesis of model predictions.

Organizer: Akil Narayan

University of Utah, USA

Organizer: Paris Perdikaris

Massachusetts Institute of Technology, USA

**10:30-10:55 Multifidelity Data Fusion As a Data-Driven Gauge Transformation**

*Ioannis Kevrekidis*, Princeton University, USA

**11:00-11:25 Learning Non-Linear Correlations Between Multi-Fidelity Models Using Deep Neural Networks**

*Ilias Biliotis* and *Rohit Tripathy*, Purdue University, USA

**11:30-11:55 Nonlinear Information Fusion for Data-Efficient Multi-Fidelity Modeling**

*Paris Perdikaris*, Massachusetts Institute of Technology, USA

**12:00-12:25 Multifidelity Information Fusion Via Manifold Learning**

*Seungjoon Lee*, Brown University, USA

Thursday, July 13

## MS73

### Nonlinear Dynamics in Mathematical Biology

10:30 AM-12:30 PM

Room:304

Part of the SIAM Workshop Celebrating Diversity

In this session we will explore very different biological problems and the mathematical techniques of dynamical systems used to approach them. Mathematical topics include model identifiability, analysis of non-autonomous and discontinuous systems, as well as analysis of delayed systems. Biological topics to be covered include cancer research, epidemiology, immunology, and sleep dynamics.

Organizer: Alicia Prieto

Langarica

Youngstown State University, USA

**10:30-10:55 Uncovering Functional Relationships in Leukemia**

*Reginald Mcgee*, The Ohio State University, USA

**11:00-11:25 Effects of Functional Switching Within Regulatory T Cells**

*Shelby Wilson*, Morehouse College, USA

**11:30-11:55 A Mathematical Model of the Effects of Temperature on Human Sleep Patterns**

*Alicia Prieto Langarica*, Youngstown State University, USA

**12:00-12:25 A Comparison of Methods for Calculations the Basic Reproductive Number for Periodic Epidemic Systems**

*Christopher Mitchell*, University of Utah, USA

Thursday, July 13

## MS74

### Panel: How Changing Implementations of National Priorities Might Affect Mathematical Funding

10:30 AM-12:30 PM

Room:406

The implementation of national priorities changes from one federal administration to the next. This panel will explore the current administration’s plans for implementation, and how the major mathematics funding agencies might contribute to these. Speakers from the National Science Foundation, Department of Energy and Department of Defense will describe how some prior initiatives might survive, transform or end, and the new opportunities that could open up for the funding of mathematics.

Organizer: C. David Levermore

University of Maryland, College Park, USA

Organizer: Rosalie Belanger-Rioux

Harvard University, USA

**NSF Funding for the Mathematical Sciences: New and Changing Opportunities**

*Deborah Lockhart*, National Science Foundation, USA

**DOE Long-range Planning for the Future of Applied Mathematics Research**

*Abani Patra*, DOE Office of Science, USA; *Steven L. Lee*, Lawrence Livermore National Laboratory, USA

**Future Directions for Mathematics Research within DoD**

*Fariba Fahroo*, DARPA/DSO, USA

Thursday, July 13

## MS87

### Parallel-in-time Integration of Differential Equations - Part I of II

10:30 AM-12:30 PM

Room:320

For Part 2 see MS98

Organized by SIAG/SC

With the advent of supercomputers consisting of 100.000s of cores classical parallelization approaches that are based on a decomposition of the computational domain in space come close to the limit of their scalability. Consequently, the interest in parallelization in time grew a lot in recent years. In many cases parallel-in-time integration methods allow for an additional gain in speedup with relatively small changes required in existing simulation codes. Often the methods are based on ideas similar to those used in multigrid methods, e.g., the Parareal method and PFASST can both be interpreted as multigrid methods. In this minisymposium different time-parallel methods, their analysis and application will be presented.

Organizer: Matthias Bolten

*University of Wuppertal, Germany*

Organizer: Robert Speck

*Jülich Supercomputing Centre, Germany*

#### 10:30-10:55 A Multigrid Perspective on the Parallel Full Approximation Scheme in Space and Time

*Matthias Bolten, University of Wuppertal, Germany; Dieter Moser and Robert Speck, Jülich Supercomputing Centre, Germany*

#### 11:00-11:25 Towards Better Scalability in the Parareal in Time Algorithm

*Yvon Maday, Université Pierre et Marie Curie, France and Brown University, USA; Olga Mula, CEREMADE Université Paris 9 Dauphine, France; Walid Kheriji, Université Pierre et Marie Curie and CEA, France*

#### 11:30-11:55 Multigrid Reduction in Time Applied to 1D Hyperbolic Problems

*Alexander Howse, University of Waterloo, Canada*

#### 12:00-12:25 Waveform Relaxation with Adaptive Pipelining

*Benjamin W. Ong, Michigan Technological University, USA; Felix Kwok, Hong Kong Baptist University, Hong Kong*

Thursday, July 13

## CP17

### Dynamical Systems and Nonlinear Analysis

10:30 AM-11:50 PM

Room:310

Chair: *David I. Spivak, Massachusetts Institute of Technology, USA*

#### 10:30-10:45 Pixel Arrays: A Fast and Elementary Method for Solving Nonlinear Systems

*David I. Spivak, Magdalen Dobson, and Sapna Kumari, Massachusetts Institute of Technology, USA*

#### 10:50-11:05 Stationary Stability for Evolutionary Dynamics in Finite Populations

*Dashiell Fryer, San Jose State University, USA; Marc Harper, University of California, Los Angeles, USA*

#### 11:10-11:25 Breaking the Vicious Limit Cycle: Addiction Relapse-Recovery As a Fast-Slow Dynamical System

*Jacob P. Duncan, Saint Mary's University, USA*

#### 11:30-11:45 Non Smooth Bifurcation Analysis in a National Electricity Market Model and Its Realistic Approach

*Johnny Valencia, Tecnológico de Antioquia, Colombia; Gerard Olivar Tost and Carlos Jaime Franco Cardona, Universidad Nacional de Colombia, Colombia; Isaac Dyer, Universidad de Bogotá Jorge Tadeo Lozano, Colombia*

Thursday, July 13

**CP18****Large-Scale Computation**

10:30 AM-12:30 PM

Room:311

*Chair: Hessah F. Alqahtani, Kent State University, USA***10:30-10:45 Simplify Generalized Block Anti-Gauss Quadrature Rules***Hessah F. Alqahtani and Lothar Reichel, Kent State University, USA; Miroslav S. Pranic, University of Banja Luka, Bosnia and Herzegovina***10:50-11:05 The Partitioned Global Address Space (PGAS) Approach in Scientific Computing: Case Study of a Compute Bound and a Memory Bound Problem***Martina Prugger, Lukas Einkemmer, and Alexander Ostermann, University of Innsbruck, Austria; Jérémie Lagravière, Johannes Langguth, and Xing Cai, Simula Research Laboratory, Norway***11:10-11:25 Distributed-Memory Direct Sparse Matrix Solver for Ansys Electronics***Zhen Wang, ANSYS, Inc., USA***11:30-11:45 High Performance Computing for Sensor Data Fusion and Closed Loop Control in 3D Printing***Michelle Pizzo, Old Dominion University, USA; Travis Taylor, University of Alabama, USA; Wade Hunter, Old Dominion University, USA; Godfrey Sauti and Dana Hammond, NASA Langley Research Center, USA***11:50-12:05 Low-Communication FFT***Cris Cecka, NVIDIA, USA***12:10-12:25 A New Numerical Method for Nonsymmetric Linear Systems***Mei Yang and Ren-Cang Li, University of Texas at Arlington, USA*

Thursday, July 13

**CP19****Life Sciences - Part V of V**

10:30 AM-12:30 PM

Room:306

**For Part 4 see CP15***Chair: Karen Larson, Brown University, USA***10:30-10:45 Interalgorithmic Consolidation for Pattern Recognition Applied to Melanoma Genomic Data***Brody J. Kutt, Rochester Institute of Technology, USA; Travaughn Bain, Florida Institute of Technology, USA; Rachel Burdorf, Colorado College, USA; Munevver Subasi and Lisa Moore, Florida Institute of Technology, USA***10:50-11:05 Bayesian Uncertainty Quantification of Dynamic Processes in Networks***Karen Larson and Anastasios Matzavinos, Brown University, USA***11:10-11:25 Dual Dilemma of Vaccination***Xingru Chen and Feng Fu, Dartmouth College, USA***11:30-11:45 Incorporating Experimental Data into Mathematical Models of Transcription of the RRN Operon***Lisa G. Davis and Tomas Gedeon, Montana State University, USA; Tamra Heberling, Los Alamos National Laboratory, USA***11:50-12:05 Using A Mathematical Model with Individual Patient Data to Quantify Differences Between Patients with Diabetic Foot Ulcers***Richard Schugart, Western Kentucky University, USA***12:10-12:25 Modeling Intervention Policies for Chlamydia Using Stochastic Network Simulations***Asma Azizi Boroojeni and James Mac Hyman, Tulane University, USA*

Thursday, July 13

**CP20****Numerical PDE - Part II of III**

10:30 AM-12:30 PM

Room:307

**For Part 1 see CP4****For Part 3 see CP25***Chair: Tengfei Su, University of Maryland, College Park, USA***10:30-10:45 Principal Orthogonal Decomposition for Fractional Differential Equations***Anna Lischke and George E. Karniadakis, Brown University, USA***10:50-11:05 Parallel Implementation of Finite Element Method with Hexahedral Elements for Forward Modelling of Gravity Data***Zhi Li and Lutz Gross, University of Queensland, Australia***11:10-11:25 A New Goal-Oriented A Posteriori Error Estimation for 2D and 3D Saddle Point Problems in hp Adaptive FEM***Arezou Ghesmati, Texas A&M University, USA; Wolfgang Bangerth, Colorado State University and Texas A&M University, USA***11:30-11:45 A Low-Rank Multigrid Method for the Stochastic Steady-State Diffusion Problem***Howard C. Elman and Tengfei Su, University of Maryland, College Park, USA***11:50-12:05 The Entropy and  $L_2$  Stability of Discontinuous Galerkin Methods for the Compressible Euler Equations***David Williams, Stanford University, USA***Lunch Break**

12:30 PM-2:00 PM

*Attendees on their own*

Thursday, July 13

**IP2****Pattern Formation in the Drylands: Self Organization in Semi-Arid Ecosystems**

2:00 PM-2:45 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Chris Budd, University of Bath, United Kingdom*

Much of our understanding of spontaneous pattern formation was developed in the “wetlands” of fluid mechanics. That setting came with fundamental equations, and benefitted from a back-and-forth between theory and experiment. Those investigations identified robust mechanisms for pattern formation, inspiring the development of equivariant bifurcation theory. Recently, these perspectives have been applied to dryland ecosystems, where aerial photographs reveal strikingly regular spatial vegetation patterns on large scales. In this far-from-pristine setting, there are no fundamental equations and no controlled laboratory experiments. Does the morphology of these patterns, readily monitored by satellite, convey information about the vulnerability of these ecosystems? We explore this within the setting of equivariant bifurcation theory, and via satellite image data.

Mary Silber

*University of Chicago, USA*

Thursday, July 13

**SP6****W. T. and Idalia Reid Prize in Mathematics Lecture: Feedback Stabilization of Control Systems**

3:00 PM-3:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: To Be Determined*

A control system is a dynamical system on which one can act by using controls. For these systems a fundamental problem is the stabilization issue: Is it possible to stabilize a given unstable equilibrium by using suitable feedback laws? (Think to the classical experiment of an upturned broomstick on the end of one’s finger.) On this problem, we present some pioneer devices and works (Ctesibius, Watt, Maxwell, Lyapunov...) and some more recent results on the finite-time stabilization and on the stabilization by means of time-varying feedback laws.

Jean-Michel Coron

*Université Pierre et Marie Curie, France***Coffee Break**

3:30 PM-4:00 PM

*Room: Ballroom Gallery - 3rd Floor*

Thursday, July 13

**MS75****Boosting and Learning in Mathematical Imaging Algorithms - Part II of II**

4:00 PM-6:00 PM

*Room: Spirit of Pittsburgh A - 3rd Floor***For Part 1 see MS67**

Existing algorithms for processing image data have covered the gamut of mathematical techniques over the past several decades. In fact, they have become so good that recent research has found that in lieu of creating completely new approaches, great advances can be made by either boosting or introducing advanced learning techniques into existing algorithms/frameworks. In this minisymposium we will explore some recent state-of-the-art work in this area.

Organizer: Stacey E. Levine

*Duquesne University, USA*

Organizer: Marcelo Bertalmío

*Universitat Pompeu Fabra, Spain***4:00-4:25 Low Dimensional Manifold Model for Image Processing**

Zuoqiang Shi, Tsinghua University, China;

*Wei Zhu and Stanley J. Osher, University of California, Los Angeles, USA***4:30-4:55 Learning Optimally Sparse Image Filters by Quotient Minimisation**

Carola-Bibiane Schönlieb and Martin

Benning, University of Cambridge, United Kingdom; Guy Gilboa, Technion Israel Institute of Technology, Israel; Joana Grah, University of Cambridge, United Kingdom

**5:00-5:25 Multiscale Regression on Intrinsically Low-dimensional Data**

Stefano Vigogna, Wenjing Liao, and Mauro

Maggioni, Johns Hopkins University, USA

**5:30-5:55 Probabilistic Subspace Clustering and Model Selection for Patch-Based Image Restoration**

Antoine Houdard, Télécom ParisTech,

France; Charles Bouveyron and Julie Delon, Université Paris Descartes, France

Thursday, July 13

## MS76

### Communication-Avoiding Algorithms - Part I of II

4:00 PM-6:00 PM

Room: Spirit of Pittsburgh B - 3rd Floor

**For Part 2 see MS93**

Organized by SIAG/SC

From physical modeling to large-scale data analysis, engineering efficient code at scale requires a critical focus on reducing communication – the movement of data between levels of memory hierarchy or between processors over a network – which is the most expensive operation in terms of both time and energy at all scales of computing. A key area of innovation within high-performance computing is thus the development of communication-avoiding algorithms. This minisymposium focuses on recent work in this area, with a range of topics including parallel algorithms, implementations, theoretical lower bounds, and applications.

Organizer: Erin C. Carson

New York University, USA

#### 4:00-4:25 Communication-Avoiding Algorithms: Challenges and New Results

Erin C. Carson, New York University, USA

#### 4:30-4:55 Communication-Optimal Loop Nests

Nicholas Knight, New York University, USA

#### 5:00-5:25 Communication Lower Bounds for Matricized-Tensor Times Khatri-Rao Product

Grey Ballard, Wake Forest University, USA; Nicholas Knight, New York University, USA; Kathryn Rouse, Wake Forest University, USA

#### 5:30-5:55 Matrix Multiplication, a Little Faster

Oded Schwartz and Elayeh E. Karstadt, Hebrew University of Jerusalem, Israel

Thursday, July 13

## MS77

### Higher Order Numerical Methods for PDEs

4:00 PM-6:00 PM

Room: 302

Numerical methods for PDEs are foundational to computations in a large number of subjects, such as structural mechanics, fluids, and electromagnetism. This minisymposium focuses on numerical methods for PDEs that achieve higher order accuracy: put another way, we focus on methods that, for the same number of degrees of freedom in the underlying discrete system, yield an answer that is much more accurate than current methods. Hence, the focus of this minisymposium is on both developing numerical methods for PDEs that are either arbitrarily higher order or manage to exceed order restrictions present in some state of the art algorithms.

Organizer: David Wells

Rensselaer Polytechnic Institute, USA

#### 4:00-4:25 High-Order Finite-Difference Time-Domain Simulation of Electromagnetic Waves at Complex Interfaces Between Dispersive Media

Michael Jenkinson, Jeffrey W. Banks, and William Henshaw, Rensselaer Polytechnic Institute, USA

#### 4:30-4:55 Galerkin Difference Methods for Wave Equations in Two Space Dimensions

John Jacangelo and Jeffrey W. Banks, Rensselaer Polytechnic Institute, USA; Thomas M. Hagstrom, Southern Methodist University, USA

#### 5:00-5:25 Improving Boundary Derivative Recovery in Elliptic PDEs

David Wells, Rensselaer Polytechnic Institute, USA

#### 5:30-5:55 Scalable Time-Stepping Through Component-Wise Approximation of Matrix Functions

Somayyeh Sheikholeslami and James V. Lambers, University of Southern Mississippi, USA

Thursday, July 13

## MS78

### Mathematical Modeling of Nano-Composites - Part II of II

4:00 PM-6:00 PM

Room: 301

**For Part 1 see MS70**

It is well known that surface energy becomes significant for physical processes occurring at nano-scales. Examples of such processes include behavior of composites reinforced by nano-dots, nano-rods or 2D-materials, and biological processes. Moreover, taking into account surface energy introduces a length-scale into problems, thus, allowing to explain experimentally observed size-dependency of the results. The minisymposium aims to bring together researchers working in the continuum modeling of solids with surface energy on the boundary. The presentations at the minisymposium will address different theories of surface-stressed solids with prominent place dedicated to renowned Gurtin-Murdoch theory which is frequently used for modeling of nano-objects. Steigmann-Ogden surface elasticity which builds upon Gurtin-Murdoch theory and additionally allows for curvature-dependence of the surface stress will be considered as well. The minisymposium will facilitate discussions, exchange of ideas, and collaborations among researchers working within continuum modeling of processes at nano-scales. A variety of analytical and numerical techniques for solving problems of this type will be discussed including analysis of partial differential equations, variational methods, methods of integral equations, and numerical methods.

Organizer: Anna Zemlyanova  
Kansas State University, USA

Organizer: Sofia Mogilevskaya  
University of Minnesota, USA

*continued on next page*

**4:00-4:25 Liquid Inclusions in Soft Materials – Capillary Effect, Mechanical Stiffening and Enhanced Electromechanical Response**

*Pradeep Sharma*, University of Houston, USA

**4:30-4:55 The Curvature-Dependent Surface Stress Model and Its Effects on the Overall Properties of Nano-Composites**

*Xiang Gao*, Tufts University, USA

**5:00-5:25 Stress Concentrations around Nanovoids and Nanoinhomogeneities**

*Changwen Mi*, Southeast University, China; *Demitris Kouris*, South Dakota School of Mines & Technology, USA

**5:30-5:55 Title Not Available At Time Of Publication**

*Paul Steinmann*, University of Erlangen-Nürnberg, Germany

Thursday, July 13

## MS79

**Multifidelity Approaches in Uncertainty Quantification - Part II of II**

4:00 PM-6:00 PM

Room:318

For Part 1 see MS72

Organized by SIAG/UQ

A persistent challenge in uncertainty quantification is the multifidelity problem: make efficient and robust predictions given several competing models, each having its own degree of trust. The abstract concept of “fidelity” -- faithfulness to physics, experimental observations, and/or idealized mathematical formulations -- arises because different simulation suites utilize different discretization types and scales, can be sampled at different cost, and make dissimilar simplifications of underlying physics. This minisymposium aims to highlight recent advances in algorithms that make optimal use of models with differing fidelities. The challenges include resource distribution among models, identification and learning of model hierarchy, and efficient synthesis of model predictions.

Organizer: Akil Narayan

*University of Utah, USA*

Organizer: Paris Perdikaris

*Massachusetts Institute of Technology, USA*

**4:00-4:25 Deep Multi-Fidelity Gaussian Processes**

*Maziar Raissi* and *George Em Karniadakis*, Brown University, USA

**4:30-4:55 Optimization of Random Systems Using Multi-Fidelity Models**

*Phaedon-Stelios Koutsourelakis*, Technische Universität München, Germany; *Maximilian Koschade*, Technical University of Munich, Germany

**5:00-5:25 A Bi-Fidelity, Low-Rank Approximation Technique for Uncertainty Quantification**

*Jerrad Hampton*, *Hillary Fairbanks*, and *Alireza Doostan*, University of Colorado Boulder, USA; *Akil Narayan*, University of Utah, USA

**5:30-5:55 Sampling, Polynomial Chaos and Function Trains Multilevel/Multifidelity Strategies for Forward UQ**

*Gianluca Geraci*, *Alex A. Gorodetsky*, *John D. Jakeman*, and *Michael S. Eldred*, Sandia National Laboratories, USA

Thursday, July 13

## MS80

**Panel: Data Science in the Applied and Computational Mathematics Curriculum**

4:00 PM-6:00 PM

Room:406

Organized by the SIAM Education Committee

Data science is an interdisciplinary field that is rapidly evolving and for which there is a demand for well-trained practitioners. In this panel, we consider effective ways to modify the mathematics curriculum to better train future data scientists. How can faculty prepare students for data science careers within existing courses and in new ones? How does the material fit into the computational and applied mathematics curriculum, rather than strictly computer science, statistics or other fields? What efforts are underway to answer these questions? How can faculty retrain to handle these courses? On this panel, mathematics faculty with experience creating and delivering instruction in data science will share their experiences.

Organizer: Suzanne L. Weekes

*Worcester Polytechnic Institute, USA*

Organizer: Rachel Levy

*Harvey Mudd College, USA*

Panelists:

**Randy Paffenroth**

*Worcester Polytechnic Institute, USA*

**Kristin Bennett**

*Rensselaer Polytechnic Institute, USA*

**Louis Rossi**

*Louis Rossi*, University of Delaware, USA

Thursday, July 13

## MS81

### Random Walks and Metrics

4:00 PM-6:00 PM

Room:371

Organized by SIAG/DM

Many massive graphs that arise from applications in biological or social sciences tend to be organized according to the principle that the social scientists call homophily, the tendency of vertices to share similarities with their direct connections. Applications that perform inference or other general machine learning tasks to mine such graph data, typically encode the similarity (or dissimilarity, in the case of a distance metric), according to some measure of graph proximity. The most informative measures have been based on understanding the behavior of random walks in these networks; finding the right metric customized for the application at hand, and computing it efficiently, either exactly or approximately, can lead to valuable new insights. This minisymposium is part of the Discrete Mathematics Activity Group track of invited minisymposia.

Organizer: Lenore J. Cowen

Tufts University, USA

#### 4:00-4:25 Diffusion Based Metrics for Naturally Occuring Networks: Background and Applications

Lenore J. Cowen, Tufts University, USA

#### 4:30-4:55 Diffusion State Distance using Exit Frequencies

Andrew J. Beveridge, Macalester College, USA

#### 5:00-5:25 Optimal Target Sets for a Random Walk On a Finite Graph

Fern Y. Hunt, National Institute of Standards and Technology, USA

#### 5:30-5:55 Algebraic Multilevel Methods for Computing Diffusion-based Metrics on Graphs

Junyuan Lin, Xiaozhe Hu, and Lenore J. Cowen, Tufts University, USA

Thursday, July 13

## MS82

### Topics in Applied Mathematics in Modeling and Numerical Analysis

4:00 PM-6:00 PM

Room:304

Part of the SIAM Workshop Celebrating Diversity

This minisymposium is aimed as a survey of some topics in Applied Mathematics as targeted to Math modeling (compartment models and ODE's) and then some numerical analysis as checking validity of models often requires numerical methods so these two areas of applied math are connected. The symposium also consists of women/minorities and jr. faculty.

Organizer: Anne M. Fernando

Norfolk State University, USA

#### 4:00-4:25 Computationally-Inferred Numerical Wave Numbers with Applications to Non Uniform Meshes

Anne M. Fernando, Norfolk State University, USA

#### 4:30-4:55 Inclusion of Asymptotic Individuals to Model Influenza Transmission

Ana Vivas Barber, Norfolk State University, USA

#### 5:00-5:25 Modeling Intermittent Preventative Treatment and Drug Resistance in Malaria

Carrie A. Manore, Tulane University, USA

#### 5:30-5:55 Isogeometric Analysis and Hierarchical T-splines

Emily Evans, Brigham Young University, USA

Thursday, July 13

## CP21

### Numerical Analysis - Part I of II

4:00 PM-5:00 PM

Room:306

For Part 2 see CP28

Chair: Nasim Eshghi, Kent State University, USA

#### 4:00-4:15 Estimates of Matrix Functions Based on the Lanczos Decomposition

Nasim Eshghi and Lothar Reichel, Kent State University, USA

#### 4:20-4:35 A Two Stage $k$ -Monotone B-Spline Regression Estimator: Uniform Lipschitz Property and Optimal Convergence Rate

Teresa Lehair, Johns Hopkins University, USA; Jinglai Shen, University of Maryland, Baltimore County, USA

#### 4:40-4:55 On the Use of Hahn's Asymptotic Formula and Stabilized Recurrence for a Fast, Simple, and Stable Chebyshev-Jacobi Transform

Richard M. Slevinsky, University of Oxford, United Kingdom

#### SIAM Presents

Since 2008, SIAM has recorded many Invited Lectures, Prize Lectures, and selected Minisymposia from various conferences. These are available by visiting SIAM Presents (<http://www.siam.org/meetings/presents.php>).



Thursday, July 13

## CP22

### Optimization - Part I of III

4:00 PM-6:00 PM

Room:310

For Part 2 see CP26

Chair: Jeffrey Zhang, Princeton University, USA

#### 4:00-4:15 Semidefinite Programming for Nash Equilibria in Bimatrix Games

Jeffrey Zhang and Amir Ali Ahmadi, Princeton University, USA

#### 4:20-4:35 Optimization with Invariance Constraints

Amir Ali Ahmadi, Princeton University, USA; Oktay Gunluk, IBM T.J. Watson Research Center, USA

#### 4:40-4:55 Geometry of 3D Environments and Sum of Squares Polynomials

Georgina Hall and Amir Ali Ahmadi, Princeton University, USA

#### 5:00-5:15 An Adaptive Model with Joint Chance Constraints for a Hybrid Wind-Conventional Generator System

Bismark Singh, University of Texas at Austin, USA; David Morton, Northwestern University, USA; Surya Santoso, University of Texas at Austin, USA

#### 5:20-5:35 Improved Teaching-Learning-Based Optimization Metaheuristic for Multiple-Choice Multidimensional Knapsack Problems

Yun Lu, Francis J. Vasko, and Ken Zyma, Kutztown University of Pennsylvania, USA

#### 5:40-5:55 Hybrid Nelder-Mead Particle-Swarm Optimization Algorithm for Finding the Global Minimizer of Nonlinear Optimization Problems

Mahmoud M. El-Alem, United Arab Emirates University, United Arab Emirates

Thursday, July 13

## CP23

### PDE - Part I of II

4:00 PM-6:00 PM

Room:307

For Part 2 see CP27

Chair: Eunju Sohn, Columbia College Chicago, USA

#### 4:00-4:15 A Diffusion Limit For A Finite Capacity Storage Allocation Model

Eunju Sohn, Columbia College Chicago, USA; Charles Knessl, University of Illinois, Chicago, USA

#### 4:20-4:35 Numerical Investigations of Pattern Formation in Binary Systems with Inhibitory Long-Range Interaction

Jiajun Lu; Frank Baginski, George Washington University, USA

#### 4:40-4:55 Poro-Visco-Elastic Compaction in a Sedimentary Basin

Dwight Holland and Ralph Showalter, Oregon State University, USA

#### 5:00-5:15 Computing PDEs on the Sphere Using Mesh Adaption by Optimal Transport

Chris Budd and Andrew McRae, University of Bath, United Kingdom

#### 5:20-5:35 A Singular Value Analysis of the Simultaneous Joint Inversion of Compact Operators

James F. Ford, Boise State University, USA

#### 5:40-5:55 Hierarchical Ensemble Kalman Inversion

Neil Chada, University of Warwick, United Kingdom; Andrew Stuart, California Institute of Technology, USA; Marco Iglesias, University of Nottingham, United Kingdom

## SIAM Council Meeting

4:00 PM-11:00 PM

Room:Westin Hotel - Butler

## Exhibit Hall Closes

4:30 PM

Thursday, July 13

## Intermission

6:00 PM-6:15 PM

## Professional Development Evening

6:15 PM-9:30 PM

Room: Spirit of Pittsburgh B - 3rd Floor

## Council Dinner

7:00 PM-8:00 PM

Room: Westin Hotel - Cambria

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— Jan Draisma, Associate Professor, Technische Universiteit Eindhoven, and Vice Chair, SIAM Activity Group on Algebraic Geometry



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## Friday, July 14

### Registration

8:00 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Closing Remarks

8:20 AM-8:30 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Friday, July 14

### IT9

#### Mathematical Opportunities and Challenges in Sustainable Energies

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Paul Constantine, Colorado School of Mines, USA

Climate change and the limited resources of fossil fuels entail fundamental changes in the way energy is being generated in the future. The higher demand for sources of sustainable energy and production capabilities poses tremendous challenges not only because of the need to find a replacement for the conventional energy sources, but also due to the restructuring of existing as well as the creation of new, smart networks for efficient storage and transport of distributed energy. Mathematics plays a key role in understanding the complex problems that arise in these areas and in exploiting underlying structures and processes. In this talk I will concentrate on several research topics to illustrate the role mathematics plays in photovoltaics, where fundamental research on the possibilities of nano-structuring of thin films are carried out with the aim to optimize light management and charge transport. I will discuss the necessity of fundamental research for the development of viable predictive mathematical models to understand the interplay of nano-morphology, light harvesting and charge transport at complex interfaces. Related multi-scale and multi-physics problems concerning the interplay of material design and battery function will also be touched on.

Barbara Wagner

Weierstrass Institute, Germany

Friday, July 14

### IT10

#### Transforming Combustion Science and Technology with Exascale Simulation

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh B - 3rd Floor

Chair: Laura Grigori, Inria, France

Exascale computing will enable combustion simulations in parameter regimes relevant to next-generation combustion devices burning alternative fuels. High fidelity combustion simulations are required to develop science-based predictive combustion models used to design fuel efficient, clean burning vehicles, planes, and power plants for electricity generation. However, making the transition to exascale poses a number of algorithmic, software and technological challenges due to power constraints and the massive concurrency expected at the exascale. Addressing issues of data movement, programmability, performance portability and scalability through combustion co-design are critical to ensure that future combustion simulations can take advantage of emerging computer architectures. Recent advances in the DOE Exascale Computing Project on combustion will be discussed: 1) the development of a block-structured adaptive mesh refinement multi-physics combustion code; and 2) the refactorization of a combustion DNS code, S3D, with an asynchronous dynamic task-based programming model and runtime, Legion, for heterogeneous machines. In particular the extensibility of S3D to incorporate in situ analytics is demonstrated with this approach.

Jacqueline Chen

Sandia National Laboratories, USA

Friday, July 14

**Compensation Committee Meeting**

9:00 AM-11:00 AM

*Room: Westin Hotel - Cambria East***IP3****Predicting Travel Time on Road Networks**

9:15 AM-10:00 AM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Tamara G. Kolda, Sandia National Laboratories, USA*

Prediction of travel time on a road network has become commonplace and central to route planning. For example, commercial mapping services provide fastest routes and associated travel times, while emergency vehicle fleets use travel time predictions to better service metropolitan areas through strategic placement of parked vehicles. However, few systems in production provide information about the reliability of the predictions. Such information could be used for risk-averse routing in mapping services, and has the potential to improve ambulance positioning decisions, not only decreasing arrival and transport times, but also significantly impacting patient survival rates. I will describe approaches for probabilistic prediction of travel time on large-scale road networks. Estimates are based on location data from vehicles traveling along the road network; for mapping services this is obtained from mobile phones, while for ambulance fleets it is obtained from automatic vehicle location devices. We demonstrate greatly improved accuracy relative to a system used in Bing Maps, and show the impact of our methods for improving ambulance fleet management decisions.

Dawn Woodard  
*Uber, USA*

**Coffee Break**

10:00 AM-10:30 AM

*Room: Ballroom Gallery - 3rd Floor*

Friday, July 14

**MT3****Compressed Sensing/ Dimension Reduction**

10:30 AM-12:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Deanna Needell, University of California, Los Angeles, USA*

The so-called “curse of dimensionality” captures the notion that most modern data is so large that acquiring, storing, and analyzing it is computationally burdensome or even impossible. In order to design efficient systems for acquiring and extracting information from data we must have accurate models for the underlying data of interest. These models can take the form of deterministic classes, generative models, or probabilistic models. A model that has gained a lot of recent traction is the use of sparsity. At the heart of this idea is that most data -- even data that is very high dimensional and large-scale -- carries only a small amount of intrinsic information. For example, although the Netflix dataset contains over 100 million ratings, most ratings can be described by a few key user/movie features. In economics, market behaviors involving a large number of variables and time steps may be dictated by only a small number of attributes. In imaging, an image containing millions of pixel values may be accurately represented by a small number of feature images corresponding to various texture scales. In these and numerous other applications, although the data is huge, it can be represented in a very sparse way. Utilizing these sparse representations allow one to acquire, store, and analyze the large-scale data in a very efficient way.

**Speakers:****Deanna Needell***University of California, Los Angeles, USA***Jeff Blanchard***Grinnell College, USA***Mark Davenport***Georgia Institute of Technology, USA*

Friday, July 14

**MS83****Approximation of High-dimensional Systems – Theory and Numerical Aspects - Part I of II**

10:30 AM-12:30 PM

*Room: 318***For Part 2 see MS92**

Organized by SIAG/UQ

The approximations of high-dimensional systems from a limited amount of data play a pivotal role in a large number of fields in science and engineering including uncertainty quantification, optimal control, inverse problems and imaging. For such systems, constructing the quantities of interest often requires repeated expensive measurements, i.e., an ensemble of complex numerical simulations or time-consuming physical experiments. This minisymposium addresses the latest developments of several sparse techniques, which provide low-cost approximations via exploiting the sparse structure of the concerned systems and therefore mitigate the computational burden. The presentations will cover mathematical analysis based on orthogonal polynomials, compressed sensing, random matrix and approximation theory, as well as novel computational techniques, such as sampling strategies and optimization.

Organizer: Hoang A. Tran  
*Oak Ridge National Laboratory, USA*

Organizer: Clayton G. Webster  
*Oak Ridge National Laboratory, USA*

**10:30-10:55 Unified Sufficient Conditions for Uniform Recovery of Sparse Signals via Nonconvex Minimizations**

*Clayton G. Webster and Hoang A. Tran, Oak Ridge National Laboratory, USA*

**11:00-11:25 Optimal Sampling for Recovering Sparse and Compressible Orthogonal Polynomial Expansions**

*Akil Narayan, University of Utah, USA*

Friday, July 14

## MS83

### Approximation of High-dimensional Systems – Theory and Numerical Aspects - Part I of II

10:30 AM-12:30 PM

continued

#### 11:30-11:55 High-dimensional Function Interpolation with Gradient-enhanced Weighted $\ell_1$ Minimization

*Yi Sui* and Ben Adcock, Simon Fraser University, Canada

#### 12:00-12:25 Sparse Optimization in Learning Governing Equations for Time-Varying Measurements

*Giang Tran*, University of Texas at Austin, USA

Friday, July 14

## MS84

### Modeling Transmission Dynamics, Vector-Host Ecologies for Controlling Tropical Vector-Borne Infectious Diseases

10:30 AM-12:30 PM

Room:304

Recent years have witnessed an increasing interest in developing models for understanding imminent challenges in controlling vector-borne diseases (such as Leishmaniasis, Lymphatic Filariasis, Chagas disease, Dengue, West Nile Virus, Schistosomiasis, and Chikungunya) in resource-limited countries. This mini-symposium will present recent advances in optimizing intervention strategies of several of these diseases to achieve their elimination, new knowledge on vector and host ecology, and evolutionary responses to interventions, through modeling. The talks will also highlight some of the issues encountered when trying to apply data-driven approaches to the real-time systems. The limited amount of surveillance data and increasing availability of data from a variety of other sources including surveys, social media, and entomological study will provide the ability to model complex ecosystems enabling human decision-making. Such models will facilitate more accurate assessment for these diseases, and will provide a basis for more efficient and targeted approaches to interventions, through an improved understanding of the mechanisms of action.

Organizer: Anuj Mubayi

*Arizona State University, USA*

Organizer: Edwin Michael

*University of Notre Dame, USA*

#### 10:30-10:55 Transmission Models and Management of Lymphatic Filariasis Elimination

*Edwin Michael*, University of Notre Dame, USA

#### 11:00-11:25 Leading Indicators for Anticipating Elimination of Mosquito-Borne Diseases

*Suzanne M. O'Regan*, North Carolina A&T State University, USA; *Jonathan Lillie*, North Hall High School, USA; *John M. Drake*, University of Georgia, USA

#### 11:30-11:55 Evaluating Long-Term Effectiveness of Sleeping Sickness Control Measures in Guinea

*Abhishek Pandey*, Clemson University, USA

#### 12:00-12:25 Modeling Infection Transmission Dynamics and Elimination of Leishmaniasis

*Anuj Mubayi*, Arizona State University, USA

*continued in next column*

Friday, July 14

**MS85****Numerical Linear Algebra in Data Science - Part I of II**

10:30 AM-12:30 PM

Room:302

**For Part 2 see MS97**

Motivated by the extremely large amounts of data streaming from scientific research and daily life, recent years have witnessed exciting developments in the theory and practice of numerical linear algebra for obtaining instantaneous insight from massive datasets. This minisymposium introduces recent advances in both theory and high-performance algorithms for fast numerical linear algebra in data science, e.g. efficient matrix decomposition and applications, fast and scalable algorithms for optimization. These techniques significantly improve the efficiency of existing algorithms for information recovery, statistical learning, and machine learning.

Organizer: Michael Ng

*Hong Kong Baptist University, Hong Kong*

Organizer: Haizhao Yang

*Duke University, USA***10:30-10:55 Low-Rank Matrix Reconstruction: Algorithms and Theory***Jian-Feng Cai, Hong Kong University of Science and Technology, Hong Kong***11:00-11:25 Fast Spatial Gaussian Process Maximum Likelihood Estimation Via Skeletonization Factorizations***Victor Minden, Anil Damle, Ken Ho, and Lexing Ying, Stanford University, USA***11:30-11:55 Communication Avoiding Primal and Dual Block Coordinate Descent Methods***Kimion Fountoulakis, Aditya Devarakonda, James Demmel, and Michael Mahoney, University of California, Berkeley, USA***12:00-12:25 Approximate Least-Squares-Based Methods for Efficient Learning***Da Kuang, University of California, Los Angeles, USA; Alex Gittens, University of California, Berkeley, USA; Raffay Hamid, DigitalGlobe, Inc., USA*

Friday, July 14

**MS86****Panel: The GAIMME Report on Mathematical Modeling in K-16**

10:30 AM-12:30 PM

Room:406

Organized by the SIAM Education Committee

Recently, SIAM and Consortium for Mathematics and Its Applications (COMAP) have partnered together to address the emerging need for direction in mathematical modeling education at the K-16 levels. As a result, the Guidelines for Assessment and Instruction in Mathematical Modeling Education (GAIMME) report has been designed by a mix of professionals to define the modeling process and provide insight to student and teacher experiences. In this session we discuss the how the GAIMME report can enable mathematical modeling in the early grades, high school grades, and at the early undergraduate level. We also provide assessment information with an overarching theme in supporting teachers as they implement math modeling into their classrooms.

Organizer: Ben Galluzzo

*Shippensburg University, USA***Mathematical Modeling at the Undergraduate Level***Joseph Skufca, Clarkson University, USA***Mathematical Modeling in Grades K-8***Jessica M. Libertini, Virginia Military Institute, USA***Assessing Mathematical Modeling***Ben Galluzzo, Shippensburg University, USA*

Friday, July 14

**MS88****Random Structures**

10:30 AM-12:00 PM

Room:317

Organized by SIAG/DM

We stem from the seminal work of Paul Erdos and Alfred Renyi, studying random structures. The study of asymptotically large random structures leads to continuous structures. For example, difference equations become approximated by differential equations. This minisymposium is part of the SIAM DM track.

Organizer: Tom Bohman

*Carnegie Mellon University, USA***10:30-10:55 The Triangle Free Process***Thomas Bohman, Carnegie Mellon University, USA***11:00-11:25 Abelian Sandpiles***Wes Pegden, Carnegie Mellon University, USA***11:30-11:55 Increasing Sequences of Integer Triples***Jason Long, Cambridge University, United Kingdom*

Friday, July 14

**MS89****Recent Advances in Solving Large-Scale Turbulent Flow Problems**

10:30 AM-12:30 PM

Room:301

Many large-scale applications of industrial and scientific interests involve flow that exhibits turbulent features. The high sensitivity of these problems to discretisation errors, model errors and uncertainty in the data makes these problems very challenging to simulate. Adding to the challenge is the fact that to resolve the solution at all scales is difficult, and sometimes impossible. This minisymposium will focus on the recent advances towards more efficient and more accurate computation of large-scale turbulent flow problems from a variety of angles - from adaptive methods to parallel-in-time methods.

Organizer: Tania Bakhos

*Stanford University, USA*

Organizer: Johan Hoffman

*Royal Institute of Technology, Stockholm, Sweden*

Organizer: Johan Jansson

*KTH Royal Institute of Technology, Sweden*

Organizer: Margarida

Moragues Ginard

*Basque Center for Applied Mathematics, Spain***10:30-10:55 Towards Low Dissipation Finite Element Schemes for High Fidelity Simulation in Complex Geometries**

*Oriol Lehmkuhl, Guillaume Houzeaux, Daniel Mira, Mariano Vázquez, Herbert Owen, and Matias Avila, Barcelona Supercomputing Center, Spain*

**11:00-11:25 Computation of Sensitivity and Stability in Chaotic Flow**

*Qiqi Wang, Massachusetts Institute of Technology, USA*

**11:30-11:55 Extremely Scalable Finite Element Solvers for Turbulent Incompressible Flows Through Segregated Runge-Kutta Schemes**

*Oriol Colomes, Duke University, USA; Santiago Badia, Universitat Politecnica de Catalunya, Spain*

**12:00-12:25 Large Eddy Simulation Reduced Order Models**

*Traian Iliescu and Xuping Xie, Virginia Tech, USA*

Friday, July 14

**MS90****Recent Advances in Theoretical and Computational Shape Analysis, Applications to Biomedical Imaging- Part I of II**

10:30 AM-12:30 PM

Room: Spirit of Pittsburgh B - 3rd Floor

**For Part 2 see MS99**

This minisymposium will focus on the fundamental and applied aspects of shape analysis. Shape analysis remains one of the key problems to many recent applications ranging from automatic object recognition in computer vision to the field of biomedical imaging in which datasets typically involve multiple geometric structures with important morphological variability. Modern methods are at the intersection of several fields in mathematics that span finite and infinite dimensional geometry, statistical data analysis and numerical optimization. The objective of the minisymposium is to bring together researchers covering those multiple aspects to present most recent ideas in the field, discuss new directions of interest for the community and foster future collaborations across different groups.

Organizer: Nicolas Charon

*Johns Hopkins University, USA*

Organizer: Martin Bauer

*Florida State University, USA*

Organizer: Akil Narayan

*University of Utah, USA*

Organizer: Mario Micheli

*Bowdoin College, USA***10:30-10:55 Higher Order Sobolev Metrics for Shape Optimization and Shape Matching**

*Martin Bauer, Florida State University, USA*

**SIAM Presents**

Since 2008, SIAM has recorded many Invited Lectures, Prize Lectures, and selected Minisymposia from various conferences. These are available by visiting SIAM Presents (<http://www.siam.org/meetings/presents.php>).



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**11:00-11:25 A New Method for Comparing Closed Surfaces in  $\mathbb{R}^3$**   
*Eric Klassen, Florida State University, USA*

**11:30-11:55 Lddmm Models of a Heartbeat**

*Sylvain Arguillere, CNRS, France*

**12:00-12:25 Generalizations of Optimal Transport and Applications**

*Francois-Xavier Vialard, Université Paris Dauphine, France*

Friday, July 14

## MS91

**Recent Development on Fractional Diffusion Equation: Analysis and Computation - Part I of II**

*10:30 AM-12:30 PM*

*Room:303*

**For Part 2 see MS100**

Fractional diffusion equation, which describes an anomalous diffusion process, has benefit a wide range of applications. Examples include photon transport in atmospheric clouds, Levy glasses, granular plasmas with dissipative collision, chemical reaction, and economy. The non-locality in the fractional operator poses great challenges in analysis and numerical computation. This minisymposium aims to report recent progress on fractional diffusion equation in both aspects, as well as its connection with stochastic models and kinetic equations.

Organizer: Weiran Sun  
*Simon Fraser University, Canada*

Organizer: Li Wang  
*State University of New York, Buffalo, USA*

**10:30-10:55 The Cauchy Problem for the Quantum Boltzmann Equation for Bosons at Very Low Temperature**

*Ricardo Alonso, Pontificia Universidade Catolica Do Rio de Janeiro, Brazil*

**11:00-11:25 Convergence of Discrete Minimizers to Continuum Minimizers for the Interaction Energy**

*Francesco Patacchini, Imperial College London, United Kingdom*

**11:30-11:55 Euler-Alignment System with Nonlinear Fractional Dissipation**  
*Changhui Tan, Rice University, USA*

**12:00-12:25 Fractional Diffusion Limit for E.COLI Chemotaxis**

*Min Tang, Shanghai Jiao Tong University, China*

Friday, July 14

## MS98

**Parallel-in-time Integration of Differential Equations - Part II of II**

*10:30 AM-12:00 PM*

*Room:320*

**For Part 1 see MS87**

Organized by SIAG/SC

With the advent of supercomputers consisting of 100.000s of cores classical parallelization approaches that are based on a decomposition of the computational domain in space come close to the limit of their scalability. Consequently, the interest in parallelization in time grew a lot in recent years. In many cases parallel-in-time integration methods allow for an additional gain in speedup with relatively small changes required in existing simulation codes. Often the methods are based on ideas similar to those used in multigrid methods, e.g., the Parareal method and PFASST can both be interpreted as multigrid methods. In this minisymposium different time-parallel methods, their analysis and application will be presented.

Organizer: Matthias Bolten  
*University of Wuppertal, Germany*

Organizer: Robert Speck  
*Jülich Supercomputing Centre, Germany*

**10:30-10:55 Asymptotic Convergence of PFASST for Linear Problems**

*Robert Speck and Dieter Moser, Jülich Supercomputing Centre, Germany; Matthias Bolten, University of Wuppertal, Germany*

**11:00-11:25 Waveform Relaxation for Circuit Simulation**

*Pratik Kumbhar and Martin J. Gander, University of Geneva, Switzerland*

**11:30-11:55 Parareal in Fusion Plasma Applications**

*Debasmita Samaddar, UK Atomic Energy Authority, United Kingdom; David Coster, Max-Planck-Institut für Plasmaphysik, Germany; Xavier Bonnin, ITER Organization, France; Wael R. Elwasif, Lee A. Berry, and Donald B. Batchelor, Oak Ridge National Laboratory, USA*

Friday, July 14

**CP24****Imaging Science**

10:30 AM-12:10 PM

Room:311

Chair: *Jue Wang, Union College, USA***10:30-10:45 A Convolutional Network Approach for Image Reconstruction from a Single X-Ray Projection***Conner S. Davis, Samiha Rouf, Yifei Lou, and Yan Cao, University of Texas at Dallas, USA***10:50-11:05 Terminating Iterative Regularization Algorithms for Large-Scale Ill-Posed Problems Using the Picard Parameter***Eitan Levin and Alexander Meltzer, Weizmann Institute of Science, Israel***11:10-11:25 Simultaneous Corneal Curvature and Elevation Computation from Optical Coherence Tomography Data***Farzana Nasrin and Ram V. Iyer, Texas Tech University, USA; Steven Mathews, West Texas Eye Associates, USA***11:30-11:45 Variational Approaches to the Restoration of Manifold-Valued Signals and Images***Andreas Weinmann, Helmholtz Zentrum München, Germany***11:50-12:05 Detecting Breast Masses and the Location of the Prostate***Jue Wang, Union College, USA*

Friday, July 14

**CP25****Numerical PDE - Part III of III**

10:30 AM-12:30 PM

Room:306

For Part 2 see CP20

Chair: *Russell B. Richins, Thiel College, USA***10:30-10:45 On the Numerical Integration of Initial-Boundary Value Problem to One Nonlinear Parabolic Equation***Mikheil Tutberidze, Iliia State University, Georgia***10:50-11:05 Radial Basis Function generated Finite Differences for Pricing Multi-Asset Financial Derivatives***Slobodan Milovanovic and Lina von Sydow, Uppsala University, Sweden***11:10-11:25 Accurate, Stable Boundary Conditions for Downwind-Biased Discretizations of Hyperbolic PDEs***Yiannis Hadjimichael and David I. Ketcheson, King Abdullah University of Science & Technology (KAUST), Saudi Arabia***11:30-11:45 A Weno Method Based on Exponential Polynomials for Hyperbolic Conservation Laws***Youngsoo Ha, Seoul National University, Korea; Chang Ho Kim, Konkuk University, Korea; Hyoseon Yang, Ewha Womans University, South Korea; Jungho Yoon, Ewha W. University, Korea***11:50-12:05 Stability of BDF-ADI Discretizations***Joao Reis, David I. Ketcheson, and Lajos Loczi, King Abdullah University of Science & Technology (KAUST), Saudi Arabia***12:10-12:25 The Saddle-Point Method for the Complex Helmholtz Equation***Russell B. Richins, Thiel College, USA*

Friday, July 14

**CP26****Optimization - Part II of III**

10:30 AM-12:30 PM

Room:310

For Part 1 see CP22

For Part 3 see CP29

Chair: *Mykhailo Kuian, Kent State University, USA***10:30-10:45 Volume Calculations for Sparse Boolean Quadric Relaxations***Daphne Skipper, United States Naval Academy, USA; Jon Lee, University of Michigan, USA***10:50-11:05 New Bounds for the Probability That at Least K-Out-of-N Events Occur with Unimodal Distributions***Munevver Subasi, Ersoy Subasi, and Ahmed Binmahfoudh, Florida Institute of Technology, USA; Andras Prekopa, Rutgers University, USA***11:10-11:25 Sufficient Conditions for Logconcavity of Multivariate Discrete Distributions***Majed Alharbi, Ersoy Subasi, and Munevver Subasi, Florida Institute of Technology, USA***11:30-11:45 Optimization of Multi-Measuring Systems with Control Parameters and its Application to Polarized Light Microscopy***Mykhailo Kuian, Lothar Reichel, and Shiyantovskii Sergij, Kent State University, USA***11:50-12:05 Vehicle Routing Problem with Interdiction***Michael Xu, McMaster University, Canada***12:10-12:25 A Cut-Based Heuristic for Solving the Bi-Directional Single-Row Machine Layout Problem***Shine-Der Lee and Chuan-Chien Cheng, National Cheng Kung University, Taiwan*

Friday, July 14

**CP27****PDE - Part II of II**

10:30 AM-12:50 PM

Room:307

**For Part 1 see CP23**Chair: *Leila Setayeshg Setayeshgar, Providence College, USA***10:30-10:45 Stochastic Simulation of Reaction-Diffusion Systems: Fluctuating Hydrodynamic Approach**

*Changho Kim, Andy Nonaka, and John B. Bell, Lawrence Berkeley National Laboratory, USA; Alejandro Garcia, San Jose State University, USA; Aleksandar Donev, Courant Institute of Mathematical Sciences, New York University, USA*

**10:50-11:05 Process of Optimization of Free Parameters in Stabilized Methods**

*Petr Lukas, Charles University, Czech Republic*

**11:10-11:25 A Novel Deformation Method for Higher Order Mesh Generation**

*Guojun Liao and Zicong Zhou, University of Texas at Arlington, USA*

**11:30-11:45 Viscosity Solutions of Stationary Hamilton-Jacobi Equations and Minimizers of  $L^\infty$  Functionals**

*Marian Bocea, Loyola University of Chicago, USA*

**11:50-12:05 Asymptotic Analysis of a Drying Model Motivated by Coffee Bean Roasting**

*Nabil T. Fadai, Colin Please, and Robert Van Gorder, University of Oxford, United Kingdom*

**12:10-12:25 Large Deviations for a Stochastic Korteweg-De Vries Equation with Additive Noise**

*Leila Setayeshgar, Providence College, USA; Chia Ying Lee, University of British Columbia, Canada and University of North Carolina, USA*

**12:30-12:45 Fractional Integrated Semi Groups and Nonlocal Cauchy Problem for Abstract Nonlinear Fractional Differential Equations**

*Mahmoud M. El-Borai and Khairia E. El-Nadi, Alexandria University, Egypt*

Friday, July 14

**Systems Oversight Committee (SOC) Meeting**

11:00 AM-12:00 PM

Room:Westin Hotel - Cambria West

**SOC/FMC Lunch Meeting**

12:00 PM-1:00 PM

Room:Westin Hotel - Westmoreland Central

**Lunch Break**

12:30 PM-2:00 PM

Attendees on their own

**Financial Management Committee (FMC) Meeting**

1:00 PM-4:00 PM

Room:Westin Hotel - Cambria West

Friday, July 14

**IP4****Chaos and Learning in Spiking Neural Networks**

2:00 PM-2:45 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: *Paul Constantine, Colorado School of Mines, USA*

Neurons in the brain must perform various computations including initiating motor commands, retaining memories, and generating complex spatiotemporal firing patterns over long time scales. It is able to accomplish these tasks in the presence of short time constants and seemingly random connectivity. Here I will describe some of our recent work regarding the dynamics of spiking neurons with random and specified time dependent synaptic connections. Under different parametric conditions, the network can exhibit states of regular firing, quasi-periodic firing, chaotic firing where the average rate is approximately constant, and chaotic firing where the rate and spike times are both chaotic. I will also show how a learning rule can be implemented to stabilize chaotic trajectories and also be used to train the neurons within network to directly follow a wide range of arbitrary spatiotemporal firing patterns, including actual neural firing data or even musical pieces.

Carson C. Chow

*National Institutes of Health, USA*

Friday, July 14

**IP5****Laplacian Matrices of Graphs: Algorithms and Applications**

2:45 PM-3:30 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Lenore J. Cowen, Tufts University, USA

The Laplacian matrices of graphs arise in fields including Machine Learning, Computer Vision, Optimization, Computational Science, and of course Network Analysis. We will explain what these matrices are and why they arise in so many applications. In particular, we will show how Laplacian system solvers can be used to quickly solve linear programs arising from natural graph problems. We then will survey recent progress on the design of algorithms that allow us to solve these systems of linear equations in nearly linear time. We will focus on the role of graph sparsification and the recent discovery that it can be used to accelerate Gaussian elimination.

Daniel Spielman  
Yale University, USA

**Coffee Break**

3:30 PM-4:00 PM



Room: Ballroom Gallery - 3rd Floor

Friday, July 14

**MS92****Approximation of High-dimensional Systems – Theory and Numerical Aspects - Part II of II**

4:00 PM-5:30 PM

Room: 318

**For Part I see MS83**

Organized by SIAG/UQ

The approximations of high-dimensional systems from a limited amount of data play a pivotal role in a large number of fields in science and engineering including uncertainty quantification, optimal control, inverse problems and imaging. For such systems, constructing the quantities of interest often requires repeated expensive measurements, i.e., an ensemble of complex numerical simulations or time-consuming physical experiments. This minisymposium addresses the latest developments of several sparse techniques, which provide low-cost approximations via exploiting the sparse structure of the concerned systems and therefore mitigate the computational burden. The presentations will cover mathematical analysis based on orthogonal polynomials, compressed sensing, random matrix and approximation theory, as well as novel computational techniques, such as sampling strategies and optimization.

Organizer: Hoang A. Tran  
Oak Ridge National Laboratory, USA

Organizer: Clayton G. Webster  
Oak Ridge National Laboratory, USA

**4:00-4:25 Design of Optimal Experiments for Compressive Sampling of Polynomial Chaos Expansions: Application to Uncertainty Quantification**

Paul Diaz and Alireza Doostan, University of Colorado Boulder, USA

**4:30-4:55 Lebesgue Constants for Weighted Leja Sequences on Unbounded Domains**

Peter Jantsch, University of Tennessee, USA

**5:00-5:25 Global Reconstruction of Solutions to Parameterized PDEs via Compressed Sensing**

Hoang A. Tran, Oak Ridge National Laboratory, USA; Nick Dexter, University of Tennessee, USA; Clayton G. Webster, Oak Ridge National Laboratory, USA

Friday, July 14

**MS93****Communication-Avoiding Algorithms - Part II of II**

4:00 PM-6:00 PM

Room: Spirit of Pittsburgh B - 3rd Floor

**For Part I see MS76**

Organized by SIAG/SC

From physical modeling to large-scale data analysis, engineering efficient code at scale requires a critical focus on reducing communication – the movement of data between levels of memory hierarchy or between processors over a network – which is the most expensive operation in terms of both time and energy at all scales of computing. A key area of innovation within high-performance computing is thus the development of communication-avoiding algorithms. This minisymposium focuses on recent work in this area, with a range of topics including parallel algorithms, implementations, theoretical lower bounds, and applications.

Organizer: Erin C. Carson  
New York University, USA

**4:00-4:25 Communication-Avoiding Primal and Dual Methods for Regularized Least-Squares**

Aditya Devarakonda, Kimon Fountoulakis, James Demmel, and Michael Mahoney, University of California, Berkeley, USA

**4:30-4:55 Communication-Avoiding Sparse Inverse Covariance Matrix Estimation**

Penporn Koanantakool, University of California, Berkeley, USA; Sang-Yun Oh, University of California, Santa Barbara, USA; Dmitriy Morozov, Aydin Buluc, and Leonid Oliker, Lawrence Berkeley National Laboratory, USA; Katherine Yelick, Lawrence Berkeley National Laboratory and University of California Berkeley, USA

**5:00-5:25 Black-box Communication Optimal Low Rank Approximations**

Alan Ayala, INRA, France; Xavier Claeys, Universite de Paris VI, France; Laura Grigori, Inria, France

**5:30-5:55 Performance of S-step and Pipelined Krylov Methods**

Ichitaro Yamazaki, University of Tennessee, Knoxville, USA; Mark Hoemmen, Sandia National Laboratories, USA

Friday, July 14

**MS94****High Performance Spectral Algorithms**

4:00 PM-6:00 PM

*Room:315*

Over the past decade, there has been substantial theoretical progress on provably efficient algorithms for spectral routines such as graph clustering, graph sparsification, and solvers for linear systems related to graphs. Such routines in turn have a wide range of applications in machine learning, image processing, and network analytics. This minisymposium aims to bring together groups that have recently either developed code packages for such spectral primitives, and/or utilized them to address more complex problems. It will focus on ways of developing faster and robust code packages for spectral algorithms, as well as ways of systematically benchmarking and evaluating various implementations.

Organizer: Richard Peng

*Georgia Institute of Technology, USA***4:00-4:25 On Empirically Evaluating the Performances of Laplacian Solvers***Richard Peng, Georgia Institute of Technology, USA***4:30-4:55 Asymmetric Multigrid Solver for Sparse Graph Systems of Linear Equations***Sloan Nietert and Brian Dean, Ilya Safro, Clemson University, USA***5:00-5:25 Towards Practically-Efficient Spectral Sparsification of Graphs***Zhuo Feng, Michigan Technological University, USA***5:30-5:55 Scalable Motif-Aware Graph Clustering***Charalampos Tsourakakis, Carnegie Mellon University, USA*

Friday, July 14

**MS95****Lagrangian Traffic Flow Control and Autonomous Vehicles**

4:00 PM-6:00 PM

*Room: Spirit of Pittsburgh A - 3rd Floor*

Vehicular traffic flow is about to undergo a fundamental transition due to the introduction of autonomous vehicles (AVs) onto our roads. Over the next 15 years, we will face traffic flow of largely human-controlled vehicles, with a few AVs intermixed. This minisymposium focuses on future traffic control strategies enabled by those low density AVs. In contrast to existing, stationary, traffic control systems (variable speed limits, ramp metering), traffic control via AVs will occur in a Lagrangian fashion, which opens novel opportunities and challenges. This session highlights recent results on flow control via moving bottlenecks, flow stabilization, and traffic experiments, via cross-disciplinary talks from applied mathematics, civil, and electrical engineering.

Organizer: Benjamin Seibold

*Temple University, USA***4:00-4:25 Traffic Flow Control and Fuel Consumption Reduction Via Moving Bottlenecks***Benjamin Seibold, Temple University, USA***4:30-4:55 Controlling Stop and Go Traffic with a Single Autonomous Vehicle: Experimental Results***Daniel Work, University of Illinois at Urbana-Champaign, USA***5:00-5:25 Analysis and Design of Velocity Controllers for Dissipation of Stop-and-Go Traffic Waves***Rahul Kumar Bhadani, University of Arizona, USA***5:30-5:55 On Well-Posedness and Control of a Moving Bottleneck Model***Thibault Liard, Rutgers University, Camden, USA*

Friday, July 14

**MS96****New Models of Fracture with Surface Elasticity**

4:00 PM-6:00 PM

*Room:304*

Modeling of fracture in materials is an important engineering problem. Fracture is an atomistic process which is a result of breaking molecular bonds and, hence, cannot be qualitatively modeled within continuum paradigm. However, modeling fracture from atomistic perspective is challenging both theoretically and computationally. The minisymposium is dedicated to new models of fracture which utilize continuum modeling in the bulk but also include surface energy on the boundary of the fracture. Presence of surface energy introduces nano-mechanics of the material into the problem. The models of this type can serve as a convenient compromise between continuum and atomistic models and have advantages over both. Modeling fracture within this approach results in introduction of length-scale into the problem and also reduces the order of the crack-tip singularities. The surface models to be discussed include Gurtin-Murdoch and Steigmann-Ogden surface elasticity, and also curvature-dependent surface tension. Contact problems with surface elasticity will be considered as well. The minisymposium will serve as a meeting place for researchers from different parts of the world and will serve as an international incubator of ideas in this area.

Organizer: Anna Zemlyanova

*Kansas State University, USA*

Organizer: Sofia Mogilevskaya

*University of Minnesota, USA**continued on next page*

Friday, July 14

**MS96****New Models of Fracture with Surface Elasticity**

4:00 PM-6:00 PM

continued

**4:00-4:25 On the Role of Surface Effects in the Linear Elastic Fracture Mechanics***Chun Il Kim, Peter Schiavone, and Ru C-Q, University of Alberta, Canada***4:30-4:55 Regularizing Fracture Boundary Value Problems Via Surface Mechanics***Jay R. Walton, Texas A&M University, USA***5:00-5:25 Mechanics of Finite Cracks in Dissimilar Anisotropic Elastic Media Considering Interfacial Elasticity***Remi Dingreville and PierreAlexandre Juan, Sandia National Laboratories, USA***5:30-5:55 Three Dimensional Contact with Surface Tension***Gangfeng Wang, Xi'an Jiaotong University, P.R. China*

Friday, July 14

**MS97****Numerical Linear Algebra in Data Science - Part II of II**

4:00 PM-6:00 PM

*Room:302***For Part 1 see MS85**

Motivated by the extremely large amounts of data streaming from scientific research and daily life, recent years have witnessed exciting developments in the theory and practice of numerical linear algebra for obtaining instantaneous insight from massive datasets. This minisymposium introduces recent advances in both theory and high-performance algorithms for fast numerical linear algebra in data science, e.g. efficient matrix decomposition and applications, fast and scalable algorithms for optimization. These techniques significantly improve the efficiency of existing algorithms for information recovery, statistical learning, and machine learning.

Organizer: Michael Ng

*Hong Kong Baptist University, Hong Kong*

Organizer: Haizhao Yang

*Duke University, USA***4:00-4:25 Multiscale Adaptive Approximations to Data and Functions Concentrated Near Low-Dimensional Sets***Wenjing Liao, Mauro Maggioni, and Stefano Vigogna, Johns Hopkins University, USA***4:30-4:55 Robust and Efficient Multi-Way Spectral Clustering***Anil Damle, Victor Minden, and Lexing Ying, Stanford University, USA***5:00-5:25 A Case for Second Order Algorithms Via Sub-Sampled Newton Methods***Fred Roosta and Michael Mahoney, University of California, Berkeley, USA***5:30-5:55 Unsupervised Machine Learning - Method and Application***Baichuan Yuan, University of California, Los Angeles, USA; Andrea L. Bertozzi, University of California, Los Angeles, USA*

Friday, July 14

**MS99****Recent Advances in Theoretical and Computational Shape Analysis, Applications to Biomedical Imaging - Part II of II**

4:00 PM-6:00 PM

*Room:301***For Part 1 see MS90**

This minisymposium will focus on the fundamental and applied aspects of shape analysis. Shape analysis remains one of the key problems to many recent applications ranging from automatic object recognition in computer vision to the field of biomedical imaging in which datasets typically involve multiple geometric structures with important morphological variability. Modern methods are at the intersection of several fields in mathematics that span finite and infinite dimensional geometry, statistical data analysis and numerical optimization. The objective of the minisymposium is to bring together researchers covering those multiple aspects to present most recent ideas in the field, discuss new directions of interest for the community and foster future collaborations across different groups.

Organizer: Nicolas Charon

*Johns Hopkins University, USA*

Organizer: Martin Bauer

*Florida State University, USA*

Organizer: Akil Narayan

*University of Utah, USA*

Organizer: Mario Micheli

*Bowdoin College, USA***4:00-4:25 Frequency Diffeomorphisms for Efficient Image Registration and Bayesian Statistical Shape Analysis***Miaomiao Zhang, Massachusetts Institute of Technology, USA**continued on next page*

**4:30-4:55 A Convenient Numerical Scheme to Compute the Parallel Transport Along Geodesics**

*Maxime Louis*, Institut du Cerveau et de la Moelle Epinière, France

**5:00-5:25 PCA and Curvature: Numerical Examples on Spaces of Landmarks**

*Sergey Kushnarev*, Singapore University of Technology & Design, Singapore

**5:30-5:55 A Vector Field Approach for Data Attachment Terms in Surface Matching**

*Laurent Younes*, Johns Hopkins University, USA

Friday, July 14

## MS100

**Recent Development on Fractional Diffusion Equation: Analysis and Computation - Part II of II**

4:00 PM-6:00 PM

Room:303

**For Part 1 see MS91**

Fractional diffusion equation, which describes an anomalous diffusion process, has benefited a wide range of applications. Examples include photon transport in atmospheric clouds, Levy glasses, granular plasmas with dissipative collision, chemical reaction, and economy. The non-locality in the fractional operator poses great challenges in analysis and numerical computation. This mini-symposium aims to report recent progress on fractional diffusion equation in both aspects, as well as its connection with stochastic models and kinetic equations.

Organizer: Weiran Sun

*Simon Fraser University, Canada*

Organizer: Li Wang

*State University of New York, Buffalo, USA*

**4:00-4:25 Asymptotic Preserving Schemes for Anisotropic Transport Equation with Fractional Diffusion Limit**

*Li Wang*, State University of New York, Buffalo, USA

**4:30-4:55 Schwartz Duality for the Spectral Collocation Approximation to the Fractional Advection Diffusion Equation with Singular Source**

He Yang, Ohio State University, USA;  
Jingyang Guo and *Jae-Hun Jung*, State University of New York at Buffalo, USA

**5:00-5:25 Numerical Methods for Kinetic Equations in the Anomalous Diffusion Limit: Heavy-Tail Equilibria and Singular Collision Frequencies**

*Mohammed Lemou*, Université de Rennes 1, France

**5:30-5:55 Numerical Methods for Kinetic Equations in the Anomalous Diffusion Limit: Critical Exponent for a Heavy-Tailed Equilibrium**

*Helene Hivert*, Unité de Mathématiques Pures et Appliquées, France

Friday, July 14

## MS101

**Synergy of Design, Analysis, and Computations in Fluid Flow Dynamics**

4:00 PM-6:00 PM

Room:305

Achieving both accuracy and efficiency in fluid flow computation relies on the design of numerical methods for models as well as their mathematical analysis. Although fluid flow problems occur in countless applications spanning a wide spectrum in science and engineering, robust solution methodologies remain elusive. With this aim and motivation, the topics of interest include (but are not limited to), recent advances in the modeling of fluid flow problems, design of numerical methods to compute solutions to the models, numerical analysis of models based on physical properties, and applications of fluid flow in natural phenomena.

Organizer: Monika Neda

*University of Nevada, Las Vegas, USA*

**4:00-4:25 Numerical Analysis and Computations of Sensitivities in Fluid Flow Problems**

*Monika Neda*, University of Nevada, Las Vegas, USA

**4:30-4:55 New Results for the EMAC Scheme for Incompressible Navier-Stokes Simulation**

*Leo Rebholz*, Clemson University, USA

**5:00-5:25 Artificial Compression Methods**

*William Layton*, University of Pittsburgh, USA

**5:30-5:55 Ensemble Simulation Models and Algorithms**

*Nan Jiang*, Missouri University of Science and Technology, USA

Friday, July 14

## CP28

### Numerical Analysis - Part II of II

4:00 PM-5:40 PM

Room:306

#### For Part 1 see CP21

Chair: *Minghao W. Rostami, Syracuse University, USA*

#### 4:00-4:15 Robust Linear Stability Analysis and a New Method for Computing the Action of the Matrix Exponential

*Minghao W. Rostami, Syracuse University, USA; Fei Xue, Clemson University, USA*

#### 4:20-4:35 A Nonlinear Krylov-Type Method for Differentiable Mixed Subordinate Matrix Norms

*Francesco Tudisco, University of Padua, Italy; Antoine Gautier and Matthias Hein, Saarland University, Germany*

#### 4:40-4:55 Fast and Backward Stable Computation of Roots of Polynomials

*Thomas Mach, Technical University of Chemnitz, Germany; Jared Aurentz, Instituto de Ciencias Matemáticas, Spain; Raf Vandebril, KU Leuven, Belgium; David S. Watkins, Washington State University, USA*

#### 5:00-5:15 The Vector Space of Finite Summations and Its Applications

*Pawel B. Marcinek, Peter Shi, and Serge Kruk, Oakland University, USA*

#### 5:20-5:35 On Jacobi Methods for the Positive Definite Generalized Eigenvalue Problem

*Vjeran Hari, University of Zagreb, Croatia*

Friday, July 14

## CP29

### Optimization - Part III of III

4:00 PM-5:40 PM

Room:310

#### For Part 2 see CP26

Chair: *Devin W. Griffith, Carnegie Mellon University, USA*

#### 4:00-4:15 Time-Varying Convex Optimization

*Bachir El Khadir and Amir Ali Ahmadi, Princeton University, USA*

#### 4:20-4:35 Terminal Regions and Costs for Discrete Time Quasi-Infinite Horizon NMPC

*Devin W. Griffith and Lorenz Biegler, Carnegie Mellon University, USA*

#### 4:40-4:55 Convexity in Hamilton-Jacobi Theory with Measurable Time-Dependence

*Qingxia Li, Fisk University, USA*

#### 5:00-5:15 A Novel Parallel Approach for Orthogonal Constrained Optimization Problems

*Xin Liu, Chinese Academy of Sciences, China*

#### 5:20-5:35 Hub Network Design under Stackelberg Game for Time-Definite Delivery Industry

*Cheng-Chang Lin, National Cheng Kung University, Taiwan*

Friday, July 14

### Board of Trustees Executive Session

4:00 PM-7:00 PM

Room:Westin Hotel - Butler West

### Conference Adjourns

6:00 PM

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## Saturday, July 15

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### **Board of Trustees Regular Session**

*8:30 AM-4:00 PM*

*Room: Westin Hotel - Butler*

### **Board Lunch**

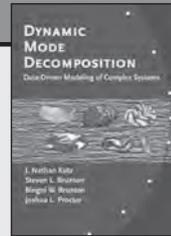
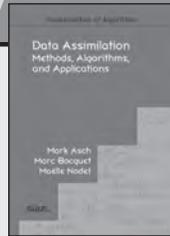
*12:00 PM-1:00 PM*

*Room: Westin Hotel - Cambria*



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Mark Asch, Marc Bocquet, and Maëlle Nodet

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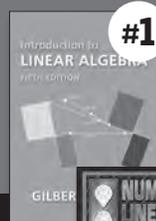
## Iterative Solution of Symmetric Quasi-Definite Linear Systems

Dominique Orban and Mario Arioli

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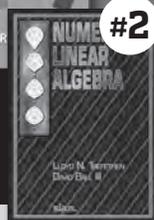


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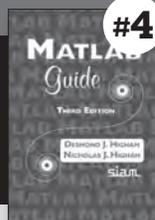
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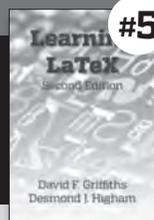
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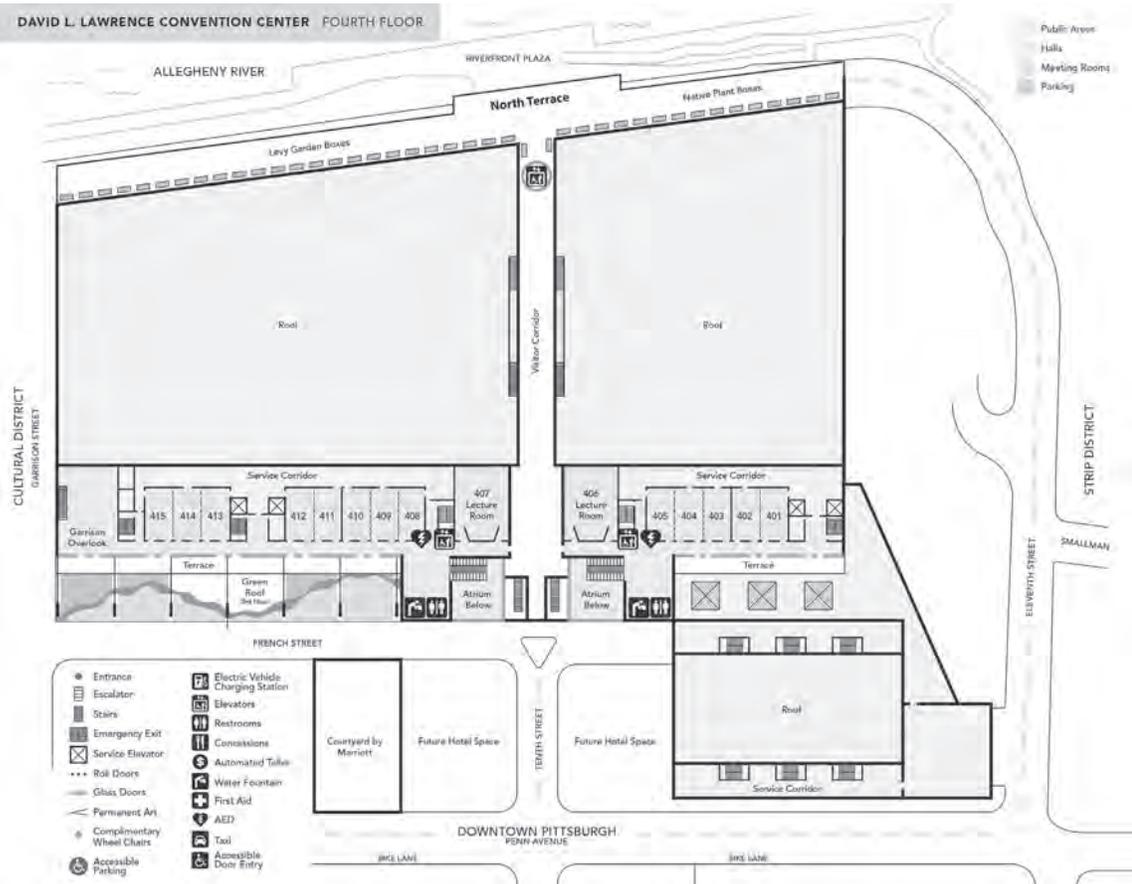
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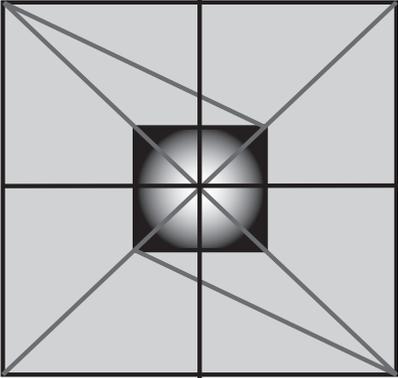
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## CT17 Program

Figure courtesy Fabio Fagnani.

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## Sunday, July 9

### Registration

2:00 PM-8:00 PM

Room: Ballroom Gallery - 3rd Floor

### Student Orientation

5:00 PM-6:00 PM

Room: 306 & 307

### Welcome Reception

6:00 PM-8:00 PM

Room: South Terrace - 3rd Floor



## Monday, July 10

### Registration

7:15 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Welcome Remarks

8:15 AM-8:30 AM

Room: Spirit of Pittsburgh B - 3rd Floor

Monday, July 10

## IT1

### Optimal Mass Transport and the Robustness of Complex Networks

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh B - 3rd Floor

Chair: Michael A. Demetriou, Worcester Polytechnic Institute, USA

Today's technological world is increasingly dependent upon the reliability, robustness, quality of service and timeliness of networks including those of power distribution, financial, transportation, communication, biological, and social. For the time-critical functionality in transferring resources and information, a key requirement is the ability to adapt and reconfigure in response to structural and dynamic changes, while avoiding disruption of service and catastrophic failures. We will outline some of the major problems for the development of the necessary theory and tools that will permit the understanding of network dynamics in a multiscale manner. Many interesting networks consist of a finite but very large number of nodes or agents that interact with each other. The main challenge when dealing with such networks is to understand and regulate the collective behavior. Our goal is to develop mathematical models and optimization tools for treating the Big Data nature of large scale networks while providing the means to understand and regulate the collective behavior and the dynamical interactions (short and long-range) across such networks. The key mathematical technique will be based upon the use of optimal mass transport theory and resulting notions of curvature applied to weighted graphs in order to characterize network robustness. Examples will be given from biology, finance, and transportation.

Allen Tannenbaum

Stony Brook University, USA

Monday, July 10

**IT2****The Moment-SOS Approach in Optimization and Control**

9:15 AM-10:00 AM

*Room: Spirit of Pittsburgh B - 3rd Floor**Chair: William M. McEneaney, University of California, San Diego, USA*

The moment-SOS approach was initially developed for solving global optimization problems whose data (objective functions and constraints) are described by polynomials (semi-algebraic functions may also be allowed). It consists of solving a « hierarchy of convex relaxations » of the initial problem. Each relaxation is a semidefinite program whose size increases in the hierarchy, and the associated monotone sequence of optimal values converges to the global minimum. Finite convergence is generic and fast in practice. In fact this methodology also applies to virtually any problem described in terms of positivity constraints, that is, « some (known or unknown) polynomials must be positive on some compact semi-algebraic sets ». From the rich duality between positive polynomials and moments, such problems have a « dual » which is an instance of what is called the Generalized Problem of Moments (GPM)). This talk describes several applications of the moment-SOS approach and in particular to some control applications, including computation of Lyapunov functions, weak formulation of optimal control problems, modeling of chance-constraints, etc. (Research funded by the European Research Council (ERC), under an ERC Advanced Grant for the TAMING project)

Jean-Bernard Lasserre  
*LAAS-CNRS, Toulouse, France*

**Coffee Break**

10:00 AM-10:30 AM

*Room: Ballroom Gallery - 3rd Floor*

Monday, July 10

**MS1****Control Problems in Nonlinear PDE Systems**

10:30 AM-12:30 PM

*Room: 403*

Most systems are most accurately modeled by nonlinear PDE systems. The resulting control and stabilization problems are challenging. Researchers have devoted substantial efforts on related control problems such as stability analysis, stabilization, controllability & observability analysis. This minisymposium will describe some recent advances in this direction. The first two presentations are about stability analysis of nonlinear dynamical systems. The first talk, by Tang, is motivated by stability analysis of a controlled piezoelectric beam. A nonlinear fourth-order ODE which shares a similar structure with the PDE is considered. She will discuss this similarity and show that the ODE system is locally asymptotically stable around the origin. A future step is to apply a similar Lyapunov functional to the PDE for its stability analysis. The second talk, by Xie, includes results of her study about the influence of long range dispersal, a common phenomenon in biology and ecology, onto the persistence of a population. The third talk, by Diagne will present his result on the stabilization, via boundary controller design, for a transport PDE/nonlinear ODE cascade system describing screw extrusion processes for additive manufacturing. The fourth talk is by de Souza. He will talk about the local exact controllability to the trajectories for the one-dimensional monodomain equations with two human atrial cell models using distributed controls with a moving support.

Organizer: Shuxia Tang  
*University of Waterloo, Canada*

Organizer: Kirsten Morris

*University of Waterloo, Canada***10:30-10:55 Stability Analysis of the Fourth-order ODE Analogous to a Piezoelectric Beam PDE**

Shuxia Tang and *Kirsten Morris*, University of Waterloo, Canada; Jean-Michel Coron, Université Pierre et Marie Curie, France

**11:00-11:25 Persistence Criteria for the Nonlocal Niche Model and Applications**

Wenxian Shen, Auburn University, USA; Xiaoxia Xie, Idaho State University, USA

**11:30-11:55 Control of Transport PDE/ Nonlinear ODE Cascades with State-dependent Propagation Speed**

*Mamadou L. Diagne*, Rensselaer Polytechnic Institute, USA; Nikolaos Bekiaris-Liberis, Technical University of Crete, Greece; Andreas Otto, Chemnitz University of Technology, Germany; Miroslav Krstic, University of California, San Diego, USA

**12:00-12:25 Exact Controllability for Nonlinear Monodomain Equations**

Karl Kunisch, Universität Graz, Austria; *Diego Souza*, Federal University of Pernambuco, Brazil

Monday

*continued in next column*

Monday, July 10

## MS2

### Overcoming the Curse of Dimensionality for Optimal Control and PDEs - Part I of II

10:30 AM-12:30 PM

Room:404

#### For Part 2 see MS12

The curse of dimensionality in solving HJ types of equations has been a long time bottleneck on many important applications in nonlinear optimal control, reachable sets, differential games, and functional differential equations. In recent years, the advancements in numerical methods together with the exponential increase in affordable computational power, including parallel devices such as CPUs, multi-GPUs, and GPU/CPU hybrid platforms, give us new hope of overcoming or effectively mitigating the curse of dimensionality in problems with real-life applications. The goal of this minisymposium is to bring together leading researchers from several different areas, including mathematics of PDEs, scientific computing, optimal control and differential games to showcase their recent success on solving problems that have high dimensions. The topics include: overcoming the curse of dimensionality for HJ equations with applications to control and differential games; decomposition of reachable sets and tubes for nonlinear systems; an efficient algorithm for embedded systems for optimal control problems in high dimensions; numerical approximation of nonlinear functionals and functional differential equations; causality-free algorithms; HJ Equations for two-point BVPs in dequantized Schrodinger equations; and applications of the generalized Hopf formula to linear control problems.

Organizer: Wei Kang  
*Naval Postgraduate School, USA*

Organizer: Jerome Darbon  
*Brown University, USA*

#### 10:30-10:55 Overcoming the Curse of Dimensionality for Hamilton-Jacobi Equations with Applications to Control and Differential Games

*Stanley J. Osher*, University of California, Los Angeles, USA; *Jerome Darbon*, Brown University, USA; *Ya-Tin Chow*, University of California, Los Angeles, USA

#### 11:00-11:25 An Efficient Algorithm That is Suitable for Embedded Systems for Solving a Class of Optimal Control Problems in High Dimensions

*Jerome Darbon*, Brown University, USA

#### 11:30-11:55 Some Examples of Causality-free Algorithms

*Wei Kang* and *Lucas Wilcox*, Naval Postgraduate School, USA

#### 12:00-12:25 Computational Challenges in the Numerical Approximation of Nonlinear Functionals and Functional Differential Equations

*Daniele Venturi*, University of California, Santa Cruz, USA

Monday, July 10

## MS3

### Nonlinear Optimization in Control Theory - Part I of III

10:30 AM-12:30 PM

Room:405

#### For Part 2 see MS13

The minisymposium contains three parts. Each of these parts includes four talks which will be given by well-known experts in the area. In the first part the speakers discuss infinite dimensional control problems and control problems with PDE. N. U. Ahmed presents results on reaction diffusion equations and their optimal control. J. Blot studies Pontryagin principles for infinite-horizon problems. M. Falcone applies the HJB-POD approach for infinite dimensional control problems. In the last talk G. Marinoschi discusses feedback stabilization of the Cahn-Hilliard system. The second part is devoted to well-posedness and stability in optimal control. R. Goebel discusses optimal control for pointwise asymptotic stability of a continuum of equilibria. Exact test for real-positiveness of fractional systems is presented by J. Kaminski. S. Migorski studies optimal control problems for a class of variational-hemivariational inequalities. In the last talk A. Zaslavski considers the stability of turnpike properties of Bolza optimal control problems. In the third part, real world applications are considered. M. Bounkhel applied nonconvex sweeping processes to real life problems. E. Grigorieva presents results on singular optimal treatment strategies for control model of psoriasis. F. L. Pereira discusses a control scheme for the sustainable management of renewable resources. In the last talk C. Silva applies optimal control to delayed HIV models.

Organizer: Boris Mordukhovich  
*Wayne State University, USA*

Organizer: Nobusumi Sagara  
*Hosei University, Japan*

Organizer: Ilya Shvartsman  
*Pennsylvania State University, USA*

Organizer: Geraldo N. Silva  
*Universidade Estadual Paulista, Brazil*

Organizer: Alexander J. Zaslavski  
*Technion Israel Institute of Technology, Israel*

**10:30-10:55 Reaction Diffusion Equations and their Optimal Control with Potential Application to Biomedical Problems**

*Nasir Ahmed, University of Ottawa, Canada*

**11:00-11:25 Infinite-dimensional Pontryagin Principles for Systems Discrete-time Infinite-horizon Optimal Control Problems**

*Joël Blot, Université Paris 1 Panthéon-Sorbonne, France*

**11:30-11:55 The HJB-POD Approach for Infinite Dimensional Control Problems**

*Maurizio Falcone, Università di Roma "La Sapienza", Italy*

**12:00-12:25 Feedback Stabilization of the Cahn-Hilliard System for Phase Separation**

*Gabriela Marinoschi, Romanian Academy, Romania*

Monday, July 10

## MS4

**Computational Challenges in Stochastic Control and Optimization of High Dimensional Systems - Part I of III**

*10:30 AM-12:30 PM*

*Room:408*

**For Part 2 see MS14**

We are bringing together researchers from various areas of dynamical system theory, stochastic control, optimal control, uncertainty quantification and optimization to highlight the challenges and possible approaches to the major theoretical and computational bottlenecks in control and optimization of high dimensional dynamical systems. The papers in these sessions aim to address these general themes in dealing with high-dimensionality, stochasticity and nonlinearity of these problems in the context of both control and optimization.

Organizer: Fariba Fahroo  
*Defense Advanced Research Projects Agency, USA*

Organizer: Michael A. Demetriou

*Worcester Polytechnic Institute, USA*

**10:30-10:55 Exploiting Low-rank Structure in Stochastic Optimal Control and Filtering Problems**

*Alex A. Gorodetsky, Sandia National Laboratories, USA*

**11:00-11:25 Data-driven Reduced-order Models for Control of PDEs with Uncertain Parameters**

*Boris Kramer, Massachusetts Institute of Technology, USA; B. Peherstorfer, University of Wisconsin, Madison, USA; Karen E. Willcox, Massachusetts Institute of Technology, USA*

**11:30-11:55 Sequential Optimal Experimental Design via Stochastic Control**

*Xun Huan, Sandia National Laboratories, USA; Youssef M. Marzouk, Massachusetts Institute of Technology, USA*

**12:00-12:25 Methods for Robust Control and Performance Analysis via Information Divergences**

*Amarjit Budhiraja, University of North Carolina at Chapel Hill, USA*

Monday, July 10

## MS5

**Stochastic Control and Applications - Part I of III**

*10:30 AM-12:30 PM*

*Room:409*

**For Part 2 see MS15**

Along with the progress in networked systems and advent of computation technology, significant progress has been made in stochastic control, optimization, and related fields in recent years. In addition to enhancing existing applications in the traditional areas, new applications have been found in such areas as financial engineering, manufacturing and production planning, real options, communication networks, renewable energy, and biological and ecological systems. To review and to update the recent progress, we have invited experts of stochastic control with applications from multi-disciplinary fields. We put together this three-part minisymposium, which enables researchers get together with a concerted effort to communicate recent progress. The central theme is to show case recent success, to present new challenges, and to identify pressing need for future research topics. The titles of the talks to be presented in the minisymposia are given.

Organizer: George Yin  
*Wayne State University, USA*

Organizer: Jongmin Yong  
*University of Central Florida, USA*

**10:30-10:55 Parabolic Equations with Quadratic Growth in  $\mathbb{R}^n$**

*Alain Bensoussan, The University of Texas at Dallas and City University of Hong Kong, Hong Kong*

**11:00-11:25 Approximations for Average Markov Decision Processes in Continuous-time**

*Jonatha Anselmi, Inria Bordeaux Sud-Ouest, France; Francois Dufour, Université Bordeaux I, France; Tomas Prieto-Rumeau, Universidad Nacional de Educación a Distancia, Spain*

*continued on next page*

Monday, July 10

## MS5

### Stochastic Control and Applications - Part I of III

10:30 AM-12:30 PM

continued

#### 11:30-11:55 On Adaptive Robust Control in Discrete Time

*Tomasz Bielecki*, Tao Chen, and Igor Cialenco, Illinois Institute of Technology, USA; Areski Cousin, University of Lyon 1, France; Monique Jeanblanc, Université d'Evry Val d'Essonne, France

#### 12:00-12:25 Regime-Switching Jump Diffusions: Coupling Method, Feller and Strong Feller Properties

Fubao Xi, Beijing Institute of Technology, China; *Chao Zhu*, University of Wisconsin, Milwaukee, USA

Monday, July 10

## MS6

### Applications of Stochastic Systems in Finance and Energy

10:30 AM-12:30 PM

Room:410

Over the past few years, an infusion of new mathematical ideas and new applications of old ideas has revolutionized the study of stochastic systems in relation to finance and energy. Problems that a decade ago were modeled almost exclusively by modified versions of classical Brownian motion today are modeled with a wide variety of mathematical machinery including Markov chains (discrete and continuous-time) and game theory. Up until recently the classical approach was preferred because assumptions based on classical Brownian motion frequently admitted closed-form solutions whereas most other assumptions did not. Closed-form solutions are highly preferred because they are easier to implement in a real-world setting by industry practitioners. However, recent mathematical advances have allowed for closed-form solutions under a wider range of non-classical assumptions. This minisymposium will feature speakers from diverse backgrounds who have recently used these new ideas to solve real-world problems in finance and energy. Emphasis will be given on cases in which closed-form implementable solutions can be obtained.

Organizer: David J. Prager

*Anderson University, USA*

Organizer: Qing Zhang

*University of Georgia, USA*

#### 10:30-10:55 Valuing Stock Loans using a Markov Chain Model

*David J. Prager*, Anderson University, USA; Qing Zhang, University of Georgia, USA

#### 11:00-11:25 A General Valuation Framework for Sabr and Stochastic Local Volatility Models

*Duy Nguyen*, Marist College, USA

#### 11:30-11:55 Robust Dynkin Game

*Song Yao*, University of Pittsburgh, USA; Erhan Bayraktar, University of Michigan, USA

#### 12:00-12:25 \*Optimal Oil Production and Taxation in Presence of Global Disruptions

*Moustapha Pemy*, Towson University, USA

\* This presentation is included in the proceedings.

Monday, July 10

## MS7

### Applications of Control in Medicine and Biology - Part I of II

10:30 AM-12:30 PM

Room:411

#### For Part 2 see MS17

Applications of control in medicine and biology take many forms, and offer diverse opportunities for interdisciplinary collaboration between the life sciences and different domains of control theory. This minisymposium will provide a forum for exploring these opportunities. Some speakers will address applications of control to a variety of rhythmic biological processes including circadian and respiratory rhythms (where strong rhythmicity is desirable) as well as in deep brain stimulation (where strong rhythmicity may be pathological). Others will address control of non-rhythmic biological systems, including functional electronic stimulation (FES), immune system response, and optimal drug delivery. Additional talks will invoke other system theoretic topics including parameter estimation within a dynamical systems model, and aspects of control involved in rewiring neuronal networks in the brain during development.

Organizer: Peter J. Thomas  
Case Western Reserve University, USA

Organizer: Jonathan E. Rubin  
University of Pittsburgh, USA

#### 10:30-10:55 Open Versus Closed Loop Control in a Respiratory Model

Casey Diekman, New Jersey Institute of Technology, USA; Peter J. Thomas, Case Western Reserve University, USA; Chris Wilson, Loma Linda University, USA

#### 11:00-11:25 Adaptive Algorithms for Suppression of Neural Biomarkers with Deep Brain Stimulation

Theoden I. Netoff, Vivek Nagaraj, and Logan Grado, University of Minnesota, USA

#### 11:30-11:55 Artificial Control of Real Muscle: FES for Clinical Applications and Movement Science

Max Berniker, University of Illinois at Chicago, USA

#### 12:00-12:25 Control in Structural Brain Networks: Developmental Phenotypes and Rewiring Mechanisms

Danielle S. Bassett, University of Pennsylvania, USA

Monday, July 10

## MS8

### Smart Grid Problems

10:30 AM-12:30 PM

Room:412

This minisymposium is concerned with problems, algorithms, and simulation tools related to “Smart Grid”, that is, the integration of new control, communication and optimization strategies into power grids where renewable energy sources, electric drive vehicles, and storage capabilities are significant factors in overall grid operation. The minisymposium contains four papers by well-known researchers that have been involved in power systems and the smart grid field for many years. The first paper develops new control strategies to address fundamental issues of power balance, line loss reduction, and voltage profile management in DC microgrids. The second paper will showcase results that employ ideas, frameworks, techniques, and results from the field of coalitional game theory to address some key issues in grid integration of renewable electricity generation. In the third paper it is argued that much of the smart grid work has not engaged with the needs of industry and often has ignored the existing science of power grids. The paper reviews some recent progress with a more scientific view to complement and enhance the more realistic developments in industry. The last paper shows how a carefully designed simulation platform can be used to benchmark dynamic response of changing electric power grids with various embedded cyber systems. One such general simulation platform, known as SGRS, is described.

Monday

Monday, July 10

## MS8

### Smart Grid Problems

10:30 AM-12:30 PM

continued

Organizer: Michael P. Polis  
Oakland University, USA

Organizer: Le Yi Wang  
Wayne State University, USA

### 10:30-10:55 Distributed Optimal Power and Voltage Management in DC Microgrids

Eyad Sindi and *Le Yi Wang*, Wayne State University, USA; Michael P. Polis, Oakland University, USA; George Yin, Wayne State University, USA; Lei Ding, Swinburne University of Technology, Australia

### 11:00-11:25 Coalitional Games and Grid Integration of Renewable Energy

*Pramod Khargonekar*, University of California, Irvine, USA; P. Chakraborty, University of California, Berkeley, USA; E. Baeyens, University of Valladolid, Spain

### 11:30-11:55 Smarter Grids using Distributed Learning Control

*David Hill*, Tao Liu, and Haomin Ma, University of Hong Kong, Hong Kong

### 12:00-12:25 Smart Grid in a Room Simulator (SGRS): A Tool for Assessing Effects of Smarts in Electric Energy Systems

*Marija Ilic* and Rupamathi Jaddivada, Carnegie Mellon University, USA

Monday, July 10

## MS9

### New Trends in Optimal Control

10:30 AM-12:30 PM

Room:413

In the study of traditional optimal control problems nonsmooth analysis plays an important role. It can be used to investigate optimal controls via gradient-like properties of value functions, Hamiltonians and exact penalty functions, which being not differentiable are not amenable to classical methods. This minisymposium is devoted to nonsmooth methods for control systems that depart from the standard controlled differential equation paradigm. That is hereditary and stochastic control systems, and infinite dimensional systems described by controlled evolution equations. Concerning hereditary control systems, the first generalized Pontryagin maximum principle for optimal control problems involving a variety of constraints is discussed. In the area of optimal control of infinite dimensional systems, new nondegenerate necessary conditions are presented for problems involving pathwise state constraints, whose derivation is based on nonsmooth distance estimates. The work on stochastic optimal control reveals the significance of first and higher order nonsmooth analysis, to take account of the second order 'Ito' terms encountered in the derivation of necessary conditions of optimality. The minisymposium also includes a presentation that reveals, in a number of different settings, how the non-uniqueness of optimal control is closely tied to nonsmoothness properties of the value function.

Organizer: Helene Frankowska  
CNRS and Université Pierre et Marie Curie, France

Organizer: Richard B. Vinter  
Imperial College London, United Kingdom

### 10:30-10:55 Optimal Control of Hereditary Systems

*Richard B. Vinter*, Imperial College London, United Kingdom

### 11:00-11:25 First and Second Order Necessary Conditions for Stochastic Optimal Controls

*Helene Frankowska*, CNRS and Université Pierre et Marie Curie, France; Haisen Zhang, Southwest University, Chongqing, China; Xu Zhang, Sichuan University, China

### 11:30-11:55 Normality of the Pontryagin Maximum Principle for Infinite Dimensional Control Systems under State Constraints

*Marco Mazzola*, University Pierre and Marie Curie (UPMC), France

### 12:00-12:25 Generalized Characteristics and Singularities of Solutions to Hamilton-Jacobi Equations

*Piermarco Cannarsa*, University of Rome II, Tor Vergata, Italy

continued in next column

Monday, July 10

## MS10

### Modeling and Control of Markov Processes

10:30 AM-12:30 PM

Room:414

This minisymposium is devoted to recent advances in the mathematical theories and applications of stochastic modeling and control for different classes of Markov stochastic processes such as branching Markov processes, Markov decision processes, Markov jump linear systems or piecewise deterministic Markov processes. Clearly, stochastic aspects play an important role in modeling, filtering and control of real-world phenomena as diverse as avalanches or response to a medical treatment, for instance. The objective of this minisymposium is to discuss and exchange ideas among experts in these areas of research with emphasis on efficient numerical procedure to solve fixed-point problems, on-line filtering problems, to detect change-points in continuous-time processes or to accurately model avalanches. The speakers will present state-of-the-art results in these topics and identify open problems and future research directions.

Organizer: Benoite de Saporta  
*Université de Montpellier, France*

Organizer: Francois Dufour  
*Université Bordeaux I, France*

#### 10:30-10:55 Optimal Stopping for Change-point Detection of Piecewise Deterministic Markov Processes

*Benoite de Saporta, Université de Montpellier, France; Alice Cleynen, CNRS - IMAGE, France*

#### 11:00-11:25 A Functional Analytic Approach to Approximate Iterative Algorithms

*Anthony Almudevar, University of Rochester, USA*

#### 11:30-11:55 Clustered Information Filter for Markov Jump Linear Systems

*Eduardo F. Costa, Universidade of São Paulo, Brazil*

#### 12:00-12:25 Stochastic Approach of Fragmentation - Application to Avalanches

*Madalina Deaconu, Inria Nancy - Grand Est, France*

Monday, July 10

## Lunch Break

12:30 PM-2:00 PM

*Attendees on their own*

## JP1

### Bio-Inspired Dynamics for Multi-Agent Decision-Making

2:00 PM-2:45 PM

*Room: Spirit of Pittsburgh A - 3rd Floor*

*Chair: Fariba Fahroo, Defense Advanced Research Projects Agency, USA*

I will present a generalizable framework that uses the singularity theory approach to bifurcation problems, and other tools of nonlinear dynamics, to translate some of the remarkable features of collective animal behavior to an abstract agent-based model. With the abstract model, analysis and design of decision-making between alternatives can be systematically pursued for natural or engineered multi-agent systems. To illustrate, I will apply the framework to explore and extend value-sensitive decision-making dynamics that explain the adaptive and robust behavior of house-hunting honeybees.

Naomi E. Leonard  
*Princeton University, USA*

Monday, July 10

## SP1

### AWM-SIAM Sonia Kovalevsky Lecture: Mitigating Uncertainty in Inverse Wave Scattering

2:45 PM-3:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor*

*Chair: Ami Radunskaya, Pomona College, USA*

Inverse wave scattering is an inverse problem for the wave equation, driven by a broad spectrum of applications. It is an interdisciplinary area that involves mathematical analysis, computational modeling, statistics and signal processing. This lecture will discuss one important challenge due the uncertainty of the model for inversion. Uncertainty is unavoidable in applications, not only because of noise, but because of lack of detailed knowledge of complex media through which the waves propagate.

Liliana Borcea  
*University of Michigan, USA*

## Coffee Break

3:30 PM-4:00 PM



*Room: Ballroom Gallery - 3rd Floor*

Monday, July 10

## MS11

### Recent Results in Optimal Control of Partial Differential Equations and Applications - Part I of II

4:00 PM-6:00 PM

Room:403

#### For Part 2 see MS21

This minisymposium shows the diversity of recent developments in theory and applications of PDE control. A first part of talks addresses latest trends in the numerical analysis of PDE optimal control problems such as the stabilization by sparse controls, problems with control functions concentrated on manifolds, identification problems, and the error analysis for the optimal control of Allen-Cahn equations or Dirichlet boundary value problems. Other talks report on different aspects of applications, namely in transplantation medicine, mathematical economics, and semiconductor crystal growth.

Organizer: Eduardo Casas  
*Universidad de Cantabria, Spain*

Organizer: Fredi Tröltzsch  
*Technische Universität, Berlin, Germany*

#### 4:00-4:25 Control of Voluntary Immunosuppression in Transplant Patients

*H.T. Banks*, North Carolina State University, USA; *Rebecca A. Everett*, Arizona State University, USA; *Neha Murad*, North Carolina State University, USA

#### 4:30-4:55 Applications of Nonlocal PDE-constrained Optimization in Economics

*Ekkehard W. Sachs* and *Laura Somorowsky*, Universität Trier, Germany

#### 5:00-5:25 Different Numerical Aspects for Dirichlet Boundary Control Problems

*Johannes Pfeffferer*, Technische Universität München, Germany; *Max Winkler*, Universität der Bundeswehr München, Germany

#### 5:30-5:55 Modeling and Optimization of a Process of Semiconductor Crystal Growth

*Olaf Klein*, Weierstrass Institute, Germany; *Peter Nestler* and *Nico Schlömer*, Technische Universität, Berlin, Germany; *Jürgen Sprekels*, Weierstrass Institute, Germany; *Fredi Tröltzsch*, Technische Universität, Berlin, Germany

Monday, July 10

## MS12

### Overcoming the Curse of Dimensionality for Optimal Control and PDEs - Part II of II

4:00 PM-6:00 PM

Room:404

#### For Part 1 see MS2

The curse of dimensionality in solving HJ types of equations has been a long time bottleneck on many important applications in nonlinear optimal control, reachable sets, differential games, and functional differential equations. In recent years, the advancements in numerical methods together with the exponential increase in affordable computational power, including parallel devices such as CPUs, multi-GPUs, and GPU/CPU hybrid platforms, give us new hope of overcoming or effectively mitigating the course of dimensionality in problems with real-life applications. The goal of this minisymposium is to bring together leading researchers from several different areas, including mathematics of PDEs, scientific computing, optimal control and differential games to showcase their recent success on solving problems that have high dimensions. The topics include: overcoming the curse of dimensionality for HJ equations with applications to control and differential games; decomposition of reachable sets and tubes for nonlinear systems; an efficient algorithm for embedded systems for optimal control problems in high dimensions; numerical approximation of nonlinear functionals and functional differential equations; causality-free algorithms; HJ Equations for two-point BVPs in dequantized Schrodinger equations; and applications of the generalized Hopf formula to linear control problems.

Organizer: Wei Kang  
*Naval Postgraduate School, USA*

Organizer: Jerome Darbon  
*Brown University, USA*

#### 4:00-4:25 Decomposition of Reachable Sets and Tubes for a Class of Nonlinear Systems

*Mo Chen*, *Sylvia Herbert*, *Mahesh Vashishtha*, *Somil Bansal*, and *Claire J. Tomlin*, University of California, Berkeley, USA

#### 4:30-4:55 Hamilton-Jacobi Equations for Two-Point Boundary-Value Problems in Conservative Systems and Dequantized Schrodinger Equations

*William M. McEneaney*, University of California, San Diego, USA; *Peter M. Dower*, University of Melbourne, Australia; *Ruobing Zhao*, University of California, San Diego, USA

#### 5:00-5:25 Applications of the Generalized Hopf Formula to Linear Control Problems

*Matthew Kirchner*, *Gary Hewer*, *Robert Mar*, and *Brian Reitz*, Naval Air Warfare Center, Weapons Division, USA; *Jerome Darbon*, University of California, Los Angeles, USA; *Stanley J. Osher*, University of California, Los Angeles, USA

#### 5:30-5:55 Pareto Front Characterization for Multi-Objective Optimal Control Problems using HJB Approach

*Anna Desilles* and *Hasnaa Zidani*, ENSTA ParisTech, France

*continued in next column*

Monday, July 10

## MS13

### Nonlinear Optimization in Control Theory - Part II of III

4:00 PM-6:00 PM

Room:405

**For Part 1 see MS3**  
**For Part 3 see MS23**

The minisymposium contains three parts. Each of these parts includes four talks which will be given by well-known experts in the area. In the first part the speakers discuss infinite dimensional control problems and control problems with PDE. N. U. Ahmed presents results on reaction diffusion equations and their optimal control. J. Blot studies Pontryagin principles for infinite-horizon problems. M. Falcone applies the HJB-POD approach for infinite dimensional control problems. In the last talk G. Marinoschi discusses feedback stabilization of the Cahn-Hilliard system. The second part is devoted to well-posedness and stability in optimal control. R. Goebel discusses optimal control for pointwise asymptotic stability of a continuum of equilibria. Exact test for real-positiveness of fractional systems is presented by J. Kaminski. S. Migorski studies optimal control problems for a class of variational-hemivariational inequalities. In the last talk A. Zaslavski considers the stability of turnpike properties of Bolza optimal control problems. In the third part, real world applications are considered. M. Bounkhel applied nonconvex sweeping processes to real life problems. E. Grigorieva presents results on singular optimal treatment strategies for control model of psoriasis. F. L. Pereira discusses a control scheme for the sustainable management of renewable resources. In the last talk C. Silva applies optimal control to delayed HIV models.

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Wayne State University, USA

Organizer: Nobusumi Sagara  
Hosei University, Japan

Organizer: Ilya Shvartsman  
Pennsylvania State University, USA

Organizer: Geraldo N. Silva  
Universidade Estadual Paulista, Brazil

Organizer: Alexander J. Zaslavski  
Technion Israel Institute of Technology, Israel

**4:00-4:25 Optimal Control for Pointwise Asymptotic Stability of a Continuum of Equilibria**  
Rafal Goebel, Loyola University Chicago, USA

**4:30-4:55 Exact Test for Real-positiveness of Fractional Systems**  
Yirmeyahu Kaminski, Holon Institute of Technology, Israel

**5:00-5:25 Optimal Control Problems for a Class of Variational-hemivariational Inequalities with Applications to Elastic Unilateral Frictional Contact**  
Stanislaw Migorski, Jagiellonian University, Poland

**5:30-5:55 Bolza Optimal Control Problems with Linear Equations and Periodic Convex Integrands on Large Intervals**  
Alexander Zaslavski, Technion Israel Institute of Technology, Israel

Monday, July 10

## MS14

### Computational Challenges in Stochastic Control and Optimization of High Dimensional Systems - Part II of III

4:00 PM-6:00 PM

Room:408

**For Part 1 see MS4**  
**For Part 3 see MS24**

We are bringing together researchers from various areas of dynamical system theory, stochastic control, optimal control, uncertainty quantification and optimization to highlight the challenges and possible approaches to the major theoretical and computational bottlenecks in control and optimization of high dimensional dynamical systems. The papers in these sessions aim to address these general themes in dealing with high-dimensionality, stochasticity and nonlinearity of these problems in the context of both control and optimization.

Organizer: Fariba Fahroo  
Defense Advanced Research Projects Agency, USA

Organizer: Michael A. Demetriou  
Worcester Polytechnic Institute, USA

**4:00-4:25 Optimization under Uncertainty of Integrated Circuits**  
Dongbin Xiu, Ohio State University, USA

**4:30-4:55 A Locally Adaptive Approach for the Solution of PDEs with Uncertain Inputs**  
Zilong Zou, Duke University, USA

**5:00-5:25 Optimal Motion Planning with Parameter Dependency**  
Qi Gong, University of California, Santa Cruz, USA

**5:30-5:55 Challenges in Discretization of High Dimensional Optimization and Control Problems**  
Fariba Fahroo, Defense Advanced Research Projects Agency, USA

Monday, July 10

## MS15

### Stochastic Control and Applications - Part II of III

4:00 PM-6:00 PM

Room:409

For Part 1 see MS5  
For Part 3 see MS25

Along with the progress in networked systems and advent of computation technology, significant progress has been made in stochastic control, optimization, and related fields in recent years. In addition to enhancing existing applications in the traditional areas, new applications have been found in such areas as financial engineering, manufacturing and production planning, real options, communication networks, renewable energy, and biological and ecological systems. To review and to update the recent progress, we have invited experts of stochastic control with applications from multi-disciplinary fields. We put together this three-part minisymposium, which enables researchers get together with a concerted effort to communicate recent progress. The central theme is to show case recent success, to present new challenges, and to identify pressing need for future research topics. The titles of the talks to be presented in the minisymposia are given.

Organizer: George Yin  
Wayne State University, USA

Organizer: Jiongmin Yong  
University of Central Florida, USA

#### 4:00-4:25 Rate Control under Heavy Traffic with Strategic Servers

Erhan Bayraktar, University of Michigan, USA; Amarjit Budhiraja, University of North Carolina at Chapel Hill, USA; Asaf Cohen, University of Michigan, USA

#### 4:30-4:55 Pairs-trading under Geometric Brownian Motions

Qing Zhang and Jingzhi Tie, University of Georgia, USA; Hanqin Zhang, National University of Singapore, Singapore

#### 5:00-5:25 Periodic Strategies in Optimal Execution with Multiplicative Price Impact

Daniel Hernandez-Hernandez, Centro de Investigacion en Matematicas, Mexico

#### 5:30-5:55 Dynamic Convex Duality in Constrained Utility Maximization

Harry Zheng and yusong li, Imperial College London, United Kingdom

Monday, July 10

## MS16

### Stochastic Control and its Applications in Economics and Finance

4:00 PM-6:00 PM

Room:410

Stochastic Control and Filtering has many applications in Economics, Finance and Actuarial Science. In this minisymposium, both old and new diverse applications will be presented. The famous Merton's problem of optimal consumption-investment has an interesting extension with continuous wealth utility, which is previously handled by generalizing the duality approach. Alain Bensoussan and his collaborator will present a different, but more straightforward approach to solve the problem. Impulse control with random reaction periods (ICRRP) has been used to derive a country's optimal foreign exchange (ForEX) rate intervention policy when the forex market reacts to the interventions. Extending the model with regime switching, Hongwei Long will present the development of an optimal impulse control with minimum cost and will give numerical demonstration of the efficacy of the new framework. Jinxia Zhu will present a study on the impulse dividend optimization problem for a broad class of growth restricted diffusions with drift and volatility dependent on both the level of surplus and the economy regime. In a ultra-high frequency trading environment, Yong Zeng and his collaborators will present the explicit solution to the classical mean—variance portfolio selection problem in a partially-observed market with one bond and multiple stocks.

Organizer: Yong Zeng  
University of Missouri, Kansas City, USA

Organizer: Tak-Kuen Siu

*Macquarie University, Sydney, Australia*

**4:00-4:25 On Merton's Problem with Continuous Wealth Utility**

*Alain Bensoussan, The University of Texas at Dallas and City University of Hong Kong, Hong Kong*

**4:30-4:55 Market-reaction-adjusted Optimal Central Bank Intervention Policy in a Forex Market with Jumps**

*Hongwei Long, Florida Atlantic University, USA*

**5:00-5:25 Optimal Impulse Dividend Control for a Growth-restricted Regime Switching Diffusion**

*Jinxia Zhu, University of New South Wales, Australia*

**5:30-5:55 Mean-variance Portfolio Selection for Partially-observed Point Processes**

*Yong Zeng, University of Missouri, Kansas City, USA*

Monday, July 10

**MS17**

**Applications of Control in Medicine and Biology - Part II of II**

*4:00 PM-6:00 PM*

*Room:411*

**For Part 1 see MS7**

Applications of control in medicine and biology take many forms, and offer diverse opportunities for interdisciplinary collaboration between the life sciences and different domains of control theory. This minisymposium will provide a forum for exploring these opportunities. Speakers will address applications of control to a variety of rhythmic biological processes including circadian and respiratory rhythms (where strong rhythmicity is desirable) as well as in deep brain stimulation (where strong rhythmicity may be pathological). Other speakers will address control of non-rhythmic biological systems, including functional electronic stimulation (FES), immune system response, and optimal drug delivery. Additional talks will invoke other system theoretic topics including parameter estimation within a dynamical system model, and aspects of control involved in rewiring neuronal networks in the brain during development.

Organizer: Peter J. Thomas

*Case Western Reserve University, USA*

Organizer: Jonathan E. Rubin

*University of Pittsburgh, USA*

**4:00-4:25 Parameter Estimation for Ensemble ODE Models**

*David Swigon, University of Pittsburgh, USA; Shelby Stanhope, Temple University, USA; Jonathan E. Rubin, University of Pittsburgh, USA*

**4:30-4:55 Controlling Acute Inflammation: A Summary of Strategies**

*Judy Day, Ouassim Bara, and Seddik Djouadi, University of Tennessee, Knoxville, USA; Michel Fliess, Ecole Polytechnique, France; Cedric Join, Université de Lorraine, France; Gregory Zitelli, University of California, Irvine, USA*

**5:00-5:25 Optimal Control as a Tool for Designing Better Drug Delivery Schedules**

*Rachel Leander, Middle Tennessee State University, USA; Zack Jones, St. Jude Children's Research Hospital, USA*

**5:30-5:55 The Entrain Project: Optimal Control and Circadian Rhythms in the Wild**

*Olivia Walch, University of Michigan, USA*

Monday

Monday, July 10

## MS18

### Lithium-ion Battery Modeling and State-of-Charge Estimation

4:00 PM-6:00 PM

Room:412

Lithium-ion batteries are being widely as a power source for portable electronics and electric vehicles. The most accurate models are electrochemical models which are physics-based and consist of coupled PDE's and ODE's. Tracking the State-of-Charge (SoC) in these batteries is very important but challenging due to limited measurements. This minisymposium focuses on advances in the modeling and SoC estimation using electrochemical models. Efforts on different aspects of improved battery modeling and SoC estimation will be presented. SoC estimation is essentially an observer design problem for a coupled PDE-ODE system. To improve the SoC estimation, the presentation of Tang will be on adding thermal behavior to the electrochemical model, and Afshar will explain using an adaptive extended Kalman filter to include varying diffusivity. SoC estimation can also be made more accurate by considering multiple (rather than one) active materials in the electrodes of lithium-ion batteries, resulting into a more complex coupled PDE-PDE model. This will be discussed by Camacho. Furthermore, Shi will present a life model for the lithium-ion battery packs, which is generic, robust, stable and computationally inexpensive for real-time implementation. All these advancements could be considered as intermediate results on a difficult problem, and it is anticipated that future collaborations among the speakers could combine some of these advancements and improve further battery performance.

Organizer: Shuxia Tang

University of Waterloo, Canada

Organizer: Kirsten Morris

University of Waterloo, Canada

#### 4:00-4:25 State-of-Charge Estimation of Lithium-ion Batteries Modeled by a Coupled PDE-ODE System

Shuxia Tang, University of Waterloo, Canada; Leobardo Camacho-Solorio, University of California, San Diego, USA; Yebin Wang, Mitsubishi Electric Research Laboratories, USA; Miroslav Krstic, University of California, San Diego, USA

#### 4:30-4:55 State of Charge Estimation using an Adaptive Extended Kalman Filter

Sepideh Afshar, Kirsten Morris, and Amir Khajepour, University of Waterloo, Canada

#### 5:00-5:25 Boundary Observers for Coupled Reaction-diffusion Systems with Applications to Lithium-ion Batteries

Leobardo Camacho-Solorio, Rafael Vazquez, and Miroslav Krstic, University of California, San Diego, USA

#### 5:30-5:55 Life Modeling and Prediction of Large Lithium-ion Battery Packs

Ying Shi and Kandler Smith, National Renewable Energy Laboratory, USA

Monday, July 10

## MS19

### Computational Techniques in Optimal Control

4:00 PM-6:00 PM

Room:413

The session focuses on computational issues that arise when numerically solving optimal control problems. Talks will focus on the analysis of discretization errors, computational strategies arising in nonlinear constrained model predictive control, and a general computational platform based on orthogonal collocation techniques.

Organizer: William Hager

University of Florida, USA

#### 4:00-4:25 High Order Discrete Approximations to Optimal Control Problems with Bang-bang Solutions

Teresa Scarinci and Vladimir Veliov, Vienna University of Technology, Austria

#### 4:30-4:55 Error Estimates for the Euler Discretization of An Optimal Control Problem with First-order State Constraints

Adriano Festa, INSA de Rouen, France; Frédéric Bonnans, Inria Saclay and CMAP Ecole Polytechnique, France

#### 5:00-5:25 Newton-Kantorovich Methods for Nonlinear Constrained Model Predictive Control

Asen Dontchev, American Mathematical Society, USA

#### 5:30-5:55 Convergence Rate for a Gauss Collocation Method Applied to Constrained Optimal Control

William Hager, Subhashree Mohapatra, and Anil Rao, University of Florida, USA

continued in next column

Monday, July 10

**MS20****Risk-averse Control of Markov Systems**

4:00 PM-6:00 PM

Room: 414

We shall present properties of Markov risk measures and their use in optimal control problems for Markov dynamical systems. We shall discuss the structure of risk measures for discrete-time Markov chains, partially-observable Markov chains, continuous-time Markov chains, diffusion processes, and partially observable chains with diffusion observations. For all these models we shall present optimality conditions, discuss numerical solution methods, and applications.

Organizer: Andrzej Ruszczynski  
Rutgers University, USA

**4:00-4:25 Risk-averse Control of Discrete-time Processes**

Andrzej Ruszczynski, Rutgers University, USA

**4:30-4:55 \*Risk-averse Control of Continuous-time Markov Chains**

Darinka Dentcheva, Stevens Institute of Technology, USA

**5:00-5:25 Numerical Methods of Risk-averse Control of Diffusion Processes**

Jianing Yao, Royal Bank of Canada, New York, USA

**5:30-5:55 Risk Models for Partially Observable Continuous-time Markov Systems**

Ruofan Yan, Rutgers University, USA

\* This presentation is included in the proceedings.

**Intermission**

6:00 PM-6:15 PM

**CT17 Forward Looking Panel**

6:15 PM-7:15 PM

Room: Spirit of Pittsburgh B - 3rd Floor

**Career Fair, Graduate Student and Industry Reception**

7:15 PM-9:15 PM

Room: 302-304

**Tuesday, July 11****Registration**

7:30 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

**Remarks**

8:20 AM-8:30 AM

Room: Spirit of Pittsburgh B - 3rd Floor

**IT3****Mathematical Challenges in Control of Large-Scale Complex Systems**

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh B - 3rd Floor

Chair: Michael P. Polis, Oakland University, USA

Large-scale, complex, and interconnected systems are now everywhere in modern life. Examples include integrated transportation and building systems, electrical power grids with distributed energy resources and highly integrated aerospace systems. Despite numerous advances in control methods over the last several decades, many practical challenges still exist for controlling such systems. Fully decentralized control is common practice in industry but often results in poor performance from neglected interaction between subsystems. Systematic methods to functionally decompose complex, interconnected systems to inform control architecture choices are needed. This talk will present some motivating examples of large-scale, complex systems and provide some interesting results on approaches to decomposition and control.

Andrew Sparks

United Technologies Research Center, USA

Tuesday, July 11

**Intermission**

9:15 AM-9:20 AM

**IT4****2015 Sicon Paper Prize Lecture #1: Joint Spectral Radius and Path-Complete Graph Lyapunov Functions**

9:20 AM-9:40 AM

Room: 408

Chair: Ruihua Liu, University of Dayton, USA

Abstract not available at time of publication. This is joint work with Raphaël M. Jungers, Pablo A. Parrilo and Mardavij Roozbehani.

Amir Ali Ahmadi  
Princeton University, USA

**IT5****2017 SICON Paper Prize Lecture #1: The Principle of Least Action and Fundamental Solutions of Mass-Spring and N-Body Two-Point Boundary Value Problems**

9:20 AM-9:40 AM

Room: 409

Chair: Francois Dufour, Université Bordeaux I, France

Abstract not available at time of publication. This is joint work with Peter Dower.

William M. McEneaney  
University of California, San Diego, USA

**Intermission**

9:40 AM-9:45 AM

Tuesday, July 11

**IT6****2015 Sicon Paper Prize  
Lecture #2: Achieving  
Pareto Optimality Through  
Distributed Learning**

9:45 AM-10:05 AM

Room: 408

Chair: Qi Gong, University of California,  
Santa Cruz, USAAbstract not available at time of  
publication. This is joint work with H.  
Peyton Young and Lucy Y. Pao.

Jason Marden

University of California, Santa Barbara, USA

**IT7****2017 SICON Paper Prize  
Lecture #2: Regularity of the  
Hamiltonian Along Optimal  
Trajectories**

9:45 AM-10:05 AM

Room: 409

Chair: Sarah King, Naval Research  
Laboratory, USAAbstract not available at time of  
publication. This is joint work with  
Richard Vinter.

Michele Palladino

Pennsylvania State University, USA

**Coffee Break**

10:00 AM-10:30 AM

Room: Ballroom Gallery - 3rd Floor



Tuesday, July 11

**MS21****Recent Results in Optimal  
Control of Partial Differential  
Equations and Applications  
- Part II of II**

10:30 AM-12:30 PM

Room: 403

**For Part 1 see MS11**

This minisymposium shows the diversity of recent developments in theory and applications of PDE control. A first part of talks addresses latest trends in the numerical analysis of PDE optimal control problems such as the stabilization by sparse controls, problems with control functions concentrated on manifolds, identification problems, and the error analysis for the optimal control of Allen-Cahn equations or Dirichlet boundary value problems. Other talks report on different aspects of applications, namely in transplantation medicine, mathematical economics, and semiconductor crystal growth.

Organizer: Eduardo Casas  
Universidad de Cantabria, SpainOrganizer: Fredi Tröltzsch  
Technische Universität, Berlin, Germany**10:30-10:55 Constrained  
Optimization for Identification of PDE  
Systems**John A. Burns, Eugene Cliff, and Terry L.  
Herdman, Virginia Tech, USA**11:00-11:25 Finite Element  
Discretizations of an Optimal Control  
Problem Related to the Allen-Cahn  
Equation**Konstantinos Chrysafinos, National  
Technical University of Athens, Greece**11:30-11:55 Optimal Control of  
PDEs with Controls from a Lower  
Dimensional Manifold and its  
Approximations**Wei Gong, Chinese Academy of Sciences,  
China**12:00-12:25 Stabilization by Sparse  
Controls for a Class of Semilinear  
Parabolic Equations**Eduardo Casas, Universidad de Cantabria,  
Spain; Karl Kunisch, Universität Graz,  
Austria

Tuesday, July 11

**MS22****Qualitative and Asymptotic  
Properties of Solutions to  
Hamilton-Jacobi Equations**

10:30 AM-12:30 PM

Room: 404

The minisymposium will cover recent problems for Hamilton-Jacobi equations, motivated by applications in network system, multi-agent systems, and numerical analysis. The main focus will be on quantitative analysis of compactness and propagation of singularities for viscosity solution to single finite dimensional Hamilton-Jacobi equations. Besides, global results for one-parameter family of Eikonal Hamilton-Jacobi equations on an embedded network will be discussed. Here the solution will be identified, via an Hopf-Lax type formula, once an admissible trace is assigned on an intrinsic boundary. The minisymposium also includes a presentation on an infinite dimensional Hamilton-Jacobi equation arisen from an optimal control problem in the space of probability measures endowed with the Wasserstein distance, where the dynamics is given by a controlled continuity equation. The main motivation is to face situations in finite-dimensional control systems evolving deterministically where the initial position of the controlled particle is not exactly known, but can be expressed by a probability measure on  $\mathbb{R}^d$ , or to describe at a macroscopical level the behaviour of multi-agent systems.

Organizer: Tien Khai E. Nguyen  
North Carolina State University, USAOrganizer: Piermarco Cannarsa  
University of Rome II, Tor Vergata, Italy

continued on next page

**10:30-10:55 Compactness Estimate for Hamilton-Jacobi Equations**

*Tien Khai E. Nguyen*, North Carolina State University, USA

**11:00-11:25 On the Qualitative Properties of the Singularities of Solutions to Hamilton-Jacobi Equations**

*Wei Cheng*, Nanjing University, China

**11:30-11:55 Global Results for Eikonal Hamilton-Jacobi Equations on Networks**

*Alfonso Sorrentino*, University of Rome II, Tor Vergata, Italy

**12:00-12:25 Control Problems in the Wasserstein Space and Applications to Multi-agent Systems**

*Antonio Marigonda*, University of Verona, Italy; *Giulia Cavagnari*, Rutgers University, Camden, USA

Tuesday, July 11

**MS23****Nonlinear Optimization in Control Theory - Part III of III**

10:30 AM-12:30 PM

Room:405

**For Part 2 see MS13**

The minisymposium contains three parts. Each of these parts includes four talks which will be given by well-known experts in the area. In the first part the speakers discuss infinite dimensional control problems and control problems with PDE. N. U. Ahmed presents results on reaction diffusion equations and their optimal control. J. Blot studies Pontryagin principles for infinite-horizon problems. M. Falcone applies the HJB-POD approach for infinite dimensional control problems. In the last talk G. Marinoschi discusses feedback stabilization of the Cahn-Hilliard system. The second part is devoted to well-posedness and stability in optimal control. R. Goebel discusses optimal control for pointwise asymptotic stability of a continuum of equilibria. Exact test for real-positiveness of fractional systems is presented by J. Kaminski. S. Migorski studies optimal control problems for a class of variational-hemivariational inequalities. In the last talk A. Zaslavski considers the stability of turnpike properties of Bolza optimal control problems. In the third part, real world applications are considered. M. Bounkhel applied nonconvex sweeping processes to real life problems. E. Grigorieva presents results on singular optimal treatment strategies for control model of psoriasis. F. L. Pereira discusses a control scheme for the sustainable management of renewable resources. In the last talk C. Silva applies optimal control to delayed HIV models.

Organizer: Boris Mordukhovich  
*Wayne State University, USA*

Organizer: Nobusumi Sagara  
*Hosei University, Japan*

Organizer: Ilya Shvartsman  
*Pennsylvania State University, USA*

Organizer: Geraldo N. Silva  
*Universidade Estadual Paulista, Brazil*

Organizer: Alexander J. Zaslavski  
*Technion Israel Institute of Technology, Israel*

**10:30-10:55 Applications of Nonconvex Sweeping Processes to Real Life Problems**  
*Messaoud Bounkhel*, King Saud University, Saudia Arabia

**11:00-11:25 \*Optimal Treatment Strategies for Control Model of Psoriasis**  
*Ellina V. Grigorieva*, Texas Woman's University, USA; *Evgenii Khailov*, Moscow State University, Russia

**11:30-11:55 A Bilevel Coordination Control Scheme for the Sustainable Management of Renewable Resources**  
*Fernando L. Pereira*, Porto University, Portugal

**12:00-12:25 Optimal Control Applied to Delayed HIV Models**  
*Cristiana J. Silva*, University of Aveiro, Portugal

\* This presentation is included in the proceedings.

Tuesday, July 11

## MS24

### Computational Challenges in Stochastic Control and Optimization of High Dimensional Systems - Part III of III

10:30 AM-12:30 PM

Room:408

#### For Part 2 see MS14

We are bringing together researchers from various areas of dynamical system theory, stochastic control, optimal control, uncertainty quantification and optimization to highlight the challenges and possible approaches to the major theoretical and computational bottlenecks in control and optimization of high dimensional dynamical systems. The papers in these sessions aim to address these general themes in dealing with high-dimensionality, stochasticity and nonlinearity of these problems in the context of both control and optimization.

Organizer: Fariba Fahroo

*Defense Advanced Research Projects Agency, USA*

Organizer: Michael A. Demetriou

*Worcester Polytechnic Institute, USA*

#### 10:30-10:55 Exploiting Low-dimensional Active Subspaces in Design under Uncertainty

*Paul Constantine, Sandia National*

*Laboratories, USA; Jeffrey M. Hokanson, Colorado School of Mines, USA; Rick Fenrich, Victorien Menier, and Juan J. Alonso, Stanford University, USA*

#### 11:00-11:25 Taylor Approximation for PDE-constrained Optimal Control Problems under High-dimensional Uncertainty: Application to a Turbulence Model

*Umberto Villa, University of Texas at Austin, USA*

#### 11:30-11:55 The Million Point Computational Optimal Control Challenge

*Isaac Ross, Mark Karpenko, and Ronald Proulx, Naval Postgraduate School, USA*

#### 12:00-12:25 A Chaotic Dynamical System that Paints and Samples

*Amit Surana, United Technologies Research Center, USA*

Tuesday, July 11

## MS25

### Stochastic Control and Applications - Part III of III

10:30 AM-12:30 PM

Room:409

#### For Part 2 see MS15

Along with the progress in networked systems and advent of computation technology, significant progress has been made in stochastic control, optimization, and related fields in recent years. In addition to enhancing existing applications in the traditional areas, new applications have been found in such areas as financial engineering, manufacturing and production planning, real options, communication networks, renewable energy, and biological and ecological systems. To review and to update the recent progress, we have invited experts of stochastic control with applications from multi-disciplinary fields. We put together this three-part minisymposium, which enables researchers get together with a concerted effort to communicate recent progress. The central theme is to show case recent success, to present new challenges, and to identify pressing need for future research topics. The titles of the talks to be presented in the minisymposia are given.

Organizer: George Yin

*Wayne State University, USA*

Organizer: Jiongmin Yong

*University of Central Florida, USA*

#### 10:30-10:55 Optimal Stopping, Smooth Pasting and the Dual Problem

*Saul Jacka and Dominic Norgilas, University of Warwick, United Kingdom*

#### 11:00-11:25 Portfolio Optimization Problems for Models with Delays

*Tao Pang, North Carolina State University, USA*

#### 11:30-11:55 Weak Formulation of Mean-field Control and Zerosum Game Problems

*Said Hamadene, University of Le Mans, France*

#### 12:00-12:25 Open-loop and Closed-loop Optimal Controls for Linear-quadratic Problems with Mean-field

*Jiongmin Yong, University of Central Florida, USA*

*continued in next column*

Tuesday, July 11

**MS26****New Developments in Stochastic Analysis, Control, Games, and their Applications - Part I of III**

10:30 AM-12:30 PM

Room:410

**For Part 2 see MS36**

This series of minisymposia features new developments in stochastic control, game and their applications. In the first session, the speakers will be presenting new perspectives and methodologies toward stochastic control problems. The specific topics to be discussed include exact controllability of linear stochastic differential equations and related problems, finite element methods for linear programming formulation for stochastic control problems, stochastic control with running max cost structures, and a weak convergence approach to inventory control using a long-term average criterion. The second session is devoted to new developments in stochastic analysis and their applications in dynamic pricing models. The speakers will be presenting asymptotic properties of certain novel switching diffusion processes in which the switching process has a countable state space, the limit of weakly interacting stochastic processes with Markov switching, and dynamic pricing models and their diffusion approximation of the optimal inventory process. The third session focuses on new developments in math finance and stochastic differential games. The speakers will be discussing the fundamental questions concerning pricing American options, optimal asset allocation with stochastic interest rate in regime switching models and optimal consumption and investment on a finite horizon, and infinite horizon non-zero-sum stochastic differential games with additive structure.

Organizer: Richard Stockbridge  
University of Wisconsin, Milwaukee, USA

Organizer: Chao Zhu  
University of Wisconsin, Milwaukee, USA

**10:30-10:55 Exact Controllability of Linear Stochastic Differential Equations and Related Problems**

Jiongmin Yong, University of Central Florida, USA

**11:00-11:25 Finite Element Methods for Linear Programming Formulations in Stochastic Control**

Martin Vieten, University of Wisconsin, Milwaukee, USA

**11:30-11:55 Stochastic Control with Running Max Costs**

Ananda Weerasinghe, Iowa State University, USA

**12:00-12:25 A Weak Convergence Approach to Inventory Control using a Long-term Average Criterion**

Richard Stockbridge, University of Wisconsin, Milwaukee, USA; Kurt Helmes, Humboldt University Berlin, Germany; Chao Zhu, University of Wisconsin, Milwaukee, USA

Tuesday, July 11

**MS27****Control of Neural Systems**

10:30 AM-12:30 PM

Room:411

In recent years, there has been growing interest in controlling neural systems. Talks in this session will consider such control with objectives including desynchronizing neural activity as motivated by deep brain stimulation treatment of Parkinson's disease, controlling spike patterns, and entraining noisy neurons to external stimuli. The control algorithms will address challenges arising from heterogeneity, noise, underactuation, and lack of knowledge of the full state of the system.

Organizer: Jeff Moehlis  
University of California, Santa Barbara, USA

Organizer: Theoden I. Netoff  
University of Minnesota, USA

**10:30-10:55 Coordinated Reset Neuromodulation - From Numerical Simulation to Medical Products**

Christian Hauptmann, DESYNCR A Operating GmbH, Bad Neuenahr, Germany; Mark Williams, DESYNCR A Technologies Ltd, United Kingdom and The Tinnitus Clinic Ltd, London, United Kingdom; Markus Haller, DESYNCR A Operating GmbH, Bad Neuenahr, Germany

**11:00-11:25 Optimal Entrainment of Neurons in Uncertain and Noisy Environments**

Dan D. Wilson, University of Pittsburgh, USA; Jeff Moehlis, University of California, Santa Barbara, USA

**11:30-11:55 Optimizing Stimulation to Suppress Pathological Neural Oscillations**

Abbey Becker and Andrew Sharott, University of Oxford, United Kingdom

**12:00-12:25 Defining Suitable Control Objectives for Sensory Prostheses**

Jason Ritt, Boston University, USA; ShiNung Ching, Washington University in St. Louis, USA

Tuesday

Tuesday, July 11

## MS28

### Exploiting Koopman Operator Theory for Control and Estimation

10:30 AM-12:30 PM

Room:412

In recent years, Koopman operator theory and conceptually related data-driven methods such as Dynamic Mode Decomposition have become popular topics in the nonlinear dynamics and fluid mechanics communities. One advantage of these methods is that they can represent nonlinear systems using a linear but globally valid set of modes. While these approaches have been successfully applied in many disciplines ranging from fluid dynamics to neuroscience, most approaches completely neglect system actuation. Indeed, integrating system inputs into the Koopman operator framework is still an area of active research. This minisymposium will highlight theoretical advancements in operator-based methods for systems with actuation, system identification methods that exploit the resulting representations, and applications that use this combination to better understand/control/estimate the state of nonlinear dynamical systems.

Organizer: Milos Ilak

*United Technologies Research Center, USA*

Organizer: Matthew Williams

*United Technologies Research Center, USA*

### 10:30-10:55 Koopman-based Control-oriented Bilinear System Identification

*Milos Ilak, Matthew Williams, and Amit Surana, United Technologies Research Center, USA*

### 11:00-11:25 Linear Predictors for Nonlinear Dynamical Systems: Koopman Operator Meets Model Predictive Control

*Milan Korda and Igor Mezic, University of California, Santa Barbara, USA*

### 11:30-11:55 An Analytical Formulation for Improved Dynamic Mode Decomposition Applied to Wind Farm Control

*Ryan King and Jennifer Annoni, National Renewable Energy Laboratory, USA*

### 12:00-12:25 Adapting Koopman Operator Theory to Handle Modern Infectious Disease Data

*Joshua L. Proctor, Institute for Disease Modeling, USA*

Tuesday, July 11

## MS29

### Direct Nonlinear Programming Strategies for Dynamic Optimization - Part I of III

10:30 AM-12:30 PM

Room:413

#### For Part 2 see MS39

Direct NLP strategies for solving differential-algebraic optimization problems have been applied in a wide variety of engineering and scientific applications. Using multiple shooting or collocation methods to describe the DAEs, these approaches lead to a fully algebraic (and frequently large) optimization problem. Due to the recent development of efficient, large-scale nonlinear programming (NLP) solvers, novel DAE-based problem formulations and software frameworks that integrate optimization models and algorithms, these methods have advanced significantly over the past decade and have led to the efficient optimization of difficult and challenging systems, for both off-line and on-line applications. This three-part minisymposium highlights these new advances and demonstrates them on real-world optimization problems. The first session considers novel decomposition schemes for fast solution of dynamic optimization problems, along with frameworks for optimization modeling and solution strategies. The second describes enabling strategies for the solution of novel, engineering applications. These include generalized sensitivity for nonlinear model predictive control (NMPC), operation of renewable energy networks for wind and solar power, and singular optimal control in chemical processes. The third session develops specialized on-line NMPC strategies as well as applications for on-line optimization of carbon capture in power plants, and wine fermentation.

Organizer: Bethany Nicholson

*Sandia National Laboratories, USA*

Organizer: Lorenz T. Biegler  
Carnegie Mellon University, USA

Organizer: Christina Schenk  
Universität Trier, Germany

**10:30-10:55 PlasmO: A Platform for Scalable Modeling and Optimization**

Yankai Cao and Jordan Jalving, University of Wisconsin, Madison, USA; Kibaek Kim, Argonne National Laboratory, USA; Victor Zavala, University of Wisconsin, Madison, USA

**11:00-11:25 Parallel Cyclic Reduction Decomposition for Dynamic Optimization Problems**

Wei Wan, Carnegie Mellon University, USA; Bethany Nicholson, Sandia National Laboratories, USA; Lorenz Biegler, Carnegie Mellon University, USA

**11:30-11:55 Fast Feedback Multi-stage NMPC Using Structure-Exploiting Numerical Methods**

Conrad Leidreiter, Andreas Potschka, and Hans Georg Bock, Universität Heidelberg, Germany

**12:00-12:25 PYOMO.DAE: A Python-based Framework for Dynamic Optimization**

Bethany Nicholson and John D. Sirola, Sandia National Laboratories, USA

**Prizes and Awards Luncheon**  
(Offsite at the connected Westin Hotel)

12:30 PM-2:30 PM



Room: Westin Hotel - Allegheny Ballroom - 3rd Floor

Ticket required

Tuesday, July 11

## SP2

**The John von Neumann Lecture: Singular Perturbations in Noisy Dynamical Systems**

2:30 PM-3:30 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Nicholas J. Higham, University of Manchester, United Kingdom

Consider a deterministic dynamical system in a domain containing a stable equilibrium, e.g., a particle in a potential well. The particle, independent of initial conditions eventually reaches the bottom of the well. If however, a particle is subjected to white noise, due, e.g., to collisions with a population of smaller, lighter particles comprising the medium through which the Brownian particle travels, a dramatic difference in the behavior of the Brownian particle occurs. The particle can exit the well. The natural questions then are: how long will it take for it to exit and from where on the boundary of the domain of attraction of the equilibrium will it exit. We compute the mean first passage time to the boundary and the probability distribution of boundary points being exit points. When the noise is small each quantity satisfies a singularly perturbed deterministic boundary value problem.

Bernard Matkowsky  
Northwestern University, USA

## Coffee Break

3:30 PM-4:00 PM



Room: Ballroom Gallery - 3rd Floor

Tuesday, July 11

## MS30

**Optimality Conditions in Optimal Control - Part I of III**

4:00 PM-6:00 PM

Room: 405

**For Part 2 see MS33**

The minisymposium contains three parts. Each of these parts includes four talks which will be given by well-known experts in the area. In the first part the speakers discuss Maximum Principles and dynamic programming approach. A. Dmitruk presents results on Maximum Principle for optimal control problems with integral equations. I. Shvartsman studies optimality conditions for an infinite horizon optimal control problem. G. N. Silva applies dynamic programming approach for minmax optimal control problems. In the last talk M. Sumin considers regularization of Pontryagin Maximum Principle in optimal control with pointwise state constraints. The second part is devoted to problems with discontinuity and averaging method. V. Gaitsgory studies averaging of control systems with slow observables. E. Kostina analyzes optimal control problems with discontinuous right hand side. One-dimensional integral functionals with discontinuous non-convex integrands are discussed by C. Mariconda. B. S. Mordukhovich presents optimality conditions for a controlled sweeping process. Infinite horizon and singularly perturbed problems are considered in the third part. Z. Artstein studies controls in the singular perturbations limit. Divergence theorem and occupational measures are discussed by I. Bright. Y. Hosoya presents result on the Euler equation and the transversality condition of macroeconomic dynamics. N. Sagara analyzes recursive variational problems in nonreflexive Banach spaces.

Organizer: Boris Mordukhovich  
Wayne State University, USA

Tuesday, July 11

## MS30

### Optimality Conditions in Optimal Control - Part I of III

4:00 PM-6:00 PM

continued

Organizer: Nobusumi Sagara  
*Hosei University, Japan*

Organizer: Ilya Shvartsman  
*Pennsylvania State University, USA*

Organizer: Geraldo N. Silva  
*Universidade Estadual Paulista, Brazil*

Organizer: Alexander Zaslavski  
*Technion Israel Institute of Technology, Israel*

#### 4:00-4:25 Maximum Principle for Optimal Control Problems with Integral Equations Subject to State and Mixed Constraints

*Andrei V. Dmitruk, Russian Academy of Sciences, Russia*

#### 4:30-4:55 Optimality Conditions in an Infinite Horizon Optimal Control Problem in Discrete Time

*Ilya Shvartsman, Pennsylvania State University, USA*

#### 5:00-5:25 Dynamic Programming Approach for Minmax Optimal Control Problems

*Geraldo N. Silva, Universidade Estadual Paulista, Brazil*

#### 5:30-5:55 Regularization of Pontryagin Maximum Principle in Optimal Control with Pointwise State Constraints

*Mikhail Sumin, University of Nizhny Novgorod, Russia*

Tuesday, July 11

## CP1

### Systems Control and Applications

4:00 PM-6:00 PM

*Room:403*

*Chair: Getachew K. Befekadu, University of Florida, USA*

*Chair: Hidehiro Kaise, Osaka University, Japan*

#### 4:00-4:15 On the Hierarchical Risk-averse Control Problems for Diffusion Processes

*Getachew K. Befekadu, University of Florida, USA; Eduardo Pasiliao, Air Force Research Laboratory, USA*

#### 4:20-4:35 Intrinsic and Apparent Singularities in Differentially Flat Systems, and Application to Global Motion Planning

*Yirmeyahu Kaminski, Holon Institute of Technology, Israel; Jean Levine, Mines ParisTech, France; François Ollivier, Ecole Polytechnique, France*

#### 5:00-5:15 Optimality Conditions for Switching Operator Differential Equations

*Fabian Rueffler and Falk M. Hante, Universität Erlangen-Nürnberg, Germany*

#### 5:20-5:35 Minimization of the Boundary Energy Functional with Inequality Constraints for the Wave Equation

*Ilya Smirnov, Lomonosov Moscow State University, Russia*

#### 5:40-5:55 Convergence of Discrete-time Games to Path-dependent Isaacs Partial Differential Equations with Quadratically Growing Hamiltonians

*Hidehiro Kaise, Osaka University, Japan*

Tuesday, July 11

## CP2

### Computational Methods and Applications

4:00 PM-5:40 PM

*Room:404*

*Chair: Andrew Knyazev, Mitsubishi Electric Research Laboratories, USA*

*Chair: Taewoo Kim, Brown University, USA*

#### 4:00-4:15 An Iterative Method for Optimal Control of Parameterized Bilinear Systems

*Jr-Shin Li and Shuo Wang, Washington University in St. Louis, USA*

#### 4:20-4:35 Efficient Time Domain Decomposition Algorithms for Time-dependent PDE-constrained Optimization Problems

*Jun Liu, Jackson State University, USA; Zhu Wang, University of South Carolina, USA*

#### 4:40-4:55 \*Preconditioned Warm-started Newton-Krylov Methods for MPC with Discontinuous Control

*Andrew Knyazev, Mitsubishi Electric Research Laboratories, USA; Alexander Malyshev, University of Bergen, Norway*

#### 5:00-5:15 Hamilton-Jacobi Equations in High Dimensions and Its Application to a Class of Optimal Control Problems

*Taewoo Kim, Brown University, USA*

#### 5:20-5:35 Minimal Realization of MIMO Linear Systems using Hermite Form

*Karim Cherifi, Institute of Electrical and Electronic Engineering, Algeria; Kamel Hariche, University of Boumerdes, Algeria*

\* This presentation is included in the proceedings.

Tuesday, July 11

**CP3****System Stability and Applications**

4:00 PM-5:40 PM

Room:408

*Chair: Boumediene Hamzi, AlFaisal University, Saudi Arabia**Chair: Derek Smith, École Polytechnique Fédérale de Lausanne, Switzerland***4:00-4:15 Control and Stabilization of the Periodic Fifth Order Korteweg-De Vries Equation***Derek Smith, École Polytechnique Fédérale de Lausanne, Switzerland; Cynthia Flores, California State University, Channel Islands, USA***4:20-4:35 Approximation of Lyapunov Functions from Noisy Data***Peter Giesl, University of Sussex, United Kingdom; Boumediene Hamzi, AlFaisal University, Saudi Arabia; Martin Rasmussen and Kevin Webster, Imperial College London, United Kingdom***4:40-4:55 On the Stability and the Optimal Decay in a Viscoelastic Problem***Salim Messaoudi and Waled Al-Khulaifi, King Fahd University of Petroleum and Minerals, Saudi Arabia***5:00-5:15 Control of Support Structure Motions of Guyed Offshore Wind Turbines under Environmental Disturbances***Manikandan Rajasekaran, Indian Institute of Technology, India***5:20-5:35 Real-time Control for the Stabilization of a Double Inverted Pendulum***Amanda Bernstein and Hien Tran, North Carolina State University, USA*

Tuesday, July 11

**CP4****Applications in Finance**

4:00 PM-6:00 PM

Room:410

*Chair: Zhuo Jin, University of Melbourne, Australia**Chair: Emel Savku, Middle East Technical University, Turkey***4:00-4:15 Liability and Dividend Management for Insurance Companies***Zhuo Jin, University of Melbourne, Australia***4:20-4:35 An Optimal Consumption Problem For a Stochastic Hybrid Model With Delay***Emel Savku and Gerhard Wilhelm Weber, Middle East Technical University, Turkey***4:40-4:55 \*A Constrained Stochastic Control Problem with Application to an Illiquid Stock Position Build-up***Xianggang Lu, Sun Yat-Sen University, China; George Yin, Wayne State University, USA; Qing Zhang, University of Georgia, USA; Caojin Zhang, Wayne State University, USA; Xianping Guo, Sun Yat-Sen University, China***5:00-5:15 A Market Driver Volatility Model via Policy Improvement Algorithm***Jun Maeda and Saul Jacka, University of Warwick, United Kingdom***5:20-5:35 A Markov-driven Portfolio Execution Strategy Across Multiple Venues with Market Impact***Qingqing Yang, University of Hong Kong, Hong Kong***5:40-5:55 Optimal Management with Hybrid Dynamics: A Case Study in Ecological Management***Puduru V. Reddy, Indian Institute of Technology Madras, India*

\* This presentation is included in the proceedings.

Tuesday, July 11

**CP5****Applications in Biology and Medicine**

4:00 PM-5:20 PM

Room:411

*Chair: Jeff Moehlis, University of California, Santa Barbara, USA**Chair: Gbenga J. Abiodun, University of the Western Cape, South Africa***4:00-4:15 Clustered Desynchronization of Neural Oscillators***Jeff Moehlis and Timothy Matchen, University of California, Santa Barbara, USA***4:20-4:35 Modeling the Impact of Climatic Variables on Malaria Transmission***Gbenga J. Abiodun, University of the Western Cape, South Africa***4:40-4:55 \*Simultaneous Null Controllability of Nonlinear Parabolic Equations***Carole Louis-Rose, Université des Antilles, France***5:00-5:15 Mathematical Modeling and Quantitative Analysis of Obesity-related Dynamic Scheme for African Americans***Xiuquan Wang, Tougaloo College, USA*

\* This presentation is included in the proceedings.

Tuesday, July 11

## CP6

### Controlled Networks and System Controllability

4:00 PM-6:00 PM

Room:412

Chair: *Saber Jafarpour, University of California, Santa Barbara, USA*

Chair: *Wei Zhang, Washington University in St. Louis, USA*

#### 4:00-4:15 Heuristic Approach to the Efficient Control of Complex Networks

*Babak Ravandi, Forough Sheikh Ansari, and Fatma Mili, Purdue University, USA*

#### 4:20-4:35 \*Error Bounds on the Solution to an Optimal Control Problem over Clustered Consensus Networks

*Sei Howe, Imperial College London, United Kingdom*

#### 4:40-4:55 Prediction of Traffic Jams over Road Networks

*Surya Prakash Malladi, Subhadeep Kumar, Ramkrishna Pasumarthy, and Nirav Bhatt, Indian Institute of Technology Madras, India*

#### 5:00-5:15 Synchronization Conditions for Nonhomogenous Kuramoto Oscillators using Power Series Methods

*Saber Jafarpour and Francesco Bullo, University of California, Santa Barbara, USA*

#### 5:20-5:35 Green's Function Approach for Approximate Controllability of Linear Systems

*Asatur Khurshudyan and Ara Avetisyan, National Academy of Sciences of Armenia, Armenia*

#### 5:40-5:55 Analyzing Controllability of Bilinear Systems via Symmetric Groups

*Jr-Shin Li and Wei Zhang, Washington University in St. Louis, USA*

\* This presentation is included in the proceedings.

Tuesday, July 11

## CP7

### Applications in Robotic Control, Chemical Engineering and Data Mining

4:00 PM-6:00 PM

Room:413

Chair: *Yajun Wang, Carnegie Mellon University, USA*

Chair: *Sarah T. Lamb, University of Hartford, USA*

#### 4:00-4:15 Real-time Control Analysis of a 3D Self-balancing Inverted Pendulum and Cart System for Stability in the Event of a Sensor Failure

*Sarah T. Lamb, Patricia Mellodge, Kiwon Sohn, and Akin Tatoglu, University of Hartford, USA*

#### 4:20-4:35 Optimal Motion Planning to Control Ensemble Properties of Robot Swarms

*Matteo Mischiati, HHMI Janelia Research Campus, USA*

#### 4:40-4:55 Investigating Periodic Attractors of Wind Turbine's Dynamics with Pitch Activated under Control Limits

*Sameh Eisa, New Mexico Institute of Mining and Technology, USA*

#### 5:00-5:15 An Assorted Approach for the Monitoring of Simple Linear Profiles

*Usman Saeed and Muhammad Riaz, King Fahd University of Petroleum and Minerals, Saudi Arabia*

#### 5:20-5:35 Parameter Estimation and Model Discrimination of Batch Solid-liquid Reactors

*Yajun Wang, Carnegie Mellon University, USA; Mukund Patel, Yisu Nie, and John Wassick, The Dow Chemical Company, USA; Lorenz T. Biegler, Carnegie Mellon University, USA*

#### 5:40-5:55 Information-theoretic Data Association over Nonuniform Partitions

*Paul Deignan, University of Texas, Dallas, USA*

Tuesday, July 11

## CP8

### Estimation, Identification, and Input-output Mapping

4:00 PM-5:40 PM

Room:409

Chair: *Agostino Martinelli, Inria, France*

Chair: *Xiaoyang Pan, University of Tennessee, Knoxville, USA*

#### 4:00-4:15 \*Further Remarks on Input-output Linearization of Siso Time-varying Delay Systems

*Ihab Haidar, Supélec-CNRS-Université Paris-Sud, France; Florentina Nicolau, INSA Rouen, France; Woihida Aggoune and Jean-Pierre Barbot, ENSEA, France*

#### 4:20-4:35 \*Fractional Nonlinear Output Error System Identification

*Karima Hammar and Tounsia Djamah, Université Mouloud Mammeri de Tizi Ouzou, Algeria; Maamar Bettayeb, American University of Sharjah, United Arab Emirates*

#### 4:40-4:55 \*Estimation and Identification for Wireless Sensor Network undergoing Uncertain Jumps

*Xiaoyang Pan and Seddik Djouadi, University of Tennessee, Knoxville, USA*

#### 5:00-5:15 \*Robust Image Transmission Scheme Based on Coupled Fractional-order Chaotic Maps

*Jean-Pierre Barbot, ENSEA, France; Ouerdia Megherbi, Sarah Kassim, and Saïd Djennoune, Université Mouloud Mammeri de Tizi Ouzou, Algeria; Maamar Bettayeb, American University of Sharjah, United Arab Emirates*

#### 5:20-5:35 \*The Unicycle in Presence of a Single Disturbance: Observability Properties

*Agostino Martinelli, Inria, France*

\* This presentation is included in the proceedings.

## Intermission

6:00 PM-6:15 PM

Tuesday, July 11

## SIAM Business Meeting and 2017 Fellows Recognition

6:15 PM-7:00 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Complimentary beer and wine will be served



## Intermission

7:00 PM-7:30 PM

## SIAG/CST Business Meeting

7:30 PM-8:00 PM

Room: Spirit of Pittsburgh B -  
3rd Floor

Complimentary beer and wine will be served



## PP1



## Poster Session and Dessert Reception

8:00 PM-10:00 PM

Room: West Atrium - 3rd Floor

### Regime-switching Competitive Lotka-Volterra Ecosystems Involving a Singularly Perturbed Markov Chain

Trang Bui and George Yin, Wayne State University, USA

### Performance of Distributed Lagrangian Methods for Network Resource Allocation with Uncertainty

Thinh T. Doan and Carolyn L. Beck, University of Illinois at Urbana-Champaign, USA

### Reduction of Linear Multivariable System Described by Internally Proper Polynomial Matrix Descriptions (PMDs) into an Equivalent State Space Model

George F. Fragulis, Western Macedonia University of Applied Science, Greece

### Applications of Multiple-scale Time Analysis and Different Pseudospectral Methods Along with MTM for CDF to Modeling, Estimation, Control, and Optimization of Large Scale Systems with Big Data

Michael Fundator, National Academy of Sciences, USA

### Local Poisson Equations Associated with Markov Control Model

Diego L. Hernández, Centro de Investigación en Matemáticas, Mexico

### Splitting Collective Motion: Geometry of Kinematic Modes

Matteo Mischiati, HHMI Janelia Research Campus, USA; P. S. Krishnaprasad, University of Maryland, USA

### Data Assimilation and Electrophysiological Modeling of Mammalian Circadian Clock Neurons

Matthew Moye, New Jersey Institute of Technology, USA

### Control Performance of Connected and Automated Vehicles with Communication Erasure Channels

Thu T. Nguyen, Le Yi Wang, George Yin, and Hongwei Zhang, Wayne State University, USA

## Wednesday, July 12

### Registration

8:00 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Closing Remarks

8:20 AM-8:30 AM

Room: Spirit of Pittsburgh B - 3rd Floor

## IT8

### On the Dynamics of Influence and Appraisal Networks

8:30 AM-9:15 AM

Room: Spirit of Pittsburgh B - 3rd Floor

Chair: Jean-Pierre Barbot, ENSEA, France

This talk will present models for the evolution of interpersonal influences, interpersonal appraisals, and social power in a group of individuals. Specifically, we will propose learning models in two scenarios: groups who discuss and form opinions along a sequence of issues, and groups who execute a sequence of decomposable tasks. In both scenarios we establish the emergence of rational optimal behavior, or lack thereof, as a result of the natural dynamical evolution of interpersonal appraisals and influence structures. Our multiagent models and analysis results are grounded in influence networks from mathematical sociology, replicator dynamics from evolutionary games, and transactive memory systems from organization science.

Francesco Bullo

University of California, Santa Barbara, USA

Wednesday, July 12

## IT9

### SIAG/CST Prize Lecture: Graph-Theoretic Convexification of Polynomial Optimization Problems with Applications to Power Systems and Distributed Control

9:15 AM-10:00 AM

Room: Spirit of Pittsburgh B - 3rd Floor

Chair: To Be Determined

The area of polynomial optimization has been actively studied in computer science, operations research, applied mathematics and engineering, where the goal is to find a high-quality solution using an efficient computational method. This area has attracted much attention in the control community since several long-standing control problems could be converted to polynomial optimization problems. The current researches on this area have been mostly focused on various important questions: i) how does the underlying structure of an optimization problem affect its complexity? ii) how does sparsity help? iii) how to find a near globally optimal solution whenever it is hard to find a global minimum? iv) how to design an efficient numerical algorithm for large-scale non-convex optimization problems? v) how to deal with problems with a mix of continuous and discrete variables? In this talk, we will develop a unified mathematical framework to study the above problems. Our framework rests on recent advances in graph theory and optimization, including the notions of OS-vertex sequence and treewidth, matrix completion, semidefinite programming, and low-rank optimization. We will also apply our results to two areas of power systems and distributed control. In particular, we will discuss how our results could be used to address several hard problems for power systems such as optimal power flow (OPF), security-constrained OPF, state estimation, and unit commitment.

Javad Lavaei

University of California, Berkeley, USA

Wednesday, July 12

## Coffee Break

10:00 AM-10:30 AM

Room: Ballroom Gallery - 3rd Floor



## MS31

### Control and Estimation of PDE Systems

10:30 AM-12:30 PM

Room: 403

Many systems are modelled by PDEs. This minisymposium brings together researchers working on various aspects of PDE systems. The first paper uses nonlinear feedback strategies to expand the stability region of a steady-state flow. The second paper proposes a computational method to reduce a full state feedback controller for parabolic PDEs by using modifications of Centroidal Voronoi Tessellation methods to select the sensor location. The third paper designs an optimal controller for mixing an inhomogeneous distribution of a passive scalar field in an unsteady Stokes flow by moving the walls or stirring at the boundaries. Finally, the last paper considers the problem of parameter identification for models defined by infinite dimensional dynamical systems with structured uncertainty.

Organizer: Michael A.

Demetriou

Worcester Polytechnic Institute, USA

Organizer: John A. Burns

Virginia Tech, USA

### 10:30-10:55 Computation and Evaluation of Nonlinear Feedback in a Flow Control Problem

Jeff Borggaard, Virginia Tech, USA

### 11:00-11:25 Using Modified Centroidal Voronoi Tessellations for Sensor Selection and State Feedback Kernel Partitioning in Parabolic PDEs

Michael A. Demetriou, Worcester Polytechnic Institute, USA

### 11:30-11:55 Boundary Control of Optimal Mixing in Stokes Flows

Weiwei Hu and Weiwei Hu, Oklahoma State University, USA

### 12:00-12:25 Identification of Dynamical Systems with Structured Uncertainty

John A. Burns and Eugene Cliff, Virginia Tech, USA

continued in next column

Wednesday, July 12

## MS32

### Boundary Stabilization for Hyperbolic Equations

10:30 AM-12:30 PM

Room:404

This minisymposium is concerned with systems governed by one-dimensional hyperbolic conservation and balance laws. Such systems appear in a wide range of physical engineering applications. The control action is modeled by the corresponding control boundary conditions. Questions of boundary feedback stabilization and optimal control are considered. In the applications, often networked systems occur, and present numerous challenges for the analysis and simulation. Speakers will address the topics on the equilibrium states of the control system, boundary stabilization, optimal control and related topics.

Organizer: Hui Yu

RWTH Aachen University, Germany

Organizer: Martin Gugat

Universität Erlangen-Nürnberg, Germany

#### 10:30-10:55 Optimal Boundary Control Problems with Hyperbolic Systems: The Turnpike Phenomenon

Martin Gugat, Universität Erlangen-Nürnberg, Germany

#### 11:00-11:25 Data-fitted Second-order Macroscopic Production Models for One Junction

Hui Yu and Michael Herty, RWTH Aachen University, Germany

#### 11:30-11:55 Exponential Stability of Hyperbolic Balance Laws with Characteristic Boundaries

Wen-An Yong, Tsinghua University, China

#### 12:00-12:25 On a Dynamic Boundary Control Game with a Star of Vibrating Strings

Sonja Steffensen, RWTH Aachen University, Germany; Martin Gugat, Universität Erlangen-Nürnberg, Germany

Wednesday, July 12

## MS33

### Optimality Conditions in Optimal Control - Part II of III

10:30 AM-12:30 PM

Room:405

For Part 1 see MS30

For Part 3 see MS42

The minisymposium contains three parts. Each of these parts includes four talks which will be given by well-known experts in the area. In the first part the speakers discuss Maximum Principles and dynamic programming approach. A. Dmitruk presents results on Maximum Principle for optimal control problems with integral equations. I. Shvartsman studies optimality conditions for an infinite horizon optimal control problem. G. N. Silva applies dynamic programming approach for minmax optimal control problems. In the last talk M. Sumin considers regularization of Pontryagin Maximum Principle in optimal control with pointwise state constraints. The second part is devoted to problems with discontinuity and averaging method. V. Gaitsgory studies averaging of control systems with slow observables. E. Kostina analyzes optimal control problems with discontinuous right hand side. One-dimensional integral functionals with discontinuous non-convex integrands are discussed by C. Mariconda. B. S. Mordukhovich presents optimality conditions for a controlled sweeping process. Infinite horizon and singularly perturbed problems are considered in the third part. Z. Artstein studies controls in the singular perturbations limit. Divergence theorem and occupational measures are discussed by I. Bright. Y. Hosoya presents result on the Euler equation and the transversality condition of macroeconomic dynamics. N. Sagara analyzes recursive variational problems in nonreflexive Banach spaces.

Organizer: Boris Mordukhovich  
Wayne State University, USA

Organizer: Nobusumi Sagara  
Hosei University, Japan

Organizer: Ilya Shvartsman  
Pennsylvania State University, USA

Organizer: Geraldo N. Silva  
Universidade Estadual Paulista, Brazil

Organizer: Alexander Zaslavski  
Technion Israel Institute of Technology, Israel

#### 10:30-10:49 Averaging of Control Systems with Slow Observables

Vladimir Gaitsgory, Macquarie University, Sydney, Australia

#### 11:00-11:25 Optimal Control Problems with Discontinuous Right Hand Side

Ekaterina Kostina, Universität Heidelberg, Germany

#### 11:30-11:55 One-dimensional Non-autonomous Integral Functionals with Discontinuous Non-convex Integrands: Lipschitz Regularity and DuBois-Reymond Necessary Conditions

Carlo Mariconda, Università degli Studi di Padova, Italy

#### 12:00-12:25 Optimality Conditions for a Controlled Sweeping Process with Applications to the Crowd Motion Model

Boris Mordukhovich, Wayne State University, USA

Wednesday, July 12

## MS34

### Data Assimilation and Large-scale Estimation for Fluid Dynamics Problems - Part I of II

10:30 AM-12:30 PM

Room:408

#### For Part 2 see MS43

Data assimilation is the process by which observational data is combined with prior information to produce a state estimate. Interest in data assimilation has continuously developed as the progression of computational methods and computing platforms has allowed ever larger and more complex systems problems to be attempted. In this session we showcase various aspects of the data assimilation problem. We look at the inclusion of novel observation types in the context of water sports and mobile sensing platforms with applications to tomography estimation. We also showcase new techniques for solving the large-scale estimation problems. Techniques such as sparse grids and dynamic mode decomposition are used to create reduced order systems in order to solve these estimation problems. While the focus of this session is primarily on fluid dynamics applications these techniques and methodologies are suitable for a range of applications.

Organizer: Sarah King  
Naval Research Laboratory, USA

Organizer: Fumin Zhang  
Georgia Institute of Technology, USA

Organizer: Wei Kang  
Naval Postgraduate School, USA

#### 10:30-10:55 A Hybrid Filter for Assimilating Lagrangian Data into a High-dimensional Model

Elaine Spiller, Marquette University, USA;  
Amit Apte, TIFR Centre, Bangalore, India;  
Laura Slivinski, CIRES, NOAA, USA

#### 11:00-11:25 Motion Tracking Sensors in Watersports as Sampling Platforms in Model-based Data Assimilation Systems for Sea Surface Dynamics

Axel Hackbarth, Edwin Kreuzer, and  
Eugen Solowjow, Technische Universität  
Hamburg, Germany

#### 11:30-11:55 Recent Progress in Motion Tomography: Using Timing Information in Flow Field Construction from Trajectory Data

Fumin Zhang and Meriam Ouerghi, Georgia  
Institute of Technology, USA

#### 12:00-12:25 \*The Error of Representation in the Ensemble Kalman Filter

Sarah King and Daniel Hodyss, Naval  
Research Laboratory, USA

\* This presentation is included in the proceedings.

Wednesday, July 12

## MS35

### Stochastic and Uncertain Systems and Applications

10:30 AM-12:30 PM

Room:409

In this minisymposium, we focus on the study of stochastic and uncertain systems arising from different applications. The session begins with the study of a controlled diffusion representation of the Schrodinger equations. Using the dequantized form of the Schrodinger equation with an initial value, which takes the form of a Hamilton-Jacobi PDE, it is shown that a representation for the solution as the value function of a certain controlled-diffusion process. Next, applications to energy systems, in particular, power controls are examined. The attention is devoted to power system frequency regulation. The setup is the H-infinity control of decentralized dynamic systems. The session proceeds with the examination of an investment and consumption model with regime switching having proportional transaction costs using log utility. Combining the viscosity solution to the Hamilton-Jacobi-Bellman equation and convex analysis of the value function, it is demonstrated how to characterize the buy, sell, and no-transaction regions. It is shown that these regions are switching regime dependent. Finally, the session is concluded with the consideration of a locally optimal strategy of a time-inconsistent control problem with random switching. Using an N-player game setup, it is shown that the equilibrium HJB equation in discrete time, converges to certain equilibrium HJB equation.

Organizer: Hongwei Mei  
University of Central Florida, USA

Organizer: George Yin  
Wayne State University, USA

**10:30-10:55 A Complex-valued Controlled-diffusion Representation for the Schrödinger Equation in a Rotating Frame**

*William M. McEneaney*, University of California, San Diego, USA; *Ruobing Zhao*, University of California, San Diego, USA

**11:00-11:25 Decentralized Dynamic and  $H^\infty$  Control in Power System Frequency Regulation**

*Le Yi Wang* and *Feixiong Chen*, Wayne State University, USA; *Minyou Chen*, Chongqing University, China

**11:30-11:55 Investment and Consumption in Regime-switching Models with Proportional Transaction Costs and Log Utility**

*Jiapeng Liu*, China Jiliang University, China; *Ruihua Liu* and *Dan Ren*, University of Dayton, USA

**12:00-12:25 Equilibrium Strategies for Time-inconsistent Stochastic Switching Systems**

*Hongwei Mei* and *Jiongmin Yong*, University of Central Florida, USA

Wednesday, July 12

## MS36

### New Developments in Stochastic Analysis, Control, Games, and Their Applications - Part II of III

10:30 AM-12:30 PM

Room:410

For Part 1 see MS26

For Part 3 see MS45

This series of minisymposia features new developments in stochastic control, game and their applications. In the first session, the speakers will be presenting new perspectives and methodologies toward stochastic control problems. The specific topics to be discussed include exact controllability of linear stochastic differential equations and related problems, finite element methods for linear programming formulation for stochastic control problems, stochastic control with running max cost structures, and a weak convergence approach to inventory control using a long-term average criterion. The second session is devoted to new developments in stochastic analysis and their applications in dynamic pricing models. The speakers will be presenting asymptotic properties of certain novel switching diffusion processes in which the switching process has a countable state space, the limit of weakly interacting stochastic processes with Markov switching, and dynamic pricing models and their diffusion approximation of the optimal inventory process. The third session focuses on new developments in math finance and stochastic differential games. The speakers will be discussing the fundamental questions concerning pricing American options, optimal asset allocation with stochastic interest rate in regime switching models and optimal consumption and investment on a finite horizon, and infinite horizon non-zero-sum stochastic differential games with additive structure.

Organizer: Chao Zhu

*University of Wisconsin, Milwaukee, USA*

Organizer: Richard Stockbridge

*University of Wisconsin, Milwaukee, USA*

**10:30-10:55 Asymptotic Properties of Recurrence and Ergodicity of Switching Diffusions with Past-dependent Switching Having a Countable State Space**

*Hai Dang Nguyen* and *George Yin*, Wayne State University, USA

**11:00-11:25 On the Limit of Weakly Interacting Stochastic Processes with Markovian Switching**

*Son L. Nguyen*, University of Puerto Rico, Río Piedras, Puerto Rico; *Tuan Hoang* and *George Yin*, Wayne State University, USA

**11:30-11:55 Dynamic Pricing with Multiple Order Sizes**

*Nyles Breecher*, University of Wisconsin, Milwaukee, USA

**12:00-12:25 Dynamic Pricing with Constant Demand Elasticity: A Diffusion Approximation of the Optimal Inventory Process**

*Kurt Helmes*, Humboldt University Berlin, Germany

Wednesday, July 12

## MS37

### Optimal Control of Biological Systems

10:30 AM-12:30 PM

Room:411

The session concerns control problems that arise in various biological systems. Some of the specific biological systems covered include the treatment of ebola based on an SIR model, optimal resource allocation in an agent-based population model, the optimal treatment of cancer based on a Stepanova type model, and an optimal control management system for anthrax epidemics.

Organizer: William Hager

University of Florida, USA

Organizer: S.M. Lenhart

University of Tennessee, Knoxville, USA

#### 10:30-10:55 Optimal Control of Sugarscape Agent-based Model via a PDE Approximation Model

Rachael Miller Neilan, Duquesne University, USA; Scott Christley, University of Texas Southwestern Medical Center, USA; Matthew Oremland, Ohio State University, USA; Rene Salinas, Appalachian State University, USA; Suzanne M. Lenhart, University of Tennessee, Knoxville, USA

#### 11:00-11:25 Cancer Treatment

Mojdeh Faraji, Georgia Institute of Technology, USA; Urszula Ledzewicz, Southern Illinois University, USA; Heinz M. Schaettler, Washington University, USA

#### 11:30-11:55 Optimal Control Applied to an Anthrax Outbreak Model for Wild Animals

Buddhi Pantha, Abraham Baldwin Agricultural College, USA; Suzanne M. Lenhart and Judy Day, University of Tennessee, Knoxville, USA

#### 12:00-12:25 Optimal Control for a Sir Epidemiological Model with Time-varying Populations

Mahya Aghaee, University of Florida, USA; Urszula Ledzewicz, Southern Illinois University, USA; Heinz M. Schaettler, Washington University, USA

Wednesday, July 12

## MS38

### Novel Approaches for Modeling, Abstraction, Composition, and Analysis of Systems of Systems (SoS) - Part I of II

10:30 AM-12:30 PM

Room:412

#### For Part 2 see MS47

Emerging new applications such as next generation transportation systems, internet of things, smart grids and autonomy, are characterized by the interactions of many complex and heterogeneous subsystems, which are networked to provide services at an unprecedented scale. These are generally called systems of systems (SoS). Novel design tools, analysis methods, and implementation paradigms that can handle different computational models, are scalable, and which provide strong guarantees on the composed behavior, are increasingly needed. This session will bring together researchers who are working on various aspects of SoS and are leveraging new mathematical methodologies that draw from Category Theory, Sheaf Theory, Homological Algebra and Monotonic Systems. Presentations will focus on theoretical results, computational aspects, verification and validation (V&V) approaches and applications.

Organizer: Alberto Speranzon

Honeywell Aerospace, USA

#### 10:30-10:55 A Sheaf Theoretic Modeling and Compositional Framework for Complex SoS

Alberto Speranzon, Honeywell Aerospace, USA

#### 11:00-11:25 Compositional Contracts for Hybrid Dynamical Systems

David I. Spivak, Massachusetts Institute of Technology, USA

#### 11:30-11:55 Sheaves over Networks for Inference

Robert W. Ghrist, University of Pennsylvania, USA

#### 12:00-12:25 Systems, Generativity and Interactional Effects

Elie Adam, Massachusetts Institute of Technology, USA

Wednesday, July 12

## MS39

### Direct Nonlinear Programming Strategies for Dynamic Optimization - Part II of III

10:30 AM-12:30 PM

Room:413

#### For Part 1 see MS29

#### For Part 3 see MS48

Direct NLP strategies for solving differential-algebraic optimization problems have been applied in a wide variety of engineering and scientific applications. Using multiple shooting or collocation methods to describe the DAEs, these approaches lead to a fully algebraic (and frequently large) optimization problem. Due to the recent development of efficient, large-scale nonlinear programming (NLP) solvers, novel DAE-based problem formulations and software frameworks that integrate optimization models and algorithms, these methods have advanced significantly over the past decade and have led to the efficient optimization of difficult and challenging systems, for both off-line and on-line applications. This three-part minisymposium highlights these new advances and demonstrates them on real-world optimization problems. The first session considers novel decomposition schemes for fast solution of dynamic optimization problems, along with frameworks for optimization modeling and solution strategies. The second describes enabling strategies for the solution of novel, engineering applications. These include generalized sensitivity for nonlinear model predictive control (NMPC), operation of renewable energy networks for wind and solar power, and singular optimal control in chemical processes. The third session develops specialized on-line NMPC strategies as well as applications for on-line optimization of carbon capture in power plants, and wine fermentation.

continued on next page

Organizer: Lorenz T. Biegler  
Carnegie Mellon University, USA

Organizer: Christina Schenk  
Universität Trier, Germany

Organizer: Bethany Nicholson  
Sandia National Laboratories, USA

**10:30-10:55 Generalized Derivatives of Nonlinear Programs for use in Model Predictive Control**

Peter G. Stechlin, Massachusetts Institute of Technology, USA; Johannes Jaschke, Norwegian University of Science and Technology, Norway; Kamil Khan, Argonne National Laboratory, USA; Paul I Barton, Massachusetts Institute of Technology, USA

**11:00-11:25 A Multi-scale Decomposition Strategy for Concentrated Solar Power Systems**

Alexander W. Dowling and Victor Zavala,  
University of Wisconsin, Madison, USA

**11:30-11:55 Optimization Formulations for Robust Nonlinear Model Predictive Control**

Zhou (Joyce) Yu and Lorenz T. Biegler,  
Carnegie Mellon University, USA

**12:00-12:25 Bilevel NLP Formulations for Singular Optimal Control Problems**

Weifeng Chen, Zhejiang University of Technology, China; Lorenz T. Biegler,  
Carnegie Mellon University, USA

**Lunch Break**

12:30 PM-2:00 PM

Attendees on their own

Wednesday, July 12

**SP3**

**Past President's Address:  
The Future of SIAM: Looking  
to the Mathematicians of  
Tomorrow**

2:00 PM-3:00 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Nicholas J. Higham, University of Manchester, United Kingdom

During my tenure as SIAM president, I sought to emphasize that the 'S' in SIAM stands for students by focusing on boosting our global presence and cultivating the next generation of mathematicians. To all the long-time SIAM members, can you guess how many new international chapters we've added since 2012? To all the new SIAM student members we've welcomed in that period, can you name all the ways SIAM can help you grow your careers? At the 2017 SIAM Annual Meeting I will invite our Student Chapters to use their own words to answer these important questions through a series of videos spanning several continents. The advances we've made should make us all proud. Of course, there's always more that SIAM can do as it continues to push ahead in order to remain at the vanguard of the scientific community.

Irene Fonseca  
Carnegie Mellon University, USA

Wednesday, July 12

**SP4**

**James H. Wilkinson  
Numerical Analysis and  
Scientific Computing  
Prize Lecture: Tensors in  
Computational Mathematics**

3:00 PM-3:30 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: To Be Determined

We show that in many instances, one would find a higher-order tensor, usually of order three, at the core of an important problem in computational mathematics. The resolution of the problem depends crucially on determining certain properties of its corresponding tensor. We will draw examples from (i) numerical linear algebra: fastest/stablest algorithms for matrix product, matrix inversion, or structured matrix computations; (ii) numerical optimization: SDP-relaxations of NP-hard problems, self-concordance, higher-order KKT conditions; and, if time permits, (iii) numerical PDEs: tensor network ranks. This talk is based on joint works with Ke Ye, with Shenglong Hu, and with Shmuel Friedland.

Lek-Heng Lim  
University of Chicago USA

**Coffee Break**

3:30 PM-4:00 PM



Room: Ballroom Gallery - 3rd Floor

Wednesday, July 12

## MS40

### Closed-loop Control for Infinite Dimensional Systems and Applications

4:00 PM-6:00 PM

Room:403

Many physical phenomena are modeled by infinite dimensional systems, e.g. partial differential equations. Closed loop control is very important due to its robustness against system perturbations. Thus, closed-loop control is required in many applications. However, optimal feedback techniques for infinite dimensional nonlinear systems have not been studied in detail. Moreover, the numerical treatment of these type of optimal control problems is quite challenge. Recent developments concerning feedback control for infinite dimensional systems and its applications are presented. The minisymposium will provide an opportunity to discuss theoretical techniques, numerical methods and applications in this field.

Organizer: Hermann Mena

*Yachay Tech University, Ecuador*

Organizer: Sergio Rodriguez

*Johann Radon Institute for Computational and Applied Mathematics, Austria*

#### 4:00-4:25 On the Feedback Stabilization to Trajectories for Semilinear Parabolic Equations

*Sergio Rodriguez, Johann Radon Institute for Computational and Applied Mathematics, Austria*

#### 4:30-4:55 Optimal Control of the Stochastic Navier-Stokes Equation with Lévy Noise

*Christoph Trautwein, Max Planck Institute, Germany; Peter Benner, Max-Planck-Institute for Dynamics of Complex Technical Systems, Germany*

#### 5:00-5:25 Differential Riccati Equations: A Matrix Exponential Approach

*Antti Koskela, KTH Royal Institute of Technology, Sweden; Hermann Mena, Yachay Tech University, Ecuador*

#### 5:30-5:55 Numerical Simulations for the Control and Estimation of the 2D Burgers Equation

*Jorge Tiago, Universidade de Lisboa, Portugal; Jean Pierre Raymond and Jean-Marie Buchot, Institut de Mathématiques de Toulouse, France*

Wednesday, July 12

## MS41

### Control and Identification for Nonlocal Systems

4:00 PM-6:00 PM

Room:404

Systems described by nonlocal operators arise frequently in diverse applications such as nonstandard diffusion, image processing, finance and shape characterization. Recently, interest has been arising in the identification and control of such systems. This minisymposium focusses on numerical approaches to inverse problems and control of nonlocal systems. Because of high dimensional integration is always involved here, the curse of dimensionality has to be avoided in a structure exploiting fashion. Since the formulations of nonlocal systems vary significantly, e.g., in the form of fractional differential equations or more general nonlocal equations in weak formulation, the numerical approaches may differ accordingly. Many of these aspects are discussed in the talks of this minisymposium.

Organizer: Volker H. Schulz

*Universität Trier, Germany*

Organizer: Martin Siebenborn

*University of Trier, Germany*

#### 4:00-4:25 Optimal Control for Nonlocal Elliptic Problems in Three Dimensions

*Volker H. Schulz and Christian Vollmann, Universität Trier, Germany*

#### 4:30-4:55 A Coupling Strategy for Nonlocal and Local Models with Applications to Static Peridynamics

*Marta D'Elia, Pavel Bochev, David Littlewood, and Mauro Perego, Sandia National Laboratories, USA*

#### 5:00-5:25 Fractional Operators with Inhomogeneous Boundary Conditions: Analysis, Control, and Discretization

*Harbir Antil, George Mason University, USA; Johannes Pfefferer, Technische Universität München, Germany; Sergejs Rogovs, Universität der Bundeswehr München, Germany*

#### 5:30-5:55 High-performance Computing for Optimal Control of Fractional Partial Differential Equations

*Dominick Gallo and Martin Siebenborn, Universität Trier, Germany*

Wednesday, July 12

## MS42

### Optimality Conditions in Optimal Control - Part III of III

4:00 PM-6:00 PM

Room:405

#### For Part 2 see MS33

The minisymposium contains three parts. Each of these parts includes four talks which will be given by well-known experts in the area. In the first part the speakers discuss Maximum Principles and dynamic programming approach. A. Dmitruk presents results on Maximum Principle for optimal control problems with integral equations. I. Shvartsman studies optimality conditions for an infinite horizon optimal control problem. G. N. Silva applies dynamic programming approach for minmax optimal control problems. In the last talk M. Sumin considers regularization of Pontryagin Maximum Principle in optimal control with pointwise state constraints. The second part is devoted to problems with discontinuity and averaging method. V. Gaitsgory studies averaging of control systems with slow observables. E. Kostina analyzes optimal control problems with discontinuous right hand side. One-dimensional integral functionals with discontinuous non-convex integrands are discussed by C. Mariconda. B. S. Mordukhovich presents optimality conditions for a controlled sweeping process. Infinite horizon and singularly perturbed problems are considered in the third part. Z. Artstein studies controls in the singular perturbations limit. Divergence theorem and occupational measures are discussed by I. Bright. Y. Hosoya presents result on the Euler equation and the transversality condition of macroeconomic dynamics. N. Sagara analyzes recursive variational problems in nonreflexive Banach spaces.

*continued on next page*

Organizer: Boris Mordukhovich  
Wayne State University, USA

Organizer: Nobusumi Sagara  
Hosei University, Japan

Organizer: Ilya Shvartsman  
Pennsylvania State University, USA

Organizer: Geraldo N. Silva  
Universidade Estadual Paulista, Brazil

Organizer: Alexander Zaslavski  
Technion Israel Institute of Technology,  
Israel

**4:00-4:25 Control in the Singular  
Perturbations Limit**  
Zvi Artstein, Weizmann Institute of Science,  
Israel

**4:30-4:55 From the Divergence  
Theorem to Occupational Measures  
and Infinite-horizon Optimization**  
Ido Bright, eBay Research Labs, USA

**5:00-5:25 On the Euler Equation  
and the Transversality Condition of  
Macroeconomic Dynamics**  
Yuhki Hosoya, Kanto Gakuin University,  
Japan

**5:30-5:55 Recursive Variational  
Problems in Nonreflexive Banach  
Spaces with an Infinite Horizon: An  
Existence Result**  
Nobusumi Sagara, Hosei University, Japan

Wednesday, July 12

## MS43

### Data Assimilation and Large- scale Estimation for Fluid Dynamics Problems - Part II of II

4:00 PM-6:00 PM

Room:408

#### For Part 1 see MS34

Data assimilation is the process by which observational data is combined with prior information to produce a state estimate. Interest in data assimilation has continuously developed as the progression of computational methods and computing platforms has allowed ever larger and more complex systems problems to be attempted. In this session we showcase various aspects of the data assimilation problem. We look at the inclusion of novel observation types in the context of water sports and mobile sensing platforms with applications to tomography estimation. We also showcase new techniques for solving the large-scale estimation problems. Techniques such as sparse grids and dynamic mode decomposition are used to create reduced order systems in order to solve these estimation problems. While the focus of this session is primarily on fluid dynamics applications these techniques and methodologies are suitable for a range of applications.

Organizer: Sarah King  
Naval Research Laboratory, USA

Organizer: Fumin Zhang  
Georgia Institute of Technology, USA

Organizer: Wei Kang  
Naval Postgraduate School, USA

#### 4:00-4:25 DMD-based Estimation of the Flow Field behind a Thin Airfoil at High Angles of Attack by Assimilating Distributed Pressure Measurements

Frank D. Lagor and Derek A. Paley,  
University of Maryland, USA

#### 4:30-4:55 Reduced Order Filtering Algorithms

Kazufumi Ito, North Carolina State  
University, USA

#### 5:00-5:25 \*A Sparse-grid UKF For the State Estimation of PDEs

Wei Kang, Naval Postgraduate School, USA;  
Sarah King and Liang Xu, Naval Research  
Laboratory, USA

#### 5:30-5:55 \*Disturbance Estimation of a Wave PDE on a Time-varying Domain

Ji Wang, Chongqing University, China;  
Shuxia Tang, University of Waterloo,  
Canada; Yangjun Pi, Chongqing  
University, China; Miroslav Krstic,  
University of California, San Diego, USA

\* This presentation is included in the  
proceedings.

Wednesday, July 12

## MS44

### Optimal Control of Stochastic Systems and Related Fields

4:00 PM-6:00 PM

Room:409

Optimal control of stochastic systems plays a central and significant role in modern control theory. In the past decades, extensive studies have been conducted for this kind of control problem and its derivatives, say, backward stochastic differential equation, sublinear expectation. However, due to the lack of techniques, rather little attention was paid to numerical solution for backward stochastic differential equation, optimal control under sublinear expectation, stochastic recursive control, etc. Then the minisymposium aims to present some recent developments in optimal control of stochastic systems, including 1) An implicit numerical scheme for a class of backward doubly stochastic differential equations; 2) Some results on optimal stopping problems for one-dimensional regular diffusions; 3) A stochastic maximum principle for processes driven by G-Brownian motion and applications to finance; 4) Connection between MP and DPP for stochastic recursive optimal control problems: viscosity solution framework in general case. By using Malliavin calculus, the characterization of the value functions for general one-dimensional regular diffusion processes, G-expectation, viscosity solution of HJB equation, etc., these four speakers together with their coauthors obtain novel and nontrivial results in different fields, respectively.

Organizer: Guangchen Wang  
Shandong University, China

Organizer: Zhen Wu  
Shandong University, China

### 4:00-4:25 An Implicit Numerical Scheme for a Class of Backward Doubly Stochastic Differential Equations

Xiaoming Song, Drexel University, USA;  
Yaozhong Hu and David Nualart,  
University of Kansas, USA

### 4:30-4:55 Some Results on Optimal Stopping Problems for One-dimensional Regular Diffusions

Jian Song and Dongchao Huang, University  
of Hong Kong, Hong Kong

### 5:00-5:25 A Stochastic Maximum Principle for Processes Driven by G-Brownian Motion and Applications to Finance

Zhongyang Sun, Sun Yat-Sen University,  
China; Xin Zhang, Southeast University,  
China; Junyi Guo, Nankai University,  
China

### 5:30-5:55 Connection Between MP and DPP for Stochastic Recursive Optimal Control Problems

Tianyang Nie, Jingtao Shi, and Zhen Wu,  
Shandong University, China

Wednesday, July 12

## MS45

### New Developments in Stochastic Analysis, Control, Games, and Their Applications - Part III of III

4:00 PM-6:00 PM

Room:410

#### For Part 2 see MS36

This series of minisymposia features new developments in stochastic control, game and their applications. In the first session, the speakers will be presenting new perspectives and methodologies toward stochastic control problems. The specific topics to be discussed include exact controllability of linear stochastic differential equations and related problems, finite element methods for linear programming formulation for stochastic control problems, stochastic control with running max cost structures, and a weak convergence approach to inventory control using a long-term average criterion. The second session is devoted to new developments in stochastic analysis and their applications in dynamic pricing models. The speakers will be presenting asymptotic properties of certain novel switching diffusion processes in which the switching process has a countable state space, the limit of weakly interacting stochastic processes with Markov switching, and dynamic pricing models and their diffusion approximation of the optimal inventory process. The third session focuses on new developments in math finance and stochastic differential games. The speakers will be discussing the fundamental questions concerning pricing American options, optimal asset allocation with stochastic interest rate in regime switching models and optimal consumption and investment on a finite horizon, and infinite horizon non-zero-sum stochastic differential games with additive structure.

Organizer: Chao Zhu

*University of Wisconsin, Milwaukee, USA*

Organizer: Richard Stockbridge

*University of Wisconsin, Milwaukee, USA*

**4:00-4:25 Are American Options European after all?**

*Soren Christensen, Universitat Hamburg, Germany*

**4:30-4:55 Optimal Asset Allocation with Stochastic Interest Rates in Regime-switching Models**

*Cheng Ye, Ruihua Liu, Dan Ren, and Muhammad Usman, University of Dayton, USA*

**5:00-5:25 Optimal Consumption and Investment on a Finite Horizon**

*Dan Ren, University of Dayton, USA*

**5:30-5:55 Infinite-horizon Non-zero-sum Stochastic Differential Games with Additive Structure**

*Hector Jasso-Fuentes, CINVESTAV-IPN, Mexico City, Mexico; B. Adriana Escobedo-Trujillo, Universidad Veracruzana, Mexico; J. Daniel Lopez-Barrientos, Universidad Anáhuac México Norte, Mexico*

Wednesday, July 12

## MS46

**Optimal Control and Applications**

*4:00 PM-6:00 PM*

*Room:411*

Advances in the theory and application of optimal control in the context of Nonsmooth Analysis.

Organizer: Norma Ortiz-Robinson

*Virginia Commonwealth University, USA*

**4:00-4:25 Growth Model for Tree Stems and Vines**

*Michele Paladino, Alberto Bressan, and Wen Shen, Pennsylvania State University, USA*

**4:30-4:55 On the Stability Property for Time-delayed Differential Inclusions**

*Vinicio Rios, Universidad del Zulia, Venezuela*

**5:00-5:25 Optimal Open-loop Strategies in a Debt Management Problem**

*Yilun Jiang and Alberto Bressan, Pennsylvania State University, USA*

**5:30-5:55 Discontinuous Solutions of Hamilton-Jacobi Equations on Networks**

*P. Jameson Graber, Baylor University, USA; Cristopher Hermosilla and Hasnaa Zidani, ENSTA ParisTech, France*

Wednesday, July 12

## MS47

**Novel Approaches for Modeling, Abstraction, Composition, and Analysis of Systems of Systems (SoS) - Part II of II**

*4:00 PM-6:00 PM*

*Room:412*

**For Part 1 see MS38**

Emerging new applications such as next generation transportation systems, internet of things, smart grids and autonomy, are characterized by the interactions of many complex and heterogeneous subsystems, which are networked to provide services at an unprecedented scale. These are generally called systems of systems (SoS). Novel design tools, analysis methods, and implementation paradigms that can handle different computational models, are scalable, and which provide strong guarantees on the composed behavior, are increasingly needed. This session will bring together researchers who are working on various aspects of SoS and are leveraging new mathematical methodologies that draw from Category Theory, Sheaf Theory, Homological Algebra and Monotonic Systems. Presentations will focus on theoretical results, computational aspects, verification and validation (V&V) approaches and applications.

Organizer: Alberto Speranzon

*Honeywell Aerospace, USA*

**4:00-4:25 When is the Interconnection of Controllable Systems Controllable?**

*Brendan Fong, University of Pennsylvania, USA*

**4:30-4:55 Exploiting Structure in the Construction of Finite-state Abstractions of Control Systems**

*Paulo Tabuada, University of California, Los Angeles, USA*

**5:00-5:25 Categorical Perspectives on Hybrid Systems with a View toward Robotics**

*Aaron D. Ames, California Institute of Technology, USA*

**5:30-5:55 A Mathematical Theory of Co-design**

*Andrea Censi, Massachusetts Institute of Technology, USA*

Wednesday, July 12

## MS48

### Direct Nonlinear Programming Strategies for Dynamic Optimization - Part III of III

4:00 PM-6:00 PM

Room:413

#### For Part 2 see MS39

Direct NLP strategies for solving differential-algebraic optimization problems have been applied in a wide variety of engineering and scientific applications. Using multiple shooting or collocation methods to describe the DAEs, these approaches lead to a fully algebraic (and frequently large) optimization problem. Due to the recent development of efficient, large-scale nonlinear programming (NLP) solvers, novel DAE-based problem formulations and software frameworks that integrate optimization models and algorithms, these methods have advanced significantly over the past decade and have led to the efficient optimization of difficult and challenging systems, for both off-line and on-line applications. This three-part minisymposium highlights these new advances and demonstrates them on real-world optimization problems. The first session considers novel decomposition schemes for fast solution of dynamic optimization problems, along with frameworks for optimization modeling and solution strategies. The second describes enabling strategies for the solution of novel, engineering applications. These include generalized sensitivity for nonlinear model predictive control (NMPC), operation of renewable energy networks for wind and solar power, and singular optimal control in chemical processes. The third session develops specialized on-line NMPC strategies as well as applications for on-line optimization of carbon capture in power plants, and wine fermentation.

Organizer: Christina Schenk  
*Universität Trier, Germany*

Organizer: Bethany Nicholson  
*Sandia National Laboratories, USA*

Organizer: Lorenz T. Biegler  
*Carnegie Mellon University, USA*

#### 4:00-4:25 Real-Time Feasible Online Computation of Constrained Nonlinear Optimal Feedback

*Hans Georg Bock, Universität Heidelberg, Germany*

#### 4:30-4:55 Optimal Feedback Control for Average Output Systems

*Juergen Gutekunst, Andreas Potschka, and Hans Georg Bock, Universität Heidelberg, Germany*

#### 5:00-5:25 Economic Nonlinear Model Predictive Control (NMPC) for CO2 Capture Systems

*David Thierry, Mingzhao Yu, and Lorenz T. Biegler, Carnegie Mellon University, USA*

#### 5:30-5:55 Nonlinear Optimal Feedback Control for Wine Fermentation by Economic NMPC

*Christina Schenk and Volker H. Schulz, Universität Trier, Germany*

### Intermission

6:00 PM-6:15 PM

Wednesday, July 12

## SP5

### I.E. Block Community Lecture: From Flatland to our Land: A Mathematician's Journey through Our Changing Planet

6:15 PM-7:15 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Nicholas J. Higham, University of Manchester, United Kingdom

Mathematics is central to our understanding of the world around us. We live in a vast dynamical system, the many dimensions of which can be interrogated with mathematical tools. In this talk I will consider our changing climate. I will describe the scientific evidence that tells us how and why our climate is changing, and what the future may hold. In this journey I will pause at various waypoints to describe in more detail some of the insight different branches of mathematics are providing. Diverse examples will include applying ideas from dynamical systems research to create novel strategies for measuring the ocean mixing processes that are critical to the flow of heat and carbon through the Earth system, through to employing statistical learning techniques to improve future predictions of Arctic sea ice, currently in perilous decline. Climate change is one of the greatest challenges facing humanity. Responding to the challenge requires robust scientific evidence to inform policies. Opportunities for mathematicians to contribute to this important issue abound.

Emily Shuckburgh

*British Antarctic Survey, United Kingdom*

Wednesday, July 12

### Community Reception

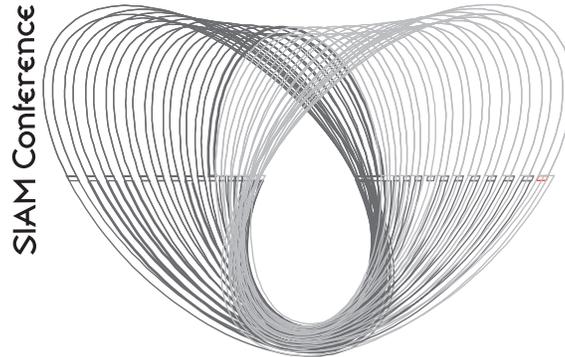
7:15 PM-8:15 PM

Room: North Terrace - 4th Floor



## GD17 Program

### SIAM Conference on Industrial and Applied Geometry



July 10-12, 2017  
David Lawrence Convention Center (DLCC)  
Pittsburgh, Pennsylvania, USA

The SIAM Conference on Industrial and Applied Geometry (GD17) is sponsored by the SIAM Activity Group on Geometric Design.

*The SIAM Activity Group on Geometric Design is concerned with the mathematical and computational issues that arise in generating and processing geometric information for various engineering applications, such as mechanical design, process planning, and manufacturing. The scope of the group's activities encompasses a wide spectrum of scientific, technological, and other skills, ranging from rigorous mathematics to the subjective aesthetics of shape. The SIAG organizes the biennial SIAM Conference on Geometric and Physical Modeling and also maintains a website, a member directory, and an electronic mailing list.*

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[www.siam.org/meetings/gd17](http://www.siam.org/meetings/gd17)

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[www.siam.org/activity/cst](http://www.siam.org/activity/cst)

*Collaborate and interact with mathematicians and applied scientists whose work involves control and systems theory.*

### ACTIVITIES INCLUDE:

- Special sessions at SIAM meetings
- Biennial conference
- SIAG/CST newsletter
- SIAG/CST Best SICON Paper Prize
- SIAG/Control and Systems Theory Prize

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- Participation in the selection of SIAG/CST officers



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[www.siam.org/activity/gd](http://www.siam.org/activity/gd)

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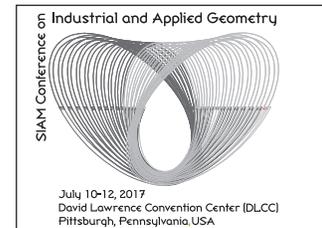
- Special sessions at SIAM meetings
- Biennial conference
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## Sunday, July 9

### Registration

2:00 PM-8:00 PM

Room: Ballroom Gallery - 3rd Floor

### Student Days: Student Orientation

5:00 PM-6:00 PM

Room: 306 & 307

### Welcome Reception

6:00 PM-8:00 PM

Room: South Terrace - 3rd Floor



## Monday, July 10

### Registration

7:15 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Welcoming Remarks

8:15 AM-8:30 AM

Room: 407

Monday, July 10

## IT1

### Computational Design Tools for Physical Surfaces

8:30 AM-9:15 AM

Room: 407

Chair: David A. Field, General Motors Research and Development Center, USA

From small-scale balloons to large-scale architectural roofs: tensioned and pressurized membrane structures are widely valued for their aesthetic appeal, material efficiency, and lightweight nature. In contrast to purely geometric surface design, these physical surfaces can only assume shapes that are equilibrium states of a complex mechanical systems. In this talk, I will describe a set of computational tools that assist the designer in creating physical surfaces with desired equilibrium shapes. This mix of physical and geometric design gives rise to several interesting challenges. First, the space of achievable surfaces is limited by problem- and material-specific restrictions that are often difficult to understand and navigate; second, while the equilibrium shape for a given design can be computed using existing structural analysis tools, finding design parameters that lead to a desired equilibrium shape is a challenging inverse problem; third, since aesthetic considerations often play a central role in the design, it is important to find a balance between automation and user control. I will formalize these challenges into equilibrium-constrained optimization problems and illustrate computational solutions on a set of real-world designs.

Bernhard Thomaszewski

Disney Research Zurich, Switzerland

Monday, July 10

**IT2****Computational Physics at Pixar**

9:15 AM-10:00 AM

Room:407

*Chair: Thomas J. Peters, University of Connecticut, USA*

Pixar's films generally rely heavily on physically simulated effects such as the motion of hair, cloth, trees, water, and smoke. Whereas physical accuracy is of paramount importance in engineering applications of physical simulation, the most important aspects for feature film production are directability and speed. In this talk I'll survey our recent work in this area, including a new material model for simulating flesh, a high performance physically inspired spatial deformation technique, and a method for solving simulation problems on subdivision surfaces.

Tony Derosé

*Pixar Animation Studios, USA***Coffee Break**

10:00 AM-10:30 AM



Room:Ballroom Gallery - 3rd Floor

Monday

Monday, July 10

**MS1****Honoring the Life of the Late Gerald Farin**

10:30 AM-12:00 PM

Room:407

This minisymposium honors the contributions of Gerald Farin to Computer Aided Geometric Design. The presentations will feature his closest friends' reflections on Gerald's life and a technical lecture on a topic of special interest to Gerald.

Organizer: David A. Field

*General Motors Research and Development Center, USA***10:30-10:55 A Life of Quality Affecting Many People***Robert Barnhill, Society for the Advancement of Chicanos and Native Americans, USA***11:00-11:25 Gerald's Life and Work - the Early Years***Hans Hagen, University of Kaiserslautern, Germany***11:30-11:55 Making Gk Simple - Spline Manifolds by Farin's Ck Construction***Hartmut Prautzsch, Universität Karlsruhe, Germany***Lunch Break**

12:30 PM-2:00 PM

*Attendees on their own*

Monday, July 10

**JP1****AN17 and CT17 Joint Plenary Speaker - Bio-Inspired Dynamics for Multi-Agent Decision-Making**

2:00 PM-2:45 PM

Room: Spirit of Pittsburgh A - 3rd Floor

*Chair: Fariba Fahroo, Defence Advance Research Projects Agency, USA*

I will present a generalizable framework that uses the singularity theory approach to bifurcation problems, and other tools of nonlinear dynamics, to translate some of the remarkable features of collective animal behavior to an abstract agent-based model. With the abstract model, analysis and design of decision-making between alternatives can be systematically pursued for natural or engineered multi-agent systems. To illustrate, I will apply the framework to explore and extend value-sensitive decision-making dynamics that explain the adaptive and robust behavior of house-hunting honeybees.

Naomi E. Leonard

*Princeton University, USA*

Monday, July 10

**SP1****AWM-SIAM Sonia Kovalevsky Lecture:  
Mitigating Uncertainty in  
Inverse Wave Scattering**

2:45 PM-3:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: Ami Radunskaya, Pomona College,  
USA*

Inverse wave scattering is an inverse problem for the wave equation, driven by a broad spectrum of applications. It is an interdisciplinary area that involves mathematical analysis, computational modeling, statistics and signal processing. This lecture will discuss one important challenge due the uncertainty of the model for inversion. Uncertainty is unavoidable in applications, not only because of noise, but because of lack of detailed knowledge of complex media through which the waves propagate.

Liliana Borcea  
*University of Michigan, USA*

**Coffee Break**

3:30 PM-4:00 PM

*Room: Ballroom Gallery - 3rd Floor*

Monday, July 10

**MS2****TAG = Topology Applied to  
Geometry**

4:00 PM-6:00 PM

*Room: 407*

This research community has historically emphasized an essential role for geometry in design, with topology often only included as an afterthought. Topological information is becoming increasingly prominent in the design of many algorithms for mathematical modeling. This collection of talks will show contemporary applications of knot theory in computational steering for molecular simulations, topological considerations for artistic expression by motion-capture data gloves, boundary representations of volumetric models for seismic modeling and understanding multiscale geometric structure within topological data analysis. The scope will cover industry, art and data science.

Organizer: Thomas J. Peters  
*University of Connecticut, USA*

**4:00-4:25 Knot Theory and  
Computational Steering for Molecular  
Simulations**

*Thomas J. Peters, University of Connecticut,  
USA*

**4:30-4:55 Topology in Artistic  
Expression**

*Kevin Marinelli, University of Connecticut,  
USA*

**5:00-5:25 Topological Properties of  
Meandering Streams**

*Ralph P. Bording, Alabama A&M University,  
USA*

**5:30-5:55 Hierarchical Metric Trees for  
Topological Data Analysis**

*Mahmoodreza Jahanseirroodsari, University  
of Connecticut, USA*

Monday, July 10

**MS3****Scripted Process Engineering**

4:00 PM-6:00 PM

*Room: 402*

One of the most effective processes for performing geometric modeling and geometry processing in industry has proven to be scripted process engineering. In this approach, processes for building models and performing geometric analysis are captured in high level scripts which have the advantages of repeatability and automation over interactive alternatives. This minisymposium will explore some of the modern features found in high end geometric scripting languages and provide compelling real-life examples of their use.

Organizer: Dan Gonsor  
*The Boeing Company, USA*

Organizer: Thomas A. Grandine  
*The Boeing Company, USA*

**4:00-4:25 Scripted Process Engineering  
at Boeing**

*Thomas A. Grandine, The Boeing Company,  
USA*

**4:30-4:55 Geometric Modeling and  
Processing in Irit**

*Gershon Elber, Technion Israel Institute of  
Technology, Israel*

**5:00-5:25 Predictive Shimming Through  
Scripted Process Engineering**

*Dan Gonsor, The Boeing Company, USA*

**5:30-5:55 Adaptive Geometric  
Modeling**

*David Großmann, MTU Aero Engines,  
Germany*

Monday, July 10

## CP1

### Geometric Data Interpolation

4:00 PM-5:40 PM

Room:401

Chair: *Stephen Mann, University of Waterloo, Canada*

#### 4:00-4:15 Approximately Continuous Scatter Data Interpolation

*Stephen Mann and Xiang Fang, University of Waterloo, Canada*

#### 4:20-4:35 Interpolation on Symmetric Riemannian Spaces.

*Geir Bogfjellmo, Chalmers University of Technology, Sweden*

#### 4:40-4:55 An Iterative Approach to Barycentric Rational Hermite Interpolation

*Emiliano Cirillo and Kai Hormann, Università della Svizzera italiana, Switzerland*

#### 5:00-5:15 From Big Data to Smart Data: Modelling Big Data Using Locally Refined Splines

*Heidi Elisabeth I. Dahl, Tor Dokken, and Oliver Barrowclough, SINTEF, Norway*

#### 5:20-5:35 Best-Fit-Deformation using a Moving-Least-Squares-Generated Deformation Vector Field

*Max Langbein, TU Kaiserslautern, Germany; Hans Hagen, University of Kaiserslautern, Germany*

## Intermission

6:00 PM-6:15 PM

Monday, July 10

## PD1

### The Ewald Quak Forward Looking Panel Discussion

6:15 PM-7:15 PM

Room:407

Chair: *Thomas A. Grandine, The Boeing Company, USA*

Chair: *Kai Hormann, Università della Svizzera italiana, Switzerland*

Computer-Aided Geometric Design has been a thriving discipline for more than 30 years. Historically anchored in classical topics such as spline curves and surfaces, this field also covers research and commercial products based on polygonal surfaces and representations of solids, as well as arising new applications, including 3D printing and isogeometric analysis. While previous editions of this panel discussion centered on identifying important trends and potential future directions of the discipline, this year we focus on the educational aspects. What kind of skills does the CAGD industry expect from university graduates and are they educated accordingly? The audience participants will have the chance to challenge the panelists on these and related questions, hopefully leading to lively discussions.

### Panelists:

#### David Großmann

MTU Aero Engines, Germany

#### Thomas Peters

University of Connecticut, USA

#### Helmut Pottmann

Technische Universität Wien, Austria and King Abdullah University of Science & Technology (KAUST), Saudi Arabia

#### Jan Vandenbrande

The Boeing Company, USA

Monday, July 10

## Career Fair, Graduate Student and Industry Reception

7:15 PM-9:15 PM

Room:302-304



## Tuesday, July 11

### Registration

7:30 AM-4:30 PM

Room:Ballroom Gallery - 3rd Floor

### Remarks

8:25 AM-8:30 AM

Room:407

Tuesday, July 11

### IT3

#### Design of 3D Printed Mathematical Art

8:30 AM-9:15 AM

Room:407

Chair: David A. Field, General Motors Research and Development Center, USA

When visualising topological objects via 3D printing, we need a three-dimensional geometric representation of the object. There are approximately three broad strategies for doing this: “Manual” - using whatever design software is available to build the object by hand; “Parametric/Implicit” - generating the desired geometry using a parametrisation or implicit description of the object; and “Iterative” - numerically solving an optimisation problem. The manual strategy is unlikely to produce good results unless the subject is very simple. In general, if there is a reasonably canonical geometric structure on the topological object, then we hope to be able to produce a parametrisation of it. However, in many cases this seems to be impossible and some form of iterative method is the best we can do. I will discuss these matters with many examples, including visualisation of four-dimensional polytopes (using orthogonal versus stereographic projection) and Seifert surfaces (comparing my work with Saul Schleimer with Jack van Wijk’s iterative techniques). I will also describe some computational problems that have come up in my 3D printed work, including the design of 3D printed mobiles (joint work with Marco Mahler), “Triple gear” and a visualisation of the Klein Quartic (joint work with Saul Schleimer), and hinged surfaces with negative curvature (joint work with Geoffrey Irving).

Henry Segerman

Oklahoma State University, USA

Tuesday, July 11

### IT4

#### Shape Control in Curve Design

9:15 AM-10:00 AM

Room:407

Chair: Kai Hormann, Università della Svizzera italiana, Switzerland

Designing techniques for curves with nice shape properties and/or subject to shape constraints is of paramount importance in several applications, ranging from geometric modeling to numerical simulation. Interpolating or approximating schemes that allow a shape control of the resulting curves have received a significant attention in the last decades. Usually, these schemes are based on suitable (spaces of) functions depending on some shape parameters that influence essentially the quality of the resulting interpolant/approximant. An appropriate selection of the shape parameters is crucial. This can be efficiently addressed whenever the shape parameters can be equipped with a suitable geometric interpretation. In this talk we review some recent results on the above schemes. For their relevance in geometric modeling we mainly focus on PH (Pythagorean-hodograph) curves and curves described by subdivision schemes.

Carla Manni

University of Rome II, Tor Vergata, Italy

### Coffee Break



10:00 AM-10:30 AM

Room:Ballroom Gallery - 3rd Floor

Tuesday, July 11

**MS4****3D-Printing: Geometric Design Implementations, Tools and Experiments**

10:30 AM-12:30 PM

Room:401

Since the early 1980's 3d-printing, then called stereo lithography, provided inexpensive models of small parts for OEM's, Original Equipment Manufactures. OEM's used these prototypes to test whether parts could be assembled and fit together precisely for a final product. Suppliers then used the models to manufacture final parts for the finale product. Today 3d-printers can create large parts, use sophisticated composites and make "one of" specialized products for medical and other applications. Less complex and less expensive 3d-printers are now available to demonstrate in an academic setting the role of mathematics in creating real objects. This minisymposium presents algorithmic implementations, creation of computational design tools, design experiments and error detection for 3D-printing and additive manufacturing.

Organizer: David A. Field

General Motors Research and Development Center, USA

Organizer: Rebecca Field

James Madison University, USA

**10:30-10:55 3D-Epug-Overlay: Intersecting Very Large 3D Triangulations in Parallel**

Randolph Franklin and Salles Viana Gomes de Magalhães, Rensselaer Polytechnic Institute, USA

**11:00-11:25 Analytic Methods for Modern Design and Manufacturing**

Morad Behandish, International Computer Science Institute, USA

**11:30-11:55 Math by Design: 3D Printing for the Working Mathematician**

Laura Taalman, James Madison University, USA

**12:00-12:25 A Circle Packing Heuristic with Applications to 3D Printing**

John Bowers, James Madison University, USA

Tuesday, July 11

**MS5****Computational Geometry Issues in Monte Methods for Partial Differential Equations**

10:30 AM-12:30 PM

Room:402

One can solve partial differential equations by many means, including some stochastic methods. These Monte Carlo methods are now popular in materials and nuclear science. One pertinent aspect of these methods is that they require a different type of interaction between the algorithm and the geometry of the region being modeled. In this minisymposium we investigate different geometrical aspects of Monte Carlo methods such as the walk-on-spheres algorithm, and the ray-tracing methods used in neutron transport. We hope to simulate interest in this community in these problems, as the hard part seems to be the geometry.

Organizer: Michael Mascagni

Florida State University, USA

**10:30-10:55 Geometry Entrapment in Walk-on-Subdomains**

Michael Mascagni, Florida State University, USA

**11:00-11:25 Tree-Based Geometrical Decomposition and the Walk-on-Spheres Monte Carlo Algorithm**

Walid Keyrouz, National Institute of Standards and Technology, USA

**11:30-11:55 Optimizing Tree Width for Performance in the Walk-on-Spheres Algorithm**

Derek Juba, National Institute of Standards and Technology, USA

**12:00-12:25 Particle Swarm Optimization for High-dimensional Stochastic Problems**

Hongmei Chi, Florida A &amp; M University, USA

Tuesday, July 11

**MS6****Splines for Surfaces of Arbitrary Topology - Part I of II**

10:30 AM-12:30 PM

Room:407

**For Part 2 see MS7**

The NURBS technology is the de-facto standard in the representation of smooth surfaces for computer design. Nevertheless, a well-recognized deficiency of NURBS is that they are constrained to the rigid tensor product structure of the surface patches. In particular, representing surfaces of arbitrary topology by means of NURBS requires cumbersome and heavy computations, mainly due to the need of enforcing smoothness between adjacent surface elements. Over the years, this deficiency of NURBS has motivated the proposal of several alternative methods of surface representation, including subdivision surfaces, T-splines, manifold splines, ambient B-splines and possibly others. Nevertheless, the quest of a sufficiently robust and efficient surface representation that be compatible with the NURBS standard seems to be far from over. This minisymposium gives an overview of the current state of the art and of some of the more recent approaches for generating surfaces of arbitrary topology.

Organizer: Carolina Beccari

University of Bologna, Italy

Organizer: Mike Neamtu

Vanderbilt University, USA

**10:30-10:55 Spline Orbifold Constructions**

Hartmut Prautzsch, Universität Karlsruhe, Germany

**11:00-11:25 Rational Geometric Splines for Surfaces of Arbitrary Topology**

Carolina Beccari, University of Bologna, Italy; Mike Neamtu, Vanderbilt University, USA

**11:30-11:55 Geometric Construction of Matrix Weighted Rational B-spline Surfaces with Arbitrary Topology**

Xunnian Yang, Zhejiang University, China

**12:00-12:25 Adaptive Surface Reconstruction From Scattered Data by Hierarchical Splines**

Cesare Bracco, University of Florence, Italy; Carlotta Giannelli, Istituto Nazionale di Alta Matematica, Italy; Alessandra Sestini, University of Florence, Italy

**Prizes and Awards Luncheon**

(Offsite at the connected Westin Hotel)

12:30 PM-2:30 PM



Room: Westin Hotel - Allegheny Ballroom - 3rd Floor

Ticket required.

Tuesday, July 11

**SP2****The John Von Neumann Lecture - Singular Perturbations in Noisy Dynamical Systems**

2:30 PM-3:30 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: Nicholas J. Higham, University of Manchester, United Kingdom

Consider a deterministic dynamical system in a domain containing a stable equilibrium, e.g., a particle in a potential well. The particle, independent of initial conditions eventually reaches the bottom of the well. If however, a particle is subjected to white noise, due, e.g., to collisions with a population of smaller, lighter particles comprising the medium through which the Brownian particle travels, a dramatic difference in the behavior of the Brownian particle occurs. The particle can exit the well. The natural questions then are: how long will it take for it to exit and from where on the boundary of the domain of attraction of the equilibrium will it exit. We compute the mean first passage time to the boundary and the probability distribution of boundary points being exit points. When the noise is small each quantity satisfies a singularly perturbed deterministic boundary value problem. We treat the problem by the method of matched asymptotic expansions (MAE) and generalizations thereof. MAE has been used successfully to solve problems in many applications. However, there exist problems for which MAE does not suffice. Among these are problems exhibiting boundary layer resonance, which led some to conclude that this was “the failure of MAE”. We present a physical argument and four mathematical arguments to modify MAE to make it successful. Finally, we discuss applications of the theory.

Bernard Matkowsky  
Northwestern University, USA

Tuesday, July 11

**Coffee Break**

3:30 PM-4:00 PM

Room: Ballroom Gallery - 3rd Floor

**MS7****Splines for Surfaces of Arbitrary Topology - Part II of II**

4:00 PM-5:30 PM

Room: 407

**For Part 1 see MS6**

The NURBS technology is the de-facto standard in the representation of smooth surfaces for computer design. Nevertheless, a well-recognized deficiency of NURBS is that they are constrained to the rigid tensor product structure of the surface patches. In particular, representing surfaces of arbitrary topology by means of NURBS requires cumbersome and heavy computations, mainly due to the need of enforcing smoothness between adjacent surface elements. Over the years, this deficiency of NURBS has motivated the proposal of several alternative methods of surface representation, including subdivision surfaces, T-splines, manifold splines, ambient B-splines and possibly others. Nevertheless, the quest of a sufficiently robust and efficient surface representation that be compatible with the NURBS standard seems to be far from over. This minisymposium gives an overview of the current state of the art and of some of the more recent approaches for generating surfaces of arbitrary topology.

Organizer: Carolina Beccari  
University of Bologna, Italy

Organizer: Mike Neamtu  
Vanderbilt University, USA

Tuesday, July 11

## MS7

### Splines for Surfaces of Arbitrary Topology - Part II of II

4:00 PM-5:30 PM

continued

#### 4:00-4:25 U-splines: Splines Over Unstructured Meshes

*Michael Scott*, Brigham Young University, USA; *Derek C. Thomas* and *Kevin B. Tew*, Coreform LLC, USA; *Michael Borden*, North Carolina State University, USA; *Zhihui Zou*, Brigham Young University, USA

#### 4:30-4:55 Refinable Surfaces with Irregular Layout

*Jorg Peters*, University of Florida, USA; *Kestutis Karciauskas*, Vilnius University, Lithuania

#### 5:00-5:25 Capping Non-Uniform Extraordinary Points

*Xin Li*, University of Science and Technology of China, China

Tuesday, July 11

## MS8

### Parameterization Techniques: From Modeling to Simulation

4:00 PM-6:00 PM

Room:402

The quality of the parameterization of an object continuously (curve or surface) or discretely (set of points) described deeply affects not only the quality of the related CAD representation but also its manipulation and use in subsequent processes/applications. Parameterizations have many direct applications in various fields of science and engineering, including reparameterization of spline surfaces, repair of CAD models, CNC (Computer Numerical Control) machines, meshing, and application to texture mapping. Besides the above classical areas, the parameterization issue has also received a renewed attention in numerical simulation due to the success of Isogeometric Analysis (IgA). IgA is a recent technology that unifies CAD and Finite Element Analysis. Its key concepts is to use the same discretization and representation tools for the design as well as for the analysis, providing a true design-through-analysis methodology. In this context the quality of the parameterization of the physical domain also plays a crucial role because it has a significant impact on the simulation results and on the efficiency of the computations. The minisymposium aims to collect recent relevant contributions about parameterization techniques in various contexts ranging from design of curves and surfaces to numerical simulation.

Organizer: *Carla Manni*

*University of Rome II, Tor Vergata, Italy*

#### 4:00-4:25 Smooth Trajectory Planning with Obstacle Avoidance Based on Pythagorean-hodograph Spline Curves with Tension

*Alessandra Sestini*, University of Florence, Italy; *Carlotta Giannelli*, Istituto Nazionale di Alta Matematica, Italy; *Duccio Mugnaini*, University of Insubria, Italy

#### 4:30-4:55 General Framework for Approximation of Circular Arcs by $G^k$ Parametric Polynomial Interpolants

*Ales Vavpetic* and *Emil Zagar*, University of Ljubljana, Slovenia

#### 5:00-5:25 Smooth Polar Splines for Isogeometric Analysis

*Hendrik Speleers*, University of Rome II, Tor Vergata, Italy; *Deepesh Toshniwal*, *Rene Hiemstra*, and *Thomas J. R. Hughes*, University of Texas at Austin, USA

#### 5:30-5:55 Smooth Parameterization of Complex Domains with Bezier Triangles

*Xiaoping Qian* and *Songtao Xia*, University of Wisconsin, Madison, USA

Tuesday, July 11

**CP2****Applied Geometry**

4:00 PM-6:00 PM

Room:401

Chair: Eric Stachura, Haverford College, USA

**4:00-4:15 Metamaterial Lens Design**Eric Stachura, Haverford College, USA;  
Cristian Gutierrez, Temple University, USA**4:20-4:35 Geometric Structures for Rods and Shells**Giulio G. Giusteri and Eliot Fried, Okinawa  
Institute of Science and Technology, Japan**4:40-4:55 Applications of  
Multidimensional Time Model for  
Probability Cumulative Function to  
Geometrical Predictions**Michael Fundator, National Academy of  
Sciences, USA**5:00-5:15 Selecting Minimum  
Explaining Variables by Pruned Primary  
Ideal Decomposition with Recursive  
Calls**Keiji Miura, Kwansai Gakuin University,  
Japan**5:20-5:35 A New Model for the Biofilm  
Growth Evolution in a Porous Medium  
and Its Effects in the Characteristics of  
the Porous Medium**

Luis A. Lopez, TU Delft, Netherlands

**5:40-5:55 Recovery of Geometrical,  
Topological and Transport Properties of  
Porous Rocks from Micro-Ct Images**Yaroslav Bazaikin, Sobolev Institute of  
Mathematics, Russia; Boris Gurevich,  
Curtin University, Australia; Tatyana  
Khachkova, Institute of Petroleum Geology  
& Geophysics of SB RAS, Russia; Dmitriy  
Kolyukhin, Trofimuk Institute of Petroleum  
Geology and Geophysics SB RAS, Russia  
and Uni CIRP, Norway; Maxim Lebedev,  
Curtin University, Australia; Vadim Lisitsa  
and Vladimir Tcheverda, Institute of  
Petroleum Geology & Geophysics of SB  
RAS, Russia**Intermission**

6:00 PM-6:15 PM

Tuesday, July 11

**SIAM Business Meeting  
and 2017 Fellows  
Recognition**

6:15 PM-7:00 PM



Room: Spirit of Pittsburgh A - 3rd Floor

Complimentary beer and wine will be served.

**Intermission**

7:00 PM-7:30 PM

**SIAG/GD Business Meeting**

7:30 PM-8:00 PM



Room:407

Complimentary beer and wine will be served

Tuesday, July 11

**PP1****Poster Session and Dessert  
Reception**

8:00 PM-10:00 PM

Room: West Atrium - 3rd Floor

**Geometrical, Algebraic, Functional,  
and Correlation Inequalities in  
Support of James-Stein Estimator for  
Multidimensional Projections**Michael Fundator, National Academy of  
Sciences, USA**Numerical Exterior Calculus Methods  
for Hydrodynamics Within Curved Fluid  
Interfaces**Ben J. Gross and Paul Atzberger, University of  
California, Santa Barbara, USA**Linear Independence of LR B-Splines**Francesco Patrizi, SINTEF ICT, Norway; Tor  
Dokken, SINTEF, Norway**Primitive Feature Extraction for  
Bivariate Spline Models**Andrea Raffo, SINTEF ICT, Norway; Tor  
Dokken, SINTEF, Norway**Impossible NURBS via Anamorphic  
Deformation and Texture**Javier Sánchez-Reyes and Jesus M. Chacon,  
Universidad de Castilla-La Mancha, Spain**Manifold Charts for Point Set Surfaces**Martin Skrodzki and Konrad Polthier, Freie  
Universitaet Berlin, Germany**Helical Meshes Via the Cylindrical  
Coordinate System Graph Algorithm**Clayton G. Thomas, Morgan State University,  
USA**Find the Action of Kauffman Bracket  
Skein Algebra on the Skein Module of  
the 3-Twist Knot Complement**Hongwei Wang and Gelca Razvan, Texas Tech  
University, USA**Fracture Model Reduction and  
Optimization for Nonlinear Flows in  
Porous Media**Pushpi J. Paranamana, Eugenio Aulisa,  
Magdalena Toda, and Akif Ibragimov,  
Texas Tech University, USA

## Wednesday, July 12

### Registration

8:00 AM-4:30 PM

Room: Ballroom Gallery - 3rd Floor

### Remarks

8:25 AM-8:30 AM

Room: 407

## IT5

### Simulating Cloth, Paper, and Other Thin Shells Using Discrete Differential Geometry

8:30 AM-9:15 AM

Room: 407

Chair: David A. Field, General Motors  
Research and Development Center, USA

Many everyday materials such as cloth and paper have the geometry of a thin surface. Although thin 2D structures are seemingly simple, such materials are challenging to simulate efficiently due to the highly geometrically nonlinear and global deformations that they undergo as they fold, wrinkle, and crumple. The physics of thin shells can be elegantly discretized using ideas from discrete differential geometry, but accurate and efficient handling of phenomena like crumpling, self-contact, swelling, and burning remains difficult. I will explain how the physical behaviors of materials like cloth and paper are intimately tied to their geometry, discuss recent approaches from computer graphics for discretizing and simulating these behaviors, describe applications to forward and inverse problems that involve growth and other changes in intrinsic geometry, and sketch the challenges and open problems that remain at this intersection of geometry and physics of thin shells.

Etienne Vouga

University of Texas at Austin, USA

Wednesday, July 12

## IT6

### Efficient Developable Surface Modeling: From Garment Design, to Paper Animation

9:15 AM-10:00 AM

Room: 407

Chair: Cynthia Phillips, Sandia National  
Laboratories, USA

Developable surfaces, which are surfaces made from bent 2D patterns, have applications ranging from commonly met crumpled sheet of paper, to specific industrial or architectural design. Still, modeling, deforming, and animating 3D developable surfaces efficiently remains a challenge. These surfaces must be isometric to their associated pattern, thus involving non-linear constraint, and may also exhibit non-smooth geometry, which doesn't fit well to standard optimization approach. In this talk, we will describe a way to design and generate developable surfaces with folds from 2D sketches, and a new hybrid model able to interactively animate a virtual sheet of paper in mixing geometric approach and simulation.

Damien Rohmer

Inria and ENS Lyon, France

### Coffee Break

10:00 AM-10:30 AM



Room: Ballroom Gallery - 3rd Floor

Wednesday, July 12

## MS9

### Discrete Vector Field Analysis and Applications

10:30 AM-12:30 PM

Room: 402

Vector-fields are omnipresent in various areas of applied geometry such as flow fields in fluid dynamics, as scalar-, tensor- and frame-fields in visualization, or as gradient or co-gradient fields of potential functions at the core of recent surface parametrization algorithms. Core issues relate to effective discretization, Hodge-type decomposition, design and others. The minisymposium brings together experts from the various fields to discuss ongoing developments and combine research activities.

Organizer: Konrad Polthier

Freie Universitaet Berlin, Germany

**10:30-10:55 Discrete (Multi-) Vector  
Field Design: Representations,  
Applications and Challenges**

Olga Diamanti, Stanford University, USA

**11:00-11:25 Title Not Available At Time  
Of Publication**

Maks Ovsjanikov, Ecole Polytechnique,  
France

**11:30-11:55 Vector Field Visualization  
with Gradient Tensor Analysis**

Eugene Zhang, Oregon State University, USA

**12:00-12:25 Boundary-Sensitive Hodge  
Decompositions**

Konrad Polthier, Freie Universitaet Berlin,  
Germany

Wednesday, July 12

## MS10

### New Trends in Generalized Barycentric Coordinates

10:30 AM-12:30 PM

Room:407

Generalized barycentric coordinates for polygons, polytopes, and smooth domains have been an area of active research in the last two decades. Besides the interesting mathematical aspects, these methods lead to applications in Geometric Design, Computer Graphics, Finite Element Methods, and Robotics. This minisymposium gives an overview of some new trends in the field. In particular, it focuses on the construction of coordinates for star polygons and smooth domains, as well as the application of barycentric coordinates to multi-sided surface patches and path planning.

Organizer: Kai Hormann

*Università della Svizzera italiana, Switzerland*

#### 10:30-10:55 Barycentric Coordinates for Star Polygons

*Eugene L. Wachspress, Columbia University, USA*

#### 11:00-11:25 On Transfinite Versions of Generalized Barycentric Coordinates

*Alexander G. Belyaev, Heriot-Watt University, Scotland*

#### 11:30-11:55 Multi-Sided Patches and Generalized Barycentric Coordinates

*Scott Schaefer, Texas A&M University, USA*

#### 12:00-12:25 Path Planning with Generalized Barycentric Coordinates

*Renjie Chen, Max Plank Institute, Germany; Craig Gotsman, Technion, Israel; Kai Hormann, Università della Svizzera italiana, Switzerland*

Wednesday, July 12

## CP3

### Geometry in Finite Elements and Optimization

10:30 AM-12:10 PM

Room:401

*Chair: Bonita V. Saunders, National Institute of Standards and Technology, USA*

#### 10:30-10:45 Adaptive Grids for Accurate Visualizations of Complex Function Data

*Bonita V. Saunders, National Institute of Standards and Technology, USA*

#### 10:50-11:05 Parametric Finite Elements with Bijective Mappings

*Patrick Zulian, Teseo Schneider, Kai Hormann, and Rolf Krause, Università della Svizzera italiana, Switzerland*

#### 11:10-11:25 Folding Flat Plates Using Surface Tension

*Nicholas D. Brubaker, University of Arizona, USA*

#### 11:30-11:45 Optimization in Shape Spaces

*Kathrin Welker, Volker H. Schulz, and Martin Siebenborn, University of Trier, Germany*

#### 11:50-12:05 Mesh Denoising Based on Normal Voting Tensor and Binary Optimization

*Sunil K. Yadav and Ulrich Reitebuch, Freie Universität Berlin, Germany; Konrad Polthier, Freie Universität Berlin, Germany*

## Lunch Break

12:30 PM-2:00 PM

*Attendees on their own*

Wednesday, July 12

## SP3

### Past President's Address: The Future of SIAM: Looking to the Mathematicians of Tomorrow

2:00 PM-3:00 PM

Room: Spirit of Pittsburgh A - 3rd Floor

*Chair: Nicholas J. Higham, University of Manchester, United Kingdom*

During my tenure as SIAM president, I sought to emphasize that the 'S' in SIAM stands for students by focusing on boosting our global presence and cultivating the next generation of mathematicians. To all the long-time SIAM members, can you guess how many new international chapters we've added since 2012? To all the new SIAM student members we've welcomed in that period, can you name all the ways SIAM can help you grow your careers? At the 2017 SIAM Annual Meeting I will invite our Student Chapters to use their own words to answer these important questions through a series of videos spanning several continents. The advances we've made should make us all proud. Of course, there's always more that SIAM can do as it continues to push ahead in order to remain at the vanguard of the scientific community.

Irene Fonseca

*Carnegie Mellon University, USA*

Wednesday, July 12

**SP4****James H. Wilkinson  
Numerical Analysis and  
Scientific Computing  
Prize Lecture: Tensors in  
Computational Mathematics**

3:00 PM-3:30 PM

*Room: Spirit of Pittsburgh A - 3rd Floor**Chair: To Be Determined*

We show that in many instances, one would find a higher-order tensor, usually of order three, at the core of an important problem in computational mathematics. The resolution of the problem depends crucially on determining certain properties of its corresponding tensor. We will draw examples from (i) numerical linear algebra: fastest/stablest algorithms for matrix product, matrix inversion, or structured matrix computations; (ii) numerical optimization: SDP-relaxations of NP-hard problems, self-concordance, higher-order KKT conditions; and, if time permits, (iii) numerical PDEs: tensor network ranks. This talk is based on joint works with Ke Ye, with Shenglong Hu, and with Shmuel Friedland.

Lek-Heng Lim

*University of Chicago, USA***Coffee Break**

3:30 PM-4:00 PM

*Room: Ballroom Gallery - 3rd Floor*

Wednesday

Wednesday, July 12

**MS11****Subdivision Schemes in  
Geometric Design - Recent  
Advances and New Trends**

4:00 PM-6:00 PM

*Room: 401*

Subdivision schemes and refinable functions are related topics of current interest and importance in computer-aided geometric design, computer graphics and visualization. The purpose of this minisymposium is to gather scientists that work on different aspects of this topic, offering them the possibility to present new results and recent steps forward in their respective fields, and providing an opportunity for discussion among the audience and the speakers, about the current state of the art and future research directions. The selected talks deal with both theoretical issues (analysis, properties investigation, construction) and applied problems arising from technology and applications.

Organizer: Lucia Romani

*University of Milano-Bicocca, Italy*

Organizer: Carolina Beccari

*University of Bologna, Italy***4:00-4:25 Subdivision Methods for  
Biomembranes**

Thomas Yu, Drexel University, USA

**4:30-4:55 Quincunx Subdivision  
Schemes and Tight Framelets with  
Linear-phase Moments**

Bin Han, University of Alberta, Canada

**5:00-5:25 Analysis of Univariate Non-  
Uniform Subdivision Schemes**

Jungho Yoon, Ewha W. University, Korea

**5:30-5:55 On the Convergence of  
Unstructured T-splines and Catmull-  
Clark Subdivision in Isogeometric  
Analysis**

Weiyan Ma, Yue Ma, and Xiaoyun Yuan, City University of Hong Kong, Hong Kong;  
Michael Scott, Brigham Young University, USA

Wednesday, July 12

**MS12****Architectural Geometry**

4:00 PM-6:00 PM

*Room: 402*

Free forms constitute one of the major trends within contemporary architecture. While the digital design of freeform geometry with current modeling tools is well understood, the actual fabrication on the architectural scale is a big challenge: one has to decompose the skins into manufacturable panels, provide appropriate support structures, meet structural constraints and last, but not least make sure that the cost does not become excessive. These practical requirements form a rich source of research topics in geometry and geometric computing. The minisymposium presents recent progress in the emerging field of Architectural Geometry, elaborates on important relations to contemporary research in Discrete Differential Geometry and Geometric Optimization, discusses fabrication-aware design systems and illustrates the transfer of mathematical research into the architectural practice at hand of selected projects.

Organizer: Helmut Pottmann

*Technische Universitaet Wien, Austria and  
King Abdullah University of Science &  
Technology (KAUST), Saudi Arabia*

**4:00-4:25 Mapping Materials:  
Computational Methods for Material-  
Aware Design**

Mark Pauly, EPFL, France

**4:30-4:55 Surface Rationalization and  
Design for Robotic Hot-Blade Cutting**

David Brander, Technical University of Denmark, Denmark

**5:00-5:25 Formfinding with Polyhedral  
Meshes**

*Helmut Pottmann, Technische Universitaet  
Wien, Austria and King Abdullah University  
of Science & Technology (KAUST), Saudi  
Arabia*

**5:30-5:55 Architectural Geometry in  
Practice**

*Konstantinos Gavriil, Evolute GmbH, Vienna  
University of Technology, Austria*

Wednesday, July 12

**MS13****Isogeometric Design and Analysis**

4:00 PM-6:00 PM

Room:407

Isogeometric design and analysis is a growing area of research in the computational engineering community. In an isogeometric approach, the exact CAD representation is adopted as the basis for analysis. To unlock the full potential of an isogeometric approach depends strongly upon the analysis-suitable nature of the underlying geometry. Analysis-suitable geometry possesses a basis that is rich enough for both shape and solution representation. The exact analysis-suitable representation of smooth geometry is essential for correct solution behavior across many application domains. Several examples, among many, include shells, contact, boundary layer phenomena, and model reduction techniques such as boundary elements. Additionally, functional smoothness, inherent in most analysis-suitable spline bases provide additional possibilities such as increased robustness and accuracy of numerical solutions and the direct discretization of higher-order PDEs. Additionally, in design, properly formulated geometry eliminates the possibility of producing “dirty” geometry that greatly hampers downstream analysis operations and prevents integrated and efficient design-through-analysis.

Organizer: Michael Scott  
*Brigham Young University, USA*

Organizer: John Evans  
*University of Colorado Boulder, USA*

Organizer: Michael Borden  
*North Carolina State University, USA*

**4:00-4:25 Mesh Quality of Mixed-Element Bernstein-Bezier Meshes**

*Luke Engvall, University of Colorado Boulder, USA*

**4:30-4:55 Title Not Available At Time Of Publication**

*Xifeng Gao, New York University, USA*

**5:00-5:25 Truncated Hierarchical Box Splines in Isogeometric Analysis**

*Tadej Kanduc, University of Firenze, Italy*

**5:30-5:55 Smooth Spline Spaces on Unstructured Quadrilateral and Hexahedral Meshes: Geometric Design and Isogeometric Analysis Considerations**

*Deepesh Toshniwal, University of Texas at Austin, USA*

**Intermission**

6:00 PM-6:15 PM

Wednesday, July 12

**SP5****I.E. Block Community Lecture: From Flatland to Our Land: A Mathematician's Journey through Our Changing Planet**

6:15 PM-7:15 PM

Room: Spirit of Pittsburgh A - 3rd Floor

Chair: *Nicholas J. Higham, University of Manchester, United Kingdom*

Mathematics is central to our understanding of the world around us. We live in a vast dynamical system, the many dimensions of which can be interrogated with mathematical tools. In this talk I will consider our changing climate. I will describe the scientific evidence that tells us how and why our climate is changing, and what the future may hold. In this journey I will pause at various waypoints to describe in more detail some of the insight different branches of mathematics are providing. Diverse examples will include applying ideas from dynamical systems research to create novel strategies for measuring the ocean mixing processes that are critical to the flow of heat and carbon through the Earth system, through to employing statistical learning techniques to improve future predictions of Arctic sea ice, currently in perilous decline. Climate change is one of the greatest challenges facing humanity. Responding to the challenge requires robust scientific evidence to inform policies. Opportunities for mathematicians to contribute to this important issue abound.

Emily Shuckburgh  
*British Antarctic Survey, United Kingdom*

**Community Reception**

7:15 PM-8:15 PM

Room: North Terrace - Level 4



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Liu, Xin, CP29, 5:00 Fri

Lockhart, Deborah, MS74, 5:00 Fri

Loe, Jennifer A., PP2, 8:00 Tue

Loh, Po-Shen, IT2, 9:15 Mon

Long, Jason, MS88, 11:30 Fri

Louis, Maxime, MS99, 4:30 Fri

Lu, Jiajun, CP23, 4:20 Thu

Lu, Yun, CP22, 5:20 Thu

Lukas, Petr, CP27, 10:50 Fri

Lunasin, Evelyn, MS48, 11:30 Wed

Lustig, Rolf, MS36, 4:30 Tue

## M

Ma, Yannan, CP7, 10:50 Tue

Mabuza, Sibusiso, CP4, 4:20 Mon

Mach, Minh N., MS25, 12:00 Tue

Mach, Thomas, CP28, 4:40 Fri

Mackay, Alex, PP4, 8:00 Tue

MacLean, John, MS21, 11:00 Tue

Mahapatra, Chitaranjan, CP12, 12:10 Wed

Maier, Matthias, MS61, 5:00 Wed

Maki, Kara L., CP2, 10:30 Mon

Maki, Kara L., PP1, 8:00 Tue

Mandli, Kyle T., MS61, 4:30 Wed

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Manore, Carrie A., MS82, 5:00 Thu

Mantic, Vladislav, MS70, 10:30 Thu

Mao, Zhiping, MS34, 5:00 Tue

Marcinek, Pawel B., CP28, 5:00 Fri

Margetis, Dionisios, MS60, 4:00 Wed

Mark, Benjamin, MS5, 10:30 Mon

Markensteijn, Anne S., PP4, 8:00 Tue

Marsden, Alison, IT6, 9:15 Wed

*Martcheva, Maia, MS26, 10:30 Tue*

Martcheva, Maia, MS26, 10:30 Tue

*Martcheva, Maia, MS38, 4:00 Tue*  
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 Mateus, William, PP1, 8:00 Tue  
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 Matkowsky, Bernard, SP2, 2:30 Tue  
 Matott, Shawn L., CP11, 11:50 Wed  
 Matveev, Victor, MS63, 4:30 Wed  
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*Mayo, Talea, MS32, 4:00 Tue*  
 Mayo, Talea, MS32, 5:30 Tue  
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*McInnes, Lois Curfman, MS61, 4:00 Wed*  
 McInnes, Lois Curfman, MS61, 4:00 Wed  
*Melara, Luis, MS9, 10:30 Mon*  
*Melara, Luis, MS19, 4:00 Mon*  
 Meng, Zhaoyi, PP2, 8:00 Tue  
 Mercado, Pedro, MS66, 11:30 Thu  
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 Mi, Changwen, MS78, 5:00 Thu  
*Michael, Edwin, MS84, 10:30 Fri*  
 Michael, Edwin, MS84, 10:30 Fri  
*Micheli, Mario, MS90, 10:30 Fri*  
*Micheli, Mario, MS99, 4:00 Fri*  
 Milovanovic, Slobodan, CP25, 10:50 Fri  
 Minden, Victor, MS85, 11:00 Fri  
 Mitchell, Christopher, MS73, 12:00 Thu  
 Mniszewski, Susan, MS43, 11:00 Wed  
*Mogilevskaia, Sofia, MS70, 10:30 Thu*  
*Mogilevskaia, Sofia, MS78, 4:00 Thu*  
*Mogilevskaia, Sofia, MS96, 4:00 Fri*  
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 Mondaini, Cecilia F., MS33, 5:00 Tue  
 Montag, Aaron, MS57, 5:00 Wed  
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*Moragues Ginard, Margarida, MS89, 10:30 Fri*  
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 Morrison, Katherine, MS29, 10:30 Tue  
 Morzfeld, Matthias, MS21, 10:30 Tue

*Morzfeld, Matthias, MS33, 4:00 Tue*  
*Morzfeld, Matthias, MS48, 10:30 Wed*  
*Mubayi, Anuj, MS84, 10:30 Fri*  
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*Mueller, Jennifer L., MS25, 10:30 Tue*  
*Mueller, Jennifer L., MS37, 4:00 Tue*  
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*Mueller, Jennifer L., MS64, 4:00 Wed*  
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*Muller, Peter A., MS25, 10:30 Tue*  
*Muller, Peter A., MS37, 4:00 Tue*  
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*Narayan, Akil, MS72, 10:30 Thu*  
*Narayan, Akil, MS79, 4:00 Thu*  
*Narayan, Akil, MS90, 10:30 Fri*  
 Narayan, Akil, MS83, 11:00 Fri  
*Narayan, Akil, MS99, 4:00 Fri*  
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 Neches, Russell Y., MS39, 5:30 Tue  
*Neda, Monika, MS101, 4:00 Fri*  
 Neda, Monika, MS101, 4:00 Fri  
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*Needell, Deanna, MT3, 10:30 Fri*  
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*Neumann, Philipp, MS24, 10:30 Tue*  
*Neumann, Philipp, MS36, 4:00 Tue*  
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*Ng, Michael, MS85, 10:30 Fri*  
*Ng, Michael, MS97, 4:00 Fri*  
 Nucci, Maria Clara, MS15, 5:30 Mon

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*Riviere, Beatrice, MS11, 4:00 Mon*

*Riviere, Beatrice, MS31, 4:00 Tue*

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Ryan, Shawn D., MS45, 10:30 Wed

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*Sargsyan, Khachik, MS59, 4:00 Wed*

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Schönlieb, Carola-Bibiane, MS75, 4:30 Thu

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*Schwartz, Russell, MS39, 4:00 Tue*

Schwartz, Russell, MS39, 4:00 Tue

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*Sun, Weiran, MS91, 10:30 Fri*

*Sun, Weiran, MS100, 4:00 Fri*

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*Teranishi, Keita, MS40, 4:00 Tue*  
 Teranishi, Keita, MS40, 4:00 Tue  
*Teranishi, Keita, MS51, 10:30 Wed*  
 Terejanu, Gabriel, MS59, 4:30 Wed  
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 Dowling, Alexander W., MS39, 11:00 Wed  
*Dufour, Francois, MS10, 10:30 Mon*  
 Dufour, Francois, MS5, 11:00 Mon

## E

Eisa, Sameh, CP7, 4:40 Tue

## F

*Fahroo, Fariba, MS4, 10:30 Mon*  
*Fahroo, Fariba, MS14, 4:00 Mon*  
 Fahroo, Fariba, MS14, 5:30 Mon  
*Fahroo, Fariba, MS24, 10:30 Tue*  
 Falcone, Maurizio, MS3, 11:30 Mon  
 Faraji, Mojdeh, MS37, 11:00 Wed  
 Festa, Adriano, MS19, 4:30 Mon  
 Fong, Brendan, MS47, 4:00 Wed  
 Fonseca, Irene, SP3, 2:00 Wed  
 Fragulis, George F., PP1, 8:00 Tue  
*Frankowska, Helene, MS9, 10:30 Mon*  
 Frankowska, Helene, MS9, 11:00 Mon  
 Fundator, Michael, PP1, 8:00 Tue

## G

Gaitsgory, Vladimir, MS33, 10:30 Wed  
 Gallo, Dominick, MS41, 5:30 Wed  
 Ghris, Robert W., MS38, 11:30 Wed  
 Goebel, Rafal, MS13, 4:00 Mon  
 Gong, Qi, MS14, 5:00 Mon  
 Gong, Wei, MS21, 11:30 Tue  
 Gorodetsky, Alex A., MS4, 10:30 Mon  
 Graber, P. Jameson, MS46, 5:30 Wed  
 Grigorieva, Ellina V., MS23, 11:00 Tue  
*Gugat, Martin, MS32, 10:30 Wed*

Gugat, Martin, MS32, 10:30 Wed  
Gutekunst, Juergen, MS48, 4:30 Wed

**H**

Hackbarth, Axel, MS34, 11:00 Wed  
*Hager, William, MS19, 4:00 Mon*  
*Hager, William, MS37, 10:30 Wed*  
Hamadene, Said, MS25, 11:30 Tue  
Hammar, Karima, CP8, 4:20 Tue  
Hamzi, Boumediene, CP3, 4:20 Tue  
Hauptmann, Christian, MS27, 10:30 Tue  
Helmes, Kurt, MS36, 12:00 Wed  
Hernández, Diego L., PP1, 8:00 Tue  
Hernandez-Hernandez, Daniel, MS15, 5:00 Mon  
Hill, David, MS8, 11:30 Mon  
Hosoya, Yuhki, MS42, 5:00 Wed  
Howe, Sei, CP6, 4:20 Tue  
Hu, Weiwei, MS31, 11:30 Wed  
Huan, Xun, MS4, 11:30 Mon

**I**

*Ilak, Milos, MS28, 10:30 Tue*  
Ilak, Milos, MS28, 10:30 Tue  
Ilic, Marija, MS8, 12:00 Mon  
Ito, Kazufumi, MS43, 4:30 Wed

**J**

Jacka, Saul, MS25, 10:30 Tue  
Jafarpour, Saber, CP6, 5:00 Tue  
Jasso-Fuentes, Hector, MS45, 5:30 Wed  
Jiang, Yilun, MS46, 5:00 Wed  
Jin, Zhuo, CP4, 4:00 Tue

**K**

Kaise, Hidehiro, CP1, 5:40 Tue  
Kaminski, Yirmeyahu, MS13, 4:30 Mon  
*Kang, Wei, MS2, 10:30 Mon*  
Kang, Wei, MS2, 11:30 Mon  
*Kang, Wei, MS12, 4:00 Mon*

*Kang, Wei, MS34, 10:30 Wed*  
*Kang, Wei, MS43, 4:00 Wed*  
Kang, Wei, MS43, 5:00 Wed  
Khargonekar, Pramod, MS8, 11:00 Mon  
Khurshudyan, Asatur, CP6, 5:20 Tue  
Kim, Taewoo, CP2, 5:00 Tue  
King, Ryan, MS28, 11:30 Tue  
*King, Sarah, MS34, 10:30 Wed*  
King, Sarah, MS34, 12:00 Wed  
*King, Sarah, MS43, 4:00 Wed*  
Kirchner, Matthew, MS12, 5:00 Mon  
Knyazev, Andrew, CP2, 4:40 Tue  
Korda, Milan, MS28, 11:00 Tue  
Koskela, Antti, MS40, 5:00 Wed  
Kostina, Ekaterina, MS33, 11:00 Wed  
Kramer, Boris, MS4, 11:00 Mon

**L**

Lagor, Frank D., MS43, 4:00 Wed  
Lamb, Sarah T., CP7, 4:00 Tue  
Lasserre, Jean-Bernard, IT2, 9:15 Mon  
Lavaei, Javad, IT9, 9:15 Wed  
Leander, Rachel, MS17, 5:00 Mon  
Leidereiter, Conrad, MS29, 11:30 Tue  
*Lenhart, S.M., MS37, 10:30 Wed*  
Leonard, Naomi E., JP1, 2:00 Mon  
Levine, Jean, CP1, 4:20 Tue  
Lim, Lek-Heng, SP4, 3:00 Wed  
Liu, Jun, CP2, 4:20 Tue  
Liu, Ruihua, MS35, 11:30 Wed  
Liu, Ruihua, MS45, 4:30 Wed  
Long, Hongwei, MS16, 4:30 Mon  
Louis-Rose, Carole, CP5, 4:40 Tue

**M**

Maeda, Jun, CP4, 5:00 Tue  
Malladi, Surya Prakash, CP6, 4:40 Tue  
Marden, Jason, IT6, 9:45 Tue  
Mariconda, Carlo, MS33, 11:30 Wed

Marigonda, Antonio, MS22, 12:00 Tue  
Marinoschi, Gabriela, MS3, 12:00 Mon  
Martinelli, Agostino, CP8, 5:20 Tue  
Matkowsky, Bernard, SP2, 2:30 Tue  
Mazzola, Marco, MS9, 11:30 Mon  
McEaney, William M., IT5, 9:20 Tue  
McEaney, William M., MS12, 4:30 Mon  
McEaney, William M., MS35, 10:30 Wed  
*Mei, Hongwei, MS35, 10:30 Wed*  
Mei, Hongwei, MS35, 12:00 Wed  
*Mena, Hermann, MS40, 4:00 Wed*  
Messaoudi, Salim, CP3, 4:40 Tue  
Migorski, Stanislaw, MS13, 5:00 Mon  
Miller Neilan, Rachael, MS37, 10:30 Wed  
Mischiati, Matteo, CP7, 4:20 Tue  
Mischiati, Matteo, PP1, 8:00 Tue  
*Moehlis, Jeff, MS27, 10:30 Tue*  
Moehlis, Jeff, CP5, 4:00 Tue  
*Mordukhovich, Boris, MS3, 10:30 Mon*  
*Mordukhovich, Boris, MS13, 4:00 Mon*  
*Mordukhovich, Boris, MS23, 10:30 Tue*  
*Mordukhovich, Boris, MS30, 4:00 Tue*  
*Mordukhovich, Boris, MS33, 10:30 Wed*  
Mordukhovich, Boris, MS33, 12:00 Wed  
*Mordukhovich, Boris, MS42, 4:00 Wed*  
*Morris, Kirsten, MS1, 10:30 Mon*  
Morris, Kirsten, MS1, 10:30 Mon  
*Morris, Kirsten, MS18, 4:00 Mon*  
Moye, Matthew, PP1, 8:00 Tue

**N**

Netoff, Theoden I., MS7, 11:00 Mon  
*Netoff, Theoden I., MS27, 10:30 Tue*  
Nguyen, Duy, MS6, 11:00 Mon  
Nguyen, Hai Dang, MS36, 10:30 Wed  
Nguyen, Son L., MS36, 11:00 Wed  
Nguyen, Thu T., PP1, 8:00 Tue

*Nguyen, Tien Khai E., MS22, 10:30 Tue*  
 Nguyen, Tien Khai E., MS22, 10:30 Tue  
*Nicholson, Bethany, MS29, 10:30 Tue*  
 Nicholson, Bethany, MS29, 12:00 Tue  
*Nicholson, Bethany, MS39, 10:30 Wed*  
*Nicholson, Bethany, MS48, 4:00 Wed*

**O**

*Ortiz-Robinson, Norma, MS46, 4:00 Wed*  
 Osher, Stanley J., MS2, 10:30 Mon

**P**

Paladino, Michele, MS46, 4:00 Wed  
 Palladino, Michele, IT7, 9:45 Tue  
 Pan, Xiaoyang, CP8, 4:40 Tue  
 Pang, Tao, MS25, 11:00 Tue  
 Pantha, Buddhi, MS37, 11:30 Wed  
 Pemy, Moustapha, MS6, 12:00 Mon  
 Pereira, Fernando L., MS23, 11:30 Tue  
 Pfefferer, Johannes, MS11, 5:00 Mon  
*Polis, Michael P., MS8, 10:30 Mon*  
*Prager, David J., MS6, 10:30 Mon*  
 Prager, David J., MS6, 10:30 Mon  
 Proctor, Joshua L., MS28, 12:00 Tue

**R**

Rajasekaran, Manikandan, CP3, 5:00 Tue  
 Rao, Anil, MS19, 5:30 Mon  
 Ravandi, Babak, CP6, 4:00 Tue  
 Reddy, Puduru V., CP4, 5:40 Tue  
 Ren, Dan, MS45, 5:00 Wed  
 Rios, Vinicio, MS46, 4:30 Wed  
 Ritt, Jason, MS27, 12:00 Tue  
*Rodriguez, Sergio, MS40, 4:00 Wed*  
 Rodriguez, Sergio, MS40, 4:00 Wed  
 Ross, Isaac, MS24, 11:30 Tue  
*Rubin, Jonathan E., MS7, 10:30 Mon*  
*Rubin, Jonathan E., MS17, 4:00 Mon*  
 Rubin, Jonathan E., MS17, 4:00 Mon  
 Rueffler, Fabian, CP1, 5:00 Tue

*Ruszczynski, Andrzej, MS20, 4:00 Mon*  
 Ruszczynski, Andrzej, MS20, 4:00 Mon

**S**

Sachs, Ekkehard W., MS11, 4:30 Mon  
 Saeed, Usman, CP7, 5:00 Tue  
*Sagara, Nobusumi, MS3, 10:30 Mon*  
*Sagara, Nobusumi, MS13, 4:00 Mon*  
*Sagara, Nobusumi, MS23, 10:30 Tue*  
*Sagara, Nobusumi, MS30, 4:00 Tue*  
*Sagara, Nobusumi, MS33, 10:30 Wed*  
*Sagara, Nobusumi, MS42, 4:00 Wed*  
 Sagara, Nobusumi, MS42, 5:30 Wed  
 Savku, Emel, CP4, 4:20 Tue  
*Schenk, Christina, MS29, 10:30 Tue*  
*Schenk, Christina, MS39, 10:30 Wed*  
*Schenk, Christina, MS48, 4:00 Wed*  
 Schenk, Christina, MS48, 5:30 Wed  
*Schulz, Volker H., MS41, 4:00 Wed*  
 Shi, Jingtao, MS44, 5:30 Wed  
 Shi, Ying, MS18, 5:30 Mon  
 Shuckburgh, Emily, SP5, 6:15 Wed  
*Shvartsman, Ilya, MS3, 10:30 Mon*  
*Shvartsman, Ilya, MS13, 4:00 Mon*  
*Shvartsman, Ilya, MS23, 10:30 Tue*  
*Shvartsman, Ilya, MS30, 4:00 Tue*  
 Shvartsman, Ilya, MS30, 4:30 Tue  
*Shvartsman, Ilya, MS33, 10:30 Wed*  
*Shvartsman, Ilya, MS42, 4:00 Wed*  
*Siebenborn, Martin, MS41, 4:00 Wed*  
 Silva, Cristiana J., MS23, 12:00 Tue  
*Silva, Geraldo N., MS3, 10:30 Mon*  
*Silva, Geraldo N., MS13, 4:00 Mon*  
*Silva, Geraldo N., MS23, 10:30 Tue*  
*Silva, Geraldo N., MS30, 4:00 Tue*  
 Silva, Geraldo N., MS30, 5:00 Tue  
*Silva, Geraldo N., MS33, 10:30 Wed*  
*Silva, Geraldo N., MS42, 4:00 Wed*  
*Siu, Tak-Kuen, MS16, 4:00 Mon*

Smirnov, Ilya, CP1, 5:20 Tue  
 Smith, Derek, CP3, 4:00 Tue  
 Song, Jian, MS44, 4:30 Wed  
 Song, Xiaoming, MS44, 4:00 Wed  
 Sorrentino, Alfonso, MS22, 11:30 Tue  
 Souza, Diego, MS1, 12:00 Mon  
 Sparks, Andrew, IT3, 8:30 Tue  
*Speranzon, Alberto, MS38, 10:30 Wed*  
 Speranzon, Alberto, MS38, 10:30 Wed  
*Speranzon, Alberto, MS47, 4:00 Wed*  
 Spiller, Elaine, MS34, 10:30 Wed  
 Spivak, David I., MS38, 11:00 Wed  
 Stechlinski, Peter G., MS39, 10:30 Wed  
 Steffensen, Sonja, MS32, 12:00 Wed  
*Stockbridge, Richard, MS26, 10:30 Tue*  
 Stockbridge, Richard, MS26, 12:00 Tue  
*Stockbridge, Richard, MS36, 10:30 Wed*  
*Stockbridge, Richard, MS45, 4:00 Wed*  
 Sumin, Mikhail, MS30, 5:30 Tue  
 Surana, Amit, MS24, 12:00 Tue

**T**

Tabuada, Paulo, MS47, 4:30 Wed  
*Tang, Shuxia, MS1, 10:30 Mon*  
*Tang, Shuxia, MS18, 4:00 Mon*  
 Tang, Shuxia, MS18, 4:00 Mon  
 Tannenbaum, Allen, IT1, 8:30 Mon  
 Thierry, David, MS48, 5:00 Wed  
*Thomas, Peter J., MS7, 10:30 Mon*  
 Thomas, Peter J., MS7, 10:30 Mon  
*Thomas, Peter J., MS17, 4:00 Mon*  
 Tiago, Jorge, MS40, 5:30 Wed  
 Trautwein, Christoph, MS40, 4:30 Wed  
*Tröltzsch, Fredi, MS11, 4:00 Mon*  
 Tröltzsch, Fredi, MS11, 5:30 Mon  
*Tröltzsch, Fredi, MS21, 10:30 Tue*

**V**

Veliov, Vladimir, MS19, 4:00 Mon

Venturi, Daniele, MS2, 12:00 Mon  
 Vieten, Martin, MS26, 11:00 Tue  
 Villa, Umberto, MS24, 11:00 Tue  
*Vinter, Richard B., MS9, 10:30 Mon*  
 Vinter, Richard B., MS9, 10:30 Mon  
 Vollmann, Christian, MS41, 4:00 Wed

## W

Walch, Olivia, MS17, 5:30 Mon  
 Wan, Wei, MS29, 11:00 Tue  
*Wang, Guangchen, MS44, 4:00 Wed*  
 Wang, Ji, MS43, 5:30 Wed  
*Wang, Le Yi, MS8, 10:30 Mon*  
 Wang, Le Yi, MS8, 10:30 Mon  
 Wang, Le Yi, MS35, 11:00 Wed  
 Wang, Shuo, CP2, 4:00 Tue  
 Wang, Xiuquan, CP5, 5:00 Tue  
 Wang, Yajun, CP7, 5:20 Tue  
 Weerasinghe, Ananda, MS26, 11:30 Tue  
*Williams, Matthew, MS28, 10:30 Tue*  
 Wilson, Dan D., MS27, 11:00 Tue  
*Wu, Zhen, MS44, 4:00 Wed*

## X

Xie, Xiaoxia, MS1, 11:00 Mon  
 Xiu, Dongbin, MS14, 4:00 Mon

## Y

Yan, Ruofan, MS20, 5:30 Mon  
 Yang, Qingqing, CP4, 5:20 Tue  
 Yao, Jianing, MS20, 5:00 Mon  
 Yao, Song, MS6, 11:30 Mon  
*Yin, George, MS5, 10:30 Mon*  
*Yin, George, MS15, 4:00 Mon*  
*Yin, George, MS25, 10:30 Tue*  
*Yin, George, MS35, 10:30 Wed*  
*Yong, Jiongmin, MS15, 4:00 Mon*  
 Yong, Jiongmin, MS26, 10:30 Tue  
*Yong, Jiongmin, MS25, 10:30 Tue*  
 Yong, Jiongmin, MS25, 12:00 Tue  
*Yong, Jiongmin, MS5, 10:30 Mon*  
 Yong, Wen-An, MS32, 11:30 Wed

*Yu, Hui, MS32, 10:30 Wed*

Yu, Hui, MS32, 11:00 Wed  
 Yu, Zhou (Joyce), MS39, 11:30 Wed

## Z

*Zaslavski, Alexander J., MS3, 10:30 Mon*  
*Zaslavski, Alexander J., MS13, 4:00 Mon*  
 Zaslavski, Alexander, MS13, 5:30 Mon  
*Zaslavski, Alexander J., MS23, 10:30 Tue*  
*Zaslavski, Alexander, MS30, 4:00 Tue*  
*Zaslavski, Alexander, MS33, 10:30 Wed*  
*Zaslavski, Alexander, MS42, 4:00 Wed*  
*Zeng, Yong, MS16, 4:00 Mon*  
 Zeng, Yong, MS16, 5:30 Mon  
 Zhang, Caojin, CP4, 4:40 Tue  
*Zhang, Fumin, MS34, 10:30 Wed*  
 Zhang, Fumin, MS34, 11:30 Wed  
*Zhang, Fumin, MS43, 4:00 Wed*  
*Zhang, Qing, MS6, 10:30 Mon*  
 Zhang, Qing, MS15, 4:30 Mon  
 Zhang, Wei, CP6, 5:40 Tue  
 Zhang, Xin, MS44, 5:00 Wed  
 Zheng, Harry, MS15, 5:30 Mon  
 Zhu, Chao, MS5, 12:00 Mon  
*Zhu, Chao, MS26, 10:30 Tue*  
*Zhu, Chao, MS36, 10:30 Wed*  
*Zhu, Chao, MS45, 4:00 Wed*  
 Zhu, Jinxia, MS16, 5:00 Mon  
 Zou, Zilong, MS14, 4:30 Mon

# GD17 Organizer and Speaker Index

## B

Barnhill, Robert, MS1, 10:30 Mon  
 Bazaikin, Yaroslav, CP2, 5:40 Tue  
*Beccari, Carolina, MS6, 10:30 Tue*  
 Beccari, Carolina, MS6, 11:00 Tue  
*Beccari, Carolina, MS7, 4:00 Tue*  
*Beccari, Carolina, MS11, 4:00 Wed*  
 Behandish, Morad, MS4, 11:00 Tue  
 Belyaev, Alexander G., MS10, 11:00 Wed  
 Bogfjellmo, Geir, CP1, 4:20 Mon  
 Borcea, Liliana, SP1, 2:45 Mon  
*Borden, Michael, MS13, 4:00 Wed*  
 Bording, Ralph P., MS2, 5:00 Mon  
 Bowers, John, MS4, 12:00 Tue  
 Bracco, Cesare, MS6, 12:00 Tue  
 Brander, David, MS12, 4:30 Wed  
 Brubaker, Nicholas D., CP3, 11:10 Wed

## C

Chen, Renjie, MS10, 12:00 Wed  
 Chi, Hongmei, MS5, 12:00 Tue  
 Cirillo, Emiliano, CP1, 4:40 Mon

## D

Dahl, Heidi Elisabeth I., CP1, 5:00 Mon  
 Derose, Tony, IT2, 9:15 Mon  
 Diamanti, Olga, MS9, 10:30 Wed

## E

Elber, Gershon, MS3, 4:30 Mon  
 Engvall, Luke, MS13, 4:00 Wed  
*Evans, John, MS13, 4:00 Wed*

## F

*Field, David A., MS1, 10:30 Mon*  
*Field, David A., MS4, 10:30 Tue*  
*Field, Rebecca, MS4, 10:30 Tue*

Fonseca, Irene, SP3, 2:00 Wed  
 Franklin, Randolph, MS4, 10:30 Tue  
 Fundator, Michael, CP2, 4:40 Tue  
 Fundator, Michael, PP1, 8:00 Tue

## G

Gao, Xifeng, MS13, 4:30 Wed  
 Gavriil, Konstantinos, MS12, 5:30 Wed  
 Giusteri, Giulio G., CP2, 4:20 Tue  
*Gonsor, Dan, MS3, 4:00 Mon*  
 Gonsor, Dan, MS3, 5:00 Mon  
*Grandine, Thomas A., MS3, 4:00 Mon*  
 Grandine, Thomas A., MS3, 4:00 Mon  
*Grandine, Thomas A., PD1, 6:15 Mon*  
 Gross, Ben J., PP1, 8:00 Tue  
 Großmann, David, MS3, 5:30 Mon  
 Großmann, David, PD1, 6:15 Mon

## H

Hagen, Hans, MS1, 11:00 Mon  
 Han, Bin, MS11, 4:30 Wed  
*Hormann, Kai, PD1, 6:15 Mon*  
*Hormann, Kai, MS10, 10:30 Wed*

## J

Jahanseiroodsari, Mahmoodreza, MS2, 5:30 Mon  
 Juba, Derek, MS5, 11:30 Tue

## K

Kanduc, Tadej, MS13, 5:00 Wed  
 Keyrouz, Walid, MS5, 11:00 Tue

## L

Langbein, Max, CP1, 5:20 Mon  
 Leonard, Naomi E., JP1, 2:00 Mon  
 Li, Xin, MS7, 5:00 Tue  
 Lim, Lek-Heng, SP4, 3:00 Wed  
 Lopez, Luis A., CP2, 5:20 Tue

## M

Ma, Weiyin, MS11, 5:30 Wed  
 Mann, Stephen, CP1, 4:00 Mon  
 Manni, Carla, IT4, 9:15 Tue  
*Manni, Carla, MS8, 4:00 Tue*  
 Marinelli, Kevin, MS2, 4:30 Mon  
*Mascagni, Michael, MS5, 10:30 Tue*  
 Mascagni, Michael, MS5, 10:30 Tue  
 Matkowsky, Bernard, SP2, 2:30 Tue  
 Miura, Keiji, CP2, 5:00 Tue

## N

*Neamtu, Mike, MS6, 10:30 Tue*  
*Neamtu, Mike, MS7, 4:00 Tue*

## O

Ovsjanikov, Maks, MS9, 11:00 Wed

## P

Paranamana, Pushpi J., PP1, 8:00 Tue  
 Patrizi, Francesco, PP1, 8:00 Tue  
 Pauly, Mark, MS12, 4:00 Wed  
 Peters, Jorg, MS7, 4:30 Tue  
*Peters, Thomas J., MS2, 4:00 Mon*  
 Peters, Thomas J., MS2, 4:00 Mon  
 Peters, Thomas J., PD1, 6:15 Mon  
*Polthier, Konrad, MS9, 10:30 Wed*  
 Polthier, Konrad, MS9, 12:00 Wed  
 Pottmann, Helmut, PD1, 6:15 Mon  
*Pottmann, Helmut, MS12, 4:00 Wed*  
 Pottmann, Helmut, MS12, 5:00 Wed  
 Prautzsch, Hartmut, MS1, 11:30 Mon  
 Prautzsch, Hartmut, MS6, 10:30 Tue

## Q

Qian, Xiaoping, MS8, 5:30 Tue

## R

Raffo, Andrea, PP1, 8:00 Tue  
 Rohmer, Damien, IT6, 9:15 Wed  
*Romani, Lucia, MS11, 4:00 Wed*

**S**

Sánchez-Reyes, Javier, PP1, 8:00 Tue  
 Saunders, Bonita V., CP3, 10:30 Wed  
 Schaefer, Scott, MS10, 11:30 Wed  
 Schneider, Teseo, CP3, 10:50 Wed  
 Scott, Michael, MS7, 4:00 Tue  
*Scott, Michael, MS13, 4:00 Wed*  
 Segerman, Henry, IT3, 8:30 Tue  
 Sestini, Alessandra, MS8, 4:00 Tue  
 Shuckburgh, Emily, SP5, 6:15 Wed  
 Skrodzki, Martin, PP1, 8:00 Tue  
 Speleers, Hendrik, MS8, 5:00 Tue  
 Stachura, Eric, CP2, 4:00 Tue

**T**

Taalman, Laura, MS4, 11:30 Tue  
 Thomas, Clayton G., PP1, 8:00 Tue  
 Thomaszewski, Bernhard, IT1, 8:30 Mon  
 Toshniwal, Deepesh, MS13, 5:30 Wed

**V**

Vandenbrande, Jan H., PD1, 6:15 Mon  
 Vouga, Etienne, IT5, 8:30 Wed

**W**

Wachspress, Eugene L., MS10, 10:30 Wed  
 Wang, Hongwei, PP1, 8:00 Tue  
 Welker, Kathrin, CP3, 11:30 Wed

**Y**

Yadav, Sunil K., CP3, 11:50 Wed  
 Yang, Xunnian, MS6, 11:30 Tue  
 Yoon, Jungho, MS11, 5:00 Wed  
 Yu, Thomas, MS11, 4:00 Wed

**Z**

Zagar, Emil, MS8, 4:30 Tue  
 Zhang, Eugene, MS9, 11:30 Wed

## 2017 SIAM Annual Meeting, held with Control and Its Applications (CT17) and Industrial and Applied Geometry (GD17)

### Conference Budget

2017 SIAM Annual Meeting (AN17)  
SIAM Conference on Control and Its Applications (CT17)  
SIAM Conference on Industrial and Applied Geometry (GD17)  
July 10-14, 2017  
Pittsburgh, PA

Expected Paid Attendance: 1,000

#### Revenue

Registration Income		\$314,400
	Total	\$314,400

#### Expenses

Printing		\$6,675
Organizing Committee		\$9,600
Invited Speakers		\$41,625
Food and Beverage		\$57,000
AV Equipment and Telecommunication		\$141,200
Advertising		\$48,000
Professional Services		\$11,000
Conference Labor (including benefits)		\$138,334
Other (supplies, staff travel, freight, misc.)		\$24,432
Proceedings		\$9,500
Administrative		\$51,171
Accounting/Distribution & Shipping		\$27,967
Information Systems		\$51,425
Customer Service		\$19,268
Marketing		\$29,740
Office Space (Building)		\$19,657
Other SIAM Services		\$20,486
	Total	\$707,080

Net Conference Expense (\$392,680)

Support Provided by SIAM		\$392,680
		\$0

#### Estimated Support for Travel Awards not included above:

Students and Early Career	104	\$78,500
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# David Lawrence Convention Center Floor Plans

DAVID L. LAWRENCE CONVENTION CENTER THIRD FLOOR



DAVID L. LAWRENCE CONVENTION CENTER FOURTH FLOOR

