Final Program and Abstracts

2017 SIAM Conference on Applications of Dynamical Systems

Figure courtesy J. Meiss and D. Simpson, DSWeb media gallery.

May 21-25, 2017
Snowbird Ski and Summer Resort
Snowbird, Utah, USA

Sponsored by the SIAM Activity Group on Dynamical Systems

The SIAM Activity Group on Dynamical Systems provides a forum for the exchange of ideas and information between mathematicians and applied scientists whose work involves dynamical systems. The goal of this group is to facilitate the development and application of new theory and methods of dynamical systems. The techniques in this area are making major contributions in many areas, including biology, nonlinear optics, fluids, chemistry, and mechanics. This activity group supports the web portal DSWeb, maintains a member directory and mailing list, sponsors special sessions at SIAM meetings, organizes the biennial SIAM Conference on Applications of Dynamical Systems, and awards biennial prizes—the Jürgen Moser Lecture, J. D. Crawford Prize, and the Red Sock Award. The activity group also sponsors the DSWeb Student Competition for tutorials on dynamical systems and its applications written by graduate and undergraduate students and recent graduates. Members of SIAG/DS receive a complimentary subscription to the all-electronic, multimedia SIAM Journal on Applied Dynamical Systems.

SIAM 2017 Events Mobile App
Scan the QR code with any QR reader and download the TripBuilder EventMobile™ app to your iPhone, iPad, iTouch or Android mobile device. You can also visit *www.tripbuildermedia.com/apps/siamevents*

Society for Industrial and Applied Mathematics
3600 Market Street, 6th Floor
Philadelphia, PA 19104-2688 USA
Telephone: +1-215-382-9800 Fax: +1-215-386-7999
Conference E-mail: *meetings@siam.org*
Conference Web: *www.siam.org/meetings/*
Membership and Customer Service:
(800) 447-7426 (USA & Canada) or +1-215-382-9800 (worldwide)
www.siam.org/meetings/ds17

Table of Contents

Organizing Committee Co-Chairs

Organizing Committee

SIAM Registration Desk

The SIAM registration desk is located in the Ballroom Foyer. It is open during the following hours:

Saturday, May 20
4:00 PM - 8:00 PM

Sunday, May 21
7:15 AM - 4:15 PM

Monday, May 22
8:00 AM - 6:15 PM

Tuesday, May 23
8:00 AM - 4:15 PM

Wednesday, May 24
8:00 AM - 4:15 PM

Thursday, May 25
8:00 AM - 4:00 PM

Hotel Address

Snowbird Ski and Summer Resort
9320 S. Cliff Lodge Drive
Snowbird, UT 84092-9000
USA
Phone Number: +1-801-742-2222
Toll Free Reservations (USA and Canada): +1-800-453-3000
Fax: +1-801-947-8227
Hotel web address: http://www.snowbird.com/

Hotel Telephone Number

To reach an attendee or leave a message, call +1-801-742-2222. If the attendee is a hotel guest, the hotel operator can connect you with the attendee's room.

Hotel Check-in and Check-out Times

Check-in time is 4:00 PM.
Check-out time is 11:00 PM.

Child Care

As a service to SIAM attendees, SIAM has made arrangements for in-room child care. If you have not already made reservations for child care and would like to inquire about availability, please call Camp Snowbird at (801) 933-2256, or e-mail the camp at *campsnowbird@snowbird.com*.

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 and sponsors. 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
Oak Ridge National Laboratory, managed by 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 April 2017.

Funding Agencies

SIAM and the Conference Organizing Committee wish to extend their thanks and appreciation to the U.S. National Science Foundation and DOE Office of Advanced Scientific Computing Research for their support of this conference.

Join SIAM and save!

Leading the applied mathematics community . . .

SIAM members save up to $130 on full registration for the 2017 SIAM Conference on Applications of Dynamical Systems (DS17). 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.

If you are a SIAM member, it only costs $15 to join the SIAM Activity Group on Dynamical Systems (SIAG/DS). As a SIAG/DS member, you are eligible for an additional $15 discount on this conference, so if you paid the SIAM member rate to attend the conference, you might be eligible for a free SIAG/DS membership. Check at the 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* 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*
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

SIAM does not provide computers for any speaker. When giving an electronic presentation, speakers must provide their own computers. SIAM is not responsible for the safety and security of speakers' computers.

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 HDMI connections, however, VGA cables will be available. Presenters requiring an alternate connection to HDMI or VGA must provide their own adaptor. Presentations should be formatted for 16:9 ratio, however, the projectors will auto adjust for presentations formatted for 4:3, in which case there will be blank spaces on the sides of the screens and the image(s) may be slightly compressed.

If you have questions regarding availability of equipment in the meeting room of your presentation, please see a SIAM staff member at the registration desk.

Internet Access

Complimentary wireless Internet access will be available in the guest rooms, public areas and meeting space of the Cliff Lodge.

Email stations will also be available during registration hours.

Registration Fee Includes

- Admission to all technical sessions
- Business Meeting (open to SIAG/DS members)
- Coffee breaks daily
- Room set-ups and audio/visual equipment
- Dessert Receptions and Poster Sessions
- Welcome Reception

Job Postings

Please check with the SIAM registration desk regarding the availability of job postings or visit *http://jobs.siam.org*.

Important Notice to Poster Presenters

Poster Session 1 is scheduled on Tuesday, May 23 from 8:30 pm- 10:30 pm. Poster Session 1 presenters are requested to put up their posters between 8:00 and 8:30 pm on Tuesday, at which time boards and push pins will be available. Poster displays must be removed at 10:30 pm, the end of Poster Session 1.

Poster Session 2 is scheduled on Wednesday, May 24, 8:30 pm- 10:30 pm. Poster Session 2 presenters are requested to put up their posters between 8:00 and 8:30 pm on Wednesday, at which time boards and push pins will be available. Poster displays must be removed at 10:30 pm, the end of Poster Session 2.

For information about preparing a poster, please visit *http://www.siam.org/meetings/guidelines/presenters.php.*

SIAM Books and Journals

Display copies of books and complimentary copies of journals are available on site. SIAM books are available at a discounted price during the conference. The books booth will be staffed from 9:00 AM through 5:00 PM. If a SIAM books representative is temporarily away from the booth, completed order forms and payment (credit cards are preferred) may be taken to the SIAM registration desk. The books table will close at 3:45 PM on Thursday.

Table Top Displays

AIP Publishing
Institute of Physics Publishing
SIAM
Springer

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*).

Get-togethers

Welcome Reception
Saturday, May 20
6:00 PM – 8:00 PM

Business Meeting
(open to SIAG/DS members)
Monday, May 22
7:00 PM – 8:00 PM
Complimentary beer and wine will be served.

Poster Session 1
Tuesday, May 23
8:30 PM - 10:30 PM

Poster Session 2
Wednesday, May 24
8:30 PM - 10:30 PM

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.

Please Note

SIAM is not responsible for the safety and security of attendees' computers. Do not leave your personal electronic devices unattended. Please remember to turn off your cell phones and other devices during sessions.

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. The hashtag for this meeting is #SIAMDS17.

SIAM's Twitter handle is @TheSIAMNews.

The SIAM 2017 Events Mobile App Powered by TripBuilder®

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:

• Create your own custom schedule
• View Sessions, Speakers, Exhibitors and more
• Take notes and export them to your email
• View Award-Winning TripBuilder Recommendations for the meeting location
• Get instant Alerts about important conference info

SIAM 2017 Events Mobile App
Scan the QR code with any QR reader and download the TripBuilder EventMobile™ app to your iPhone, iPad, iTouch or Android mobile device.
You can also visit *www.tripbuildermedia.com/apps/siamevents*

SIAM Activity Group on Dynamical Systems (SIAG/DS)

www.siam.org/activity/ds

A GREAT WAY TO GET INVOLVED!

Collaborate and interact with mathematicians and applied scientists whose work involves dynamical systems.

2017 SIAM Conference on Applications of Dynamical Systems

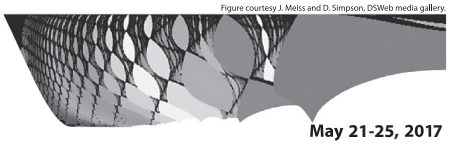


Figure courtesy J. Meiss and D. Simpson, DSWeb media gallery.

May 21-25, 2017
Snowbird Ski and Summer Resort
Snowbird, Utah, USA

ACTIVITIES INCLUDE:

- DSWeb portal
- ► Special sessions at SIAM meetings
- ► Biennial conference
- ► Jürgen Moser Lecture
- ► J. D. Crawford Prize
- ► Red Sock Award

BENEFITS OF SIAG/DS MEMBERSHIP:

- Listing in the SIAG's online membership directory
- Additional $15 discount on registration at the SIAM Conference on Applied Dynamical Systems *(excludes students)*
- Dynamical Systems Magazine
- Subscription to *SIAM Journal on Applied Dynamical Systems*
- ► Electronic communications about recent developments in your specialty
- ► Eligibility for candidacy for SIAG/DS office
- ► Participation in the selection of SIAG/DS officers

ELIGIBILITY:

- Be a current SIAM member.

COST:

- $15 per year
- Student members can join 2 activity groups for free!

2016-17 SIAG/DS OFFICERS

Chair: Mary Silber, The University of Chicago
Vice Chair: Vivien Kirk, University of Auckland
Program Director: Evelyn Sander, George Mason University
Secretary & Co-Chief Editor of DSWeb Magazine: Mason Porter, University of California, Los Angeles
Co-Chief Editor of DSWeb Magazine: Danny Abrams, Northwestern University
Editor in Chief of DSWeb: Elizabeth Cherry, Rochester Institute of Technology

TO JOIN:

SIAG/DS: *my.siam.org/forms/join_siag.htm*
SIAM: *www.siam.org/joinsiam*

Prize Presentation and Special Lecture

***** The Prize Presentation and Special Lecture will take place in the Ballroom*****

SIAM Activity Group on Dynamical Systems Prizes

Sunday, May 21

6:00 PM - 6:15 PM

Prize Presentations - Jürgen Moser and J. D. Crawford

J. D. Crawford Prize Recipient

Martin Wechselberger, *University of Sydney, Australia*

Jürgen Moser Lecturer

Edward Ott, *University of Maryland, College Park, USA*

6:15 PM - 7:00 PM

Jürgen Moser Lecture: Emergent Behavior in Large Systems of Many Coupled Oscillators

Edward Ott, *University of Maryland, USA*

Invited Plenary Speakers

***** All Invited Plenary Presentations will take place in the Ballroom*****

Sunday, May 21

11:00 AM - 11:45 AM

IP1 Some Geometrical and Physical Aspects of Morphogenesis
L Mahadevan, *Harvard University, USA*

Monday, May 22

11:00 AM - 11:45 AM

IP2 Pattern Formation in the Drylands:
Vegetation Patterns in Mathematical Models and
in Satellite Images of the Horn of Africa
Mary Silber, *University of Chicago, USA*

6:00 PM - 6:45 PM

IP3 Random Long Time Dynamics for Large Systems of Interacting Oscillators
Giambattista Giacomin, *Université Paris VII - Denis Diderot, France*

Tuesday, May 23

11:00 AM - 11:45 AM

IP4 Computational Approach Elucidating the Mechanisms of Cardiovascular Diseases
Hiroshi Suito, *Tohoku University, Japan*

Invited Plenary Speakers

***** All Invited Plenary Speakers will take place in the Ballroom *****

Wednesday, May 24

11:00 AM - 11:45 AM

IP5 Dynamics, Mixing, and Coherence

Gary Froyland, *University of New South Wales, Australia*

Thursday, May 25

11:00 AM - 11:45 AM

IP6 Stochastic Arnold Diffusion of Deterministic Systems

Vadim Kaloshin, *University of Maryland, USA*

6:15 PM - 7:00 PM

IP7 Interactions, Deformations and Bifurcations of Singular Patterns

Arjen Doelman, *Leiden University, Netherlands*

Minitutorials

Sunday, May 21

8:15 AM - 10:15 AM

Ballroom 1

MT1: Rigorous Numerics in Dynamics

Organizer: **Konstantin Mischaikow,** *Rutgers University, USA*

1:15 PM - 3:15 PM

Ballroom 2

MT2: Data Assimilation

Organizer: **Elaine Spiller,** *Marquette University, USA*

SIAM Presents is an audio-visual archive

comprised of more than 2,000 presentations posted in over 40 searchable topics, including:

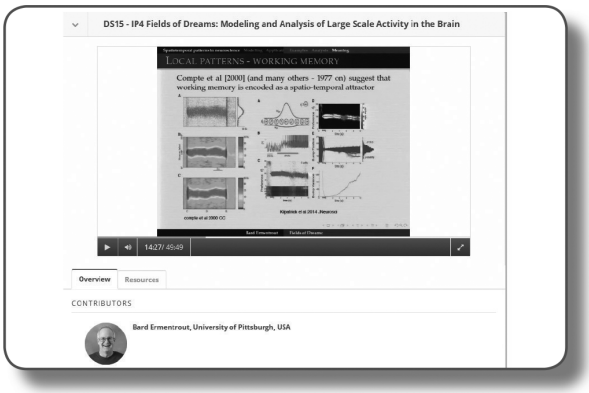
- **algebraic geometry**
- **atmospheric and oceanographic science**
- **computational science**
- **data mining**
- **geophysical science**
- **optimization**
- **uncertainty quantification and more…**

The collection, *Featured Lectures from our Archives*, includes audio and slides from more than 30 conferences since 2008, including talks by invited and prize speakers, select minisymposia, and minitutorials. Presentations from SIAM meetings are being added throughout the year.

In addition you can view short video clips of speaker interviews from sessions at Annual Meetings starting in 2010.

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.

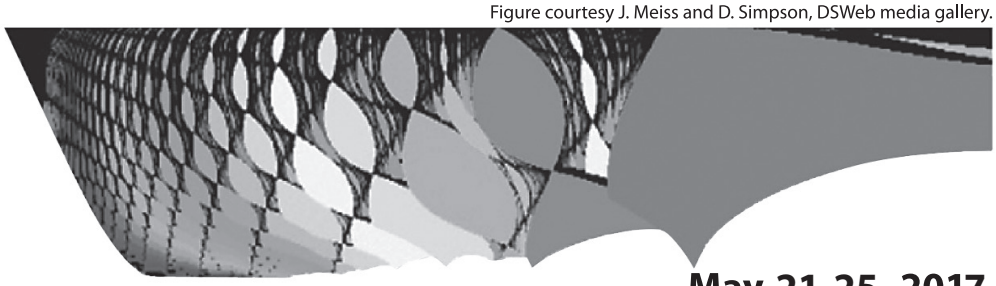
www.siam.org/meetings/presents.php

Society for Industrial and Applied Mathematics • 3600 Market Street, 6th Floor • Philadelphia, PA 19104-2688 USA
Phone: +1-215-382-9800 • Fax +1-215-386-7999 • *service@siam.org* • *www.siam.org*

Program Schedule

2017 SIAM Conference on Applications of Dynamical Systems

Figure courtesy J. Meiss and D. Simpson, DSWeb media gallery.



May 21-25, 2017
Snowbird Ski and Summer Resort
Snowbird, Utah, USA

Saturday, May 20

Registration

4:00 PM-8:00 PM

Room:Ballroom Foyer

Student Icebreaker

5:00 PM-6:00 PM

Room:Primrose A

Chair: Chad M. Topaz, Macalester College, USA

On Saturday immediately before the opening reception, there will be an informal Student Icebreaker session. Through structured activities, the primary goal is for attendees to leave feeling comfortable about the meeting, and having made new connections to depend on as friendly faces during the conference. There is no additional cost, but in order to get a count on how many people to expect, we request that you register for this session when you register for the conference.

Welcome Reception

6:00 PM-8:00 PM

Room:Ballroom

Sunday, May 21

Registration

7:15 AM-4:15 PM

Room:Ballroom Foyer

Sunday, May 21

MT1

Rigorous Numerics in Dynamics

8:15 AM-10:15 AM

Room:Ballroom 1

Chair: Konstantin Mischaikow, Rutgers University, USA

These lectures provide an introduction to a novel approach to computational dynamics that describes rigorously the dynamics of systems for which the nonlinearities are imprecisely known or have weakly constrained parameters. This question arises from the need to understand dynamics of multiscale models for phenomena that are too complex for nonlinearities to be derived from first principles; the life sciences is a typical example. These challenges also arise in settings where models are derived from time series data. It is likely impossible to give a precise description of dynamics without precise nonlinearities. However, if the model is based on accurate heuristics, or the time series data provides an accurate description of trajectories through phase space, then a description of the dynamics that matches the model accuracy might be attainable. We discuss three topics which aim to address this problem in a computationally tractable manner: 1. a coarse combinatorial representation of dynamics and its justification, 2. how this framework allows for efficient computations in both phase space and across parameter space, and 3. how the results of the computations can be rigorously identified with dynamics of the heuristic models. To demonstrate the applicability of these methods, we consider examples arising from the study of cell proliferation and malaria.

Lattice Structures for Dynamics

William D. Kalies, Florida Atlantic University, USA

Dynamics of Gene Regulatory Networks with Unknown Parameters

Tomas Gedeon, Montana State University, USA

Validation of the Computations

Konstantin Mischaikow, Rutgers University, USA

Sunday, May 21

MS1

Isochrons and Isostables

8:15 AM-10:15 AM

Room:Ballroom 2

The notion of isochrons is a remarkably powerful tool in the study of physical, chemical, and biological oscillatory systems. The analogous concept of isostables has recently gained traction as a strategy for characterizing the approach of a dynamical system towards a stationary solution. This minisymposium will emphasize recent advances in the calculation of both isochrons and isostables and will illustrate their applications to the understanding of stochastic oscillations and in the reduction of complex nonlinear systems.

Organizer: Dan D. Wilson

University of Pittsburgh, USA

Organizer: Jeff Moehlis

University of California, Santa Barbara, USA

8:15-8:40 Time-Optimal Control of Biological Oscillators using Isochrons and Isostables

Bharat Monga and Jeff Moehlis, University of California, Santa Barbara, USA

8:45-9:10 Isostable Reduction for Stable Limit-Cycling Systems

Sho Shirasaka, Tokyo Institute of Technology, Japan; Wataru Kurebayashi, Aomori University, Japan; Hiroya Nakao, Tokyo Institute of Technology, Japan

9:15-9:40 Defining the "Phase" of a Stochastic Oscillator

Peter J. Thomas and Alexander Cao, Case Western Reserve University, USA; Benjamin Lindner, Bernstein Center for Computational Neuroscience and Humboldt University, Berlin, Germany

9:45-10:10 Isochrons for Saddle-Type Periodic Orbits in Three-Dimensional Space

James Hannam, Hinke M. Osinga, and Bernd Krauskopf, University of Auckland, New Zealand

Sunday, May 21

MS2

Data-driven Approaches for Distinguishing Direct from Indirect Interactions in Networks

8:15 AM-10:15 AM

Room:Ballroom 3

Complex networks are powerful representations of spatially extended systems, where the elements of the systems are nodes and interactions between elements are edges. When inferring directed interactions from data, one is faced with the challenge of distinguishing direct from indirect interactions, in order to infer possible causal relationships. Important examples include brain functional networks and climate networks. Despite a large number of analysis techniques that address this issue, there still exist a number of problems (short and noisy datasets, temporal variability of interactions, trends, different time-scales in the dynamics, assessing confidence levels, etc.) for which there are currently no satisfactory solutions. This minisymposium addresses some of these problems in order to advance the field.

Organizer: Klaus Lehnertz

University of Bonn, Germany

Organizer: Cristina Masoller

Universitat Politecnica de Catalunya, Spain

8:15-8:40 Inferring Directed Interactions from Data: An Overview

Klaus Lehnertz, University of Bonn, Germany

8:45-9:10 Coupling Function Decomposition

Tomislav Stankovski, Saints Cyril and Methodius University of Skopje, Macedonia

9:15-9:40 Tackling Indirect Directional Couplings in Large Oscillator Networks: Partial Or Non-Partial Phase Analysis?

Thorsten Rings and Klaus Lehnertz, University of Bonn, Germany

9:45-10:10 Pairwise Network Information and Direct Connectivity

Jaroslav Hlinka, Academy of Sciences of the Czech Republic, Prague, Czech Republic; Joern Davidsen, Max Planck Institute for Physics of Complex Systems, Germany

Sunday, May 21

MS3

Network Topology and Dynamics in Complex Systems: Modeling and Data Analysis - Part I of II

8:15 AM-10:15 AM

Room:Primrose A

For Part 2 see MS15

Complex networks are a powerful tool in modeling, and data-based analysis of dynamical systems made up of many interacting units. The notion of network topology provides a framework for the mathematical representation of different interaction patterns in dynamical systems. A central pursuit of complex network theory is to study the impacts of different network topology on the functioning of a system. In this minisymposium, we plan to address the following questions related to this pursuit. What is the role of network topology in dynamical phenomena such as synchronization, diffusion of opinions, epidemics and other contagions on networks, etc.? We wish to address this question in a variety of network settings such as static, co-evolving and multi-layers, etc. We will also explore these issues in environments involving the interplay of noise and dynamics. In data analysis, we will present novel tools and methods for classification and extraction of network topology from large multidimensional data sets.

Organizer: Nishant Malik

Dartmouth College, USA

Organizer: Anna Zakharova

Institute of Theoretical Physics, Berlin, Germany

8:15-8:40 Transitivity Reinforcement in Co-Evolving Network Models

Nishant Malik, Dartmouth College, USA; Hsuan-Wei Lee, University of Nebraska, Lincoln, USA; Bill Shi, University of Chicago, USA; Peter J. Mucha, University of North Carolina at Chapel Hill, USA

continued on next page

Sunday, May 21

MS3

Network Topology and Dynamics in Complex Systems: Modeling and Data Analysis - Part I of II

8:15 AM-10:15 AM

continued

8:45-9:10 Evaluating the Sensitivity of Dynamical Systems to Interaction Network Topology

Stephen Eubank, Yihui Ren, and Madhurima Nath, Virginia Tech, USA

9:15-9:40 Indirect Targeting in Networks

Sean P. Cornelius and Adilson E. Motter, Northwestern University, USA

9:45-10:10 Networks of Networks: Dispersal induced Supersaturation in Meta-Communities

Anshul Choudhary, University of Oldenburg, Germany; Ramesh Arumugam and Partha Sharathi Dutta, Indian Institute of Technology, India; Ulrike Feudel, University of Oldenburg, Germany

Sunday, May 21

MS4

Aperiodic Order and Quasicrystals in Nonlinear Pattern Formation

8:15 AM-10:15 AM

Room:Primrose B

This minisymposium explores how the study of aperiodic long-range order in pattern-forming nonlinear systems enhances and complements the understanding of similar order exhibited by quasicrystals in soft-matter and solid-state systems. The first talk will introduce pattern forming models that exhibit quasiperiodic patterns and relate them to the stability of quasicrystals. Other talks will span a range of approaches to this problem, from the dynamical spectrum of quasiperiodic patterns and its connection to diffraction theory, to new models that describe three-dimensional nonlinear quasiperiodic patterns in soft matter systems.

Organizer: Priya Subramanian
University of Leeds, United Kingdom

Organizer: Alastair M. Rucklidge
University of Leeds, United Kingdom

8:15-8:40 Two Decades of Multiple Scale Patterns: From Faraday Waves to Soft Quasicrystals

Ron Lifshitz, Tel Aviv University, Israel

8:45-9:10 Spectral Notions of Aperiodic Order

Uwe Grimm, The Open University, United Kingdom

9:15-9:40 Spatially Localized Quasicrystals

Priya Subramanian, University of Leeds, United Kingdom; Andrew Archer, Loughborough University, United Kingdom; Edgar Knobloch, University of California, Berkeley, USA - Nonlinearity, Institute of Physics; Alastair M. Rucklidge, University of Leeds, United Kingdom

9:45-10:10 Growth Rules for Icosahedral Quasicrystalline Tilings

Joshua Socolar, Duke University, USA

Sunday, May 21

MS5

State and Parameter Estimation in Models of Cellular Electrical Activity

8:15 AM-10:15 AM

Room:Maybird

A fundamental challenge in the dynamic understanding of cell excitability and signaling is to link the observable variables to the unobserved biophysical mechanisms that produce it. Neurons and endocrine cells exhibit electrical dynamics critical to their function, and computational models of these dynamics typically possess many variables and parameters. Furthermore, one typically has access to only a subset of the variables needed to mathematically describe the underlying processes. For these reasons, rigorous matching of the model dynamics to the observed neuronal data remains difficult. This opens questions regarding appropriate methodologies to properly estimate the model parameters from the available information. Several methodologies are currently being applied to this problem, including Markov chain Monte Carlo, direct search, Kalman filters, and variational approaches. In this workshop we explore these questions by bringing together researchers applying various parameter estimation methods in representative fields involving neuronal and endocrine cell electrical excitability with the goal of building common ground to advance the link between dynamics and experimental data.

Organizer: Patrick A. Fletcher
National Institutes of Health, USA

Organizer: Horacio G. Rotstein
New Jersey Institute of Technology, USA

continued on next page

Sunday, May 21

MS5

State and Parameter Estimation in Models of Cellular Electrical Activity

8:15 AM-10:15 AM

continued

8:15-8:40 Feature-Based Parameter Estimation in a Model of Anterior Pituitary Cell Electrical Activity

Patrick A. Fletcher, National Institutes of Health, USA

8:45-9:10 Markov Chain Monte Carlo Estimation of Conductance-Based Model Parameters

Joseph Mckenna, Florida State University, USA

9:15-9:40 Variational Approach for Estimation of Parameters in Hodgkin-Huxley Models

Daniel Breen, University of San Diego, USA

9:45-10:10 Data Assimilation and Electrophysiological Modeling of Mammalian Circadian Clock Neurons

Matthew Moye, New Jersey Institute of Technology, USA

Sunday, May 21

MS6

Random Dynamics in Microbiology

8:15 AM-10:15 AM

Room:Magpie B

Stochastic methods for describing the evolution of systems in microbiology often involve two components: one or several continuous stochastic differential equations (SDE), and possibly a random discrete process used for switching between SDEs. Examples include the transport of molecular motors, kinetics of biochemical reactions, and oscillatory behavior in genetic circuits. This minisymposium will focus on methods used in both continuous and discrete stochastic processes, as well as techniques for understanding effective behavior for coupled processes on multiple scales. Speakers will highlight various topics in SDEs, including renewal theory, homogenization, non-Markov models, and stochastic delay.

Organizer: Joe Klobusicky
Rensselaer Polytechnic Institute, USA

8:15-8:40 Effective Dynamics of Multiple Molecular Motors

Joe Klobusicky, Rensselaer Polytechnic Institute, USA

8:45-9:10 A Non-Markov Model for Swimming Droplets

Katherine Newhall, University of North Carolina at Chapel Hill, USA

9:15-9:40 Biological Applications of Diffusion in a Randomly Switching Environment

Sean Lawley, University of Utah, USA

9:45-10:10 Oscillatory Behavior of a Genetic Circuit with Delayed Negative Feedback

David Lipshutz, Brown University, USA; Ruth J. Williams, University of California, San Diego, USA

Sunday, May 21

MS7

Nonlinear Dynamics of Mechanical Metamaterials - Part I of II

8:15 AM-10:15 AM

Room:Wasatch B

For Part 2 see MS19

The minisymposium will focus on experimental and theoretical advances in the field of nonlinear mechanical metamaterials such as granular crystals, coupled Helmholtz resonators, trusses or origami-based metamaterials. Such systems are able to sustain different types of nonlinear waves (solitary waves, breathers, shock waves, edge modes), and their dynamical properties are highly attractive for engineering applications, for example shock absorbtion or wave redirection. There is a clear need for interaction between experimentalists and theoreticians in the present context, due to the complexity of many strongly nonlinear effects observed in experiments. Moreover, due to the large (potentially infinite) number of possible configurations for mechanical metamaterials, exploratory analytical and numerical studies are fundamental in order to isolate the most promising experimental setups leading to appropriate innovative dynamical properties. The minisymposium will present recent advances in the field and foster collaborations between leading experts in different areas.

Organizer: Guillaume James
Inria Grenoble, France

Organizer: Anna Vainchtein
University of Pittsburgh, USA

continued on next page

Sunday, May 21

MS7

Nonlinear Dynamics of Mechanical Metamaterials - Part I of II

8:15 AM-10:15 AM

continued

8:15-8:40 Formation of Rarefaction Waves and Reverse Shocks in Strain-Softening Lattices

Jinkyu Yang, Hiromi Yasuda, and Hryunryung Kim, University of Washington, USA; Christopher Chong, Bowdoin College, USA; Panayotis Kevrekidis, University of Massachusetts, USA

8:45-9:10 Impact Dispersion Using 2D and 3D Composite Granular Packing

Surajit Sen, State University of New York at Buffalo, USA; Mukesh Tiwari, Ambani Institute of Information and Communication Technology, India; T R Krishna Mohan, CSIR Centre for Mathematical Modelling and Computer Simulations, India

9:15-9:40 Exploring Microstructural Mechanisms for Tailoring Effective Material Nonlinear Response

Nicholas Boechler, University of Washington, USA

9:45-10:10 Topological Sound and Odd Viscosity in Chiral Active Materials

Vincenzo Vitelli, Universiteit Leiden, The Netherlands

Sunday, May 21

MS8

Set Oriented and Transfer Operator Methods for Turbulent Flows - Part I of II

8:15 AM-10:15 AM

Room:Superior B

For Part 2 see MS20

Transfer operator methods are very effective tools for the global numerical analysis of complicated dynamical systems. Transfer operators are linear operators that describe the evolution of probability measures, densities, and observables under the action of the nonlinear dynamical system. Their spectral analysis reveals macroscopic structures that form a backbone of the large-scale dynamical behavior. This includes coherent sets, which are highly persistent, long-living structures, or dynamic modes. Transfer operators can be approximated in terms of the transition matrix of a finite-state Markov chain within a set oriented numerical approach. With increasing efficiency and computational power, these methods can now be successfully applied also to systems with a cascade of different scales, like it is the case for turbulence. Due to this, there has been much scientific interest directed towards the application of these tools in turbulence research, which is witnessed by recent public research programs (e.g. the 6-year Priority Program "Turbulent Superstructures" funded by the German Research Foundation (DFG)). The purpose of this minisymposium is to gather both scientists who are pushing the frontiers of turbulence research and those of set oriented numerics, with the aim of discussing the opportunities behind the application of these dynamical systems tools to turbulent systems.

Organizer: Peter Koltai

Freie Universitaet Berlin, Germany

Organizer: Kathrin Padberg-Gehle

Leuphana University Lueneburg, Germany

8:15-8:40 Trajectory-based Computational Analysis of Coherent Structures in Flows

Kathrin Padberg-Gehle, Leuphana University Lueneburg, Germany

8:45-9:10 Numerical Studies of Turbulent Rayleigh-Bénard Convection Flows in Large-aspect-ratio Cells

Joerg Schumacher, Technische Universitaet Ilmenau, Germany

9:15-9:40 Data-Driven Techniques for Modeling, Control and Sensor Placement

Eurika Kaiser, University of Washington, USA; Bernd Noack, Technical University Braunschweig, Germany; Andreas Spohn, ENS, France; Robert K. Niven, University of New South Wales, Australia; Louis N. Cattafesta, Florida State University, USA; Marek Morzynski, Poznan University of Technology, Poland; Steven Brunton, Bingni W. Brunton, and Nathan Kutz, University of Washington, USA

9:45-10:10 Space-Time Computational Methods for Coherent Sets

Peter Koltai, Freie Universitaet Berlin, Germany

continued in next column

Sunday, May 21

MS9

Delay Models of Machining Processes

8:15 AM-10:15 AM

Room:Superior A

Cutting processes have essential time delays in their mathematical models. These delays are inversely proportional to the actual cutting speeds. The major source of instability in cutting processes is the so-called regenerative effect and its model involving a single scalar time delay has been known since the 1960s for turning processes. The analysis of these models developed parallel to the theory of functional differential equations. Nowadays, the mathematical theory is available for nonlinear systems with time-periodic and/or state dependent delays, also with discrete and/or continuous delays, and the related numerical methods developed simultaneously. In recent years, mathematical models also appeared to describe advanced cutting problems, like in the case of deep drilling, or milling, or machining thin-walled structures. The four lectures give an overview of these advanced models and the results of their analyses with the aim of making the results accessible for the industry where the maximization of the efficiency of production lines is an essential task.

Organizer: Gabor Stepan

Budapest University of Technology and Economics, Hungary

8:15-8:40 State-Dependent Delay Effects in Drilling

Balakumar Balachandran and Xie Zheng, University of Maryland, USA

8:45-9:10 Time-Periodic Delay Models of Milling Processes

Neil D. Sims, Luis Urena, and Erdem Ozturk, University of Sheffield, United Kingdom

9:15-9:40 Analytical Results in Nonlinear Dynamics of Turning

Tamas G. Molnar, Zoltan Dombovari, Tamas Insperger, and Gabor Stepan, Budapest University of Technology and Economics, Hungary

9:45-10:10 Effect of Unstable Quasiperiodic Orbits on Heavy-Duty Milling Operation

Zoltan Dombovari, Budapest University of Technology and Economics, Hungary; Jokin Munoa, IK4 Research Alliance, Spain

continued in next column

Sunday, May 21

MS10

Dynamical Systems at the Interfaces of Biology and Medicine

8:15 AM-10:15 AM

Room:Wasatch A

Mathematical modelling has long been used in biology and medicine to study behaviours, predict outcomes, and optimise treatments. As our mechanistic understanding of biological systems has been refined, due in large part to the continued improvement of experimental techniques and the availability of data, it is increasingly recognised that varying degrees of model complexity are necessary to capture underlying dynamics. Though we generally perceive modelling to be a tool used to comprehend and interpret biology, often the intricacy of the biological system inspires and informs very elegant mathematical descriptions and methods. This session will explore dynamical systems at the interfaces of biology and medicine by highlighting research that elucidates biological phenomena while advancing mathematical analyses. The systems studied here range from the cellular level to the global scale, and have have had an impact on fundamental experimental research and clinical decisions. Topics include: hematopoiesis analysed via delay-differential equation models to explain pathological oscillatory blood cell dynamics and the division of hematopoietic stem cells; the study of droplet formation and bubble bursting to determine how pathogens are transmitted to understand the spread of disease from person to person; and the influence of travel between meta-populations, and how data from the global air traffic network can be used to control epidemics and pandemics.

Organizer: Morgan Craig

Harvard University, USA

continued on next page

Sunday, May 21

MS10

Dynamical Systems at the Interfaces of Biology and Medicine

8:15 AM-10:15 AM

continued

8:15-8:40 Division Patterns and Dynamics of Hematopoietic Stem Cells

Morgan Craig, Harvard University, USA

8:45-9:10 Normal and Pathological Dynamics of Platelets in Humans

Gabriel Langlois, Brown University, USA; Morgan Craig, Harvard University, USA; Tony R. Humphries and Michael Mackey, McGill University, Canada; Joseph M. Mahaffy, San Diego State University, USA; Jacques Belair, Université de Montréal, Canada; Thibault Moulin, Université de Bourgogne, France; Sean Sinclair, McGill University, Canada; Liangliang Wang, Simon Fraser University, Canada

9:15-9:40 Revisiting Contact and Disease Transmission Through the Lens of Fluid Dynamics

Lydia Bourouiba, Massachusetts Institute of Technology, USA

9:45-10:10 Spatial and Temporal Spread of Infectious Pathogens

Julien Arino, University of Manitoba, Canada

Sunday, May 21

MS11

Modeling of Intracellular Transport and Cell Organization - Part I of II

8:15 AM-10:15 AM

Room:Magpie A

For Part 2 see MS23

Pattern formation through transport of molecules along cytoskeleton filaments is key in the proper development of a wide range of organisms. Mathematical models have become essential in understanding movement of particles as well as the dynamics of cytoskeleton structures in these biological systems. This minisymposium will provide an opportunity to connect dynamical systems and stochastic methods used to model both intracellular transport and the resulting spatial organization at the cell level. It will also highlight methods used to interpret experimental data in the context of cellular transport, as well as avenues for proposing new experimental designs.

Organizer: Bin Xu
University of Utah, USA

Organizer: Veronica M. Ciocanel
Brown University, USA

8:15-8:40 Model for Cell Polarization Based on Coupled Membrane-Bulk Diffusion

Alexandra Jilkine, University of Notre Dame, USA

8:45-9:10 Partner Search Strategy and Mechanisms of Polarization During Fission Yeast Mating

Dimitrios Vavylonis and Bita Khalili, Lehigh University, USA

9:15-9:40 Mathematical Models for Cell Polarization and Gradient Sensing

Timothy Elston, University of North Carolina, Chapel Hill, USA

9:45-10:10 A PDE-DDE Model for Cell Polarization in Fission Yeast

Bin Xu, University of Utah, USA

Sunday, May 21

MS12

Optimal Control Design for Complex Systems

8:15 AM-10:15 AM

Room:White Pine

With ever so increasing complexity of new engineering problems, whether it is design of smart grids or self-driving cars, it becomes more challenging to develop efficient control strategies. Optimal control design can become computationally intractable even for moderate-size problems. In industrial environment these challenges translate into large product development cost overruns, which are arguably main limiting factor in new technology penetration. This minisymposium aims to address some of these challenges and present a comprehensive view of future needs and key technology gaps in design engineering. The speakers will present their recent advances in developing methods for optimal control design and sensor placement, as well as computational methods for dynamic constrained optimization. While the talks will focus on specific industry applications, they will also provide a broader view on how to exploit network topology, hierarchical structures and weak couplings in the problem. The minisymposium will also address development of design computation methods that can take advantage of massively parallel computational environments.

Organizer: Slaven Peles
Lawrence Livermore National Laboratory, USA

8:15-8:40 Transactive System Design and Analysis for Smart Grid Applications

Jianming Lian and Karanjit Kalsi, Pacific Northwest National Laboratory, USA

continued on next page

Sunday, May 21

MS12

Optimal Control Design for Complex Systems

8:15 AM-10:15 AM

continued

8:45-9:10 Optimal Sensor Placement Using Graph Metrics

Tuhin Sahai, United Technologies Research Center, USA; George Mathew, iRhythm Technologies, USA

9:15-9:40 A Multiobjective MPC Approach for Autonomously Driven Electric Vehicles

Sebastian Peitz and Kai Schäfer, University of Paderborn, Germany; Sina Ober-Blöbaum, Oxford University, United Kingdom; Julian Eckstein and Ulrich Köhler, Hella KGaA Hueck & Co., Germany; Michael Dellnitz, University of Paderborn, Germany

9:45-10:10 Computational Methods for Dynamic Constrained Optimization

Slaven Peles and Cosmin G. Petra, Lawrence Livermore National Laboratory, USA

Coffee Break

10:15 AM-10:45 AM

Room:Golden Cliff

Welcome Remarks

10:45 AM-11:00 AM

Room:Ballroom

Sunday, May 21

IP1

Some Geometrical and Physical Aspects of Morphogenesis

11:00 AM-11:45 AM

Room:Ballroom

Chair: Anna Vainchtein, University of Pittsburgh, USA

How is living matter organized in space and time during morphogenesis? A comparative view across animal and plant species suggests that the answer may lie in reusing just a few geometric cellular principles and organ-sculpting motifs. Using examples, I will discuss the quantitative basis for three of these motifs: elongation, lumenization and folding.

L. Mahadevan
Harvard University, USA

Lunch Break

11:45 AM-1:15 PM

Attendees on their own

Sunday, May 21

MT2

Data Assimilation

1:15 PM-3:15 PM

Room:Ballroom 2

Chair: Elaine Spiller, Marquette University, USA

We live in an increasingly data rich world, but if we are interested in extrapolating, forecasting, and/or understanding the behavior of unobserved variables in a system, we need models. The ultimate goal of data assimilation is to combine physical models and observed data to get an estimate of the state of a system. We want not just a good estimate, but one that reflects the attendant uncertainties inherent in both observations and models. Observations of a system can be noisy, partial, and/or sparse in space or time. Models often depend on uncertain parameters – rate constants, boundary conditions, initial conditions , etc. which we might want to characterize with available observations. Furthermore, nonlinearity in a system typically makes analytic data assimilation strategies intractable. We will introduce some standard approaches to data assimilation – ensemble Kalman filter methods, particle filter methods, and variational methods. We will discuss theoretical and computational challenges, practical strategies for implementation, and applications including numerical weather forecasting, forest ecology and flood forecasting. Additionally, we will give a brief overview of recent advances and open problems in data assimilation.

Elaine Spiller, Marquette University, USA

Eric J. Kostelich, Arizona State University, USA

Sarah Dance, University of Reading, United Kingdom

Sunday, May 21

MS13

Computer Assisted Proofs in Dynamical Systems - Part I of II

1:15 PM-3:15 PM

Room:Ballroom 1

For Part 2 see MS25

While topological and variational analysis provide strong general "existence" theorems for families/ classes of problems, information about the shape of the solutions (e.g. the patterns they describe) can usually be obtained only with the help of a computer calculations. Indeed, our understanding of high and infinite dimensional nonlinear dynamical systems is largely based on numerical simulations, which provide much intuition but we have little or no rigorous control on the computational error. Computer assisted proofs of the existence of low dimensional dynamical structures, e.g. fixed points, periodic orbits, heteroclinic and homoclinic orbits, can be used as building blocks in global analysis, either using gluing methods from dynamical systems theory or via Morse-Conley-Floer theory. In this way local, rigorously verified, numerical solutions form the seeds of information from which additional global understanding can be gained. This minisymposium explores recent advances in computer assisted theorems for numerical integration, spatio-temporal periodic solutions, parameter continuation and bifurcations in both ordinary and partial differential equations as well as delay equations.

Organizer: Jonathan C. Jaquette

Rutgers University, USA

Organizer: Jan Bouwe Van Den Berg

VU University, Amsterdam, Netherlands

1:15-1:40 Recent Progress on Computational Theorems in Dynamics

Jan Bouwe Van Den Berg, VU University, Amsterdam, Netherlands

1:45-2:10 Nontrivial Dynamics in the Forced Navier-Stokes Equations: A Computer-Assisted Proof

Jean-Philippe Lessard, Universite Laval, Canada; Jan Bouwe Van Den Berg, VU University, Amsterdam, Netherlands; Maxime Breden, Ecole Normale Superieure Paris-Saclay, France and Universite Laval, Canada; Lennaert van Veen, University of Ontario Institute of Technology, Canada

2:15-2:40 Rigorous Integration Forward in Time of Pdes Using Chebyshev Basis

Jacek Cyranka, Rutgers University, USA; Jan-Philippe Lessard, Universite de Laval, Quebec, Canada

2:45-3:10 Validated Computation of Transport Barriers in Unsteady Flows

Shane D. Kepley and Jason D. Mireles James, Florida Atlantic University, USA

continued in next column

Sunday, May 21

MS14

Astrocyte Calcium Dynamics and Astro-neural Interactions

1:15 PM-3:15 PM

Room:Ballroom 3

Astrocytes are a common type of glial cells found in the brain. They serve many supportive roles in the brain: waste removal, clearing of neurotransmitters, enabling the blood-brain barrier, neuronal migration, etc. Astrocyte pathologies have been also implicated in some diseases. Intriguingly, astrocytes could also be active players in shaping neuronal activity. They bind neurotransmitters on their surface, produce large calcium transients, modulate extracellular ion concentrations, and secrete neuroactive substances. Thus, form intertwined neuron-glial networks supporting two-way signaling pathways between the two cell populations. Participants of this minisymposium use mathematical models and dynamical systems theory to address fundamental open questions in mechanisms of astrocyte function and astrocyte-neuron dynamics. In particular, we will discuss different mechanisms of astrocyte calcium signaling, variability of evoked calcium transients, potassium and glutamate buffering by astrocytes in pathological conditions, regulation of extracellular ion concentrations by astrocytes, and role of astrocytes in seizures.

Organizer: Alla Borisyuk

University of Utah, USA

1:15-1:40 Mathematical Investigation of Ion Dynamics in Astrocytes and the Extracellular Space

Gregory A. Handy and Marsa Taheri, University of Utah, USA; John A. White, Boston University, USA; Alla Borisyuk, University of Utah, USA

continued on next page

Sunday, May 21

MS14

Astrocyte Calcium Dynamics and Astro-neural Interactions

1:15 PM-3:15 PM

continued

1:45-2:10 Minimal Modeling of GPCR-Mediated Calcium Signaling

Maurizio De Pittà, University of Chicago, USA

2:15-2:40 The Role of Astrocytic Glutamate Uptake in Neuronal Ion Homeostasis: A Case Study of Spreading Depolarization

Ghanim Ullah and Niklas Hubel, University of South Florida, USA; Jokubas Ziburkus, University of Houston, USA

2:45-3:10 Role of Neuron-Glia Interaction in Epileptogenesis

Maxim Bazhenov, University of California, Riverside, USA

Sunday, May 21

MS15

Network Topology and Dynamics in Complex Systems: Modeling and Data Analysis - Part II of II

1:15 PM-3:15 PM

Room:Primrose A

For Part 1 see MS3

Complex networks are a powerful tool in modeling, and data-based analysis of dynamical systems made up of many interacting units. The notion of network topology provides a framework for the mathematical representation of different interaction patterns in dynamical systems. A central pursuit of complex network theory is to study the impacts of different network topology on the functioning of a system. In this minisymposium, we plan to address the following questions related to this pursuit. What is the role of network topology in dynamical phenomena such as synchronization, diffusion of opinions, epidemics and other contagions on networks, etc.? We wish to address this question in a variety of network settings such as static, co-evolving and multi-layers, etc. We will also explore these issues in environments involving the interplay of noise and dynamics. In data analysis, we will present novel tools and methods for classification and extraction of network topology from large multidimensional data sets.

Organizer: Nishant Malik
Dartmouth College, USA

Organizer: Anna Zakharova
Institute of Theoretical Physics, Berlin, Germany

1:15-1:40 Eigenvector Localization in Complex Networks

Sarika Jalan, Indian Institute of Technology, Indore, India

1:45-2:10 Inferring Network Topology from Observational Data: Potentials and Pitfalls

Juergen Kurths, Potsdam Institute for Climate Impact Research and Humboldt University Berlin, Germany

2:15-2:40 Partial Cascades on One-Dimensional Geographic Networks

Yosef M. Treitman, Rensselaer Polytechnic Institute, USA

2:45-3:10 Experimental Observation of Spiral Wave Chimera in a Very Large Network of Chemical Oscillators

Jan Totz, Technische Universität Berlin, Germany; Kenneth Showalter, West Virginia University, USA; Harald Engel, Technische Universität Berlin, Germany

continued in next column

Sunday, May 21

MS16

Large Deviations in Stochastic Populations with Spatial Structure

1:15 PM-3:15 PM

Room:Primrose B

Understanding and predicting rare events caused by large fluctuations is often crucial in describing dynamics of complex systems. Rare events may lead to diverse phenomena such as crystal nucleation and growth, self-assembly of macromolecules, protein folding, population extinction, and loss of biodiversity. An important category of such complex systems includes systems containing a discrete, large yet finite, population of interacting agents. For a sufficiently large population, fluctuations on the order of the typical system size are very rare. Yet it is precisely these extreme rare events, giving rise e.g. to population extinction, disease eradication or cellular switching, which may be of key importance. As such systems are often far from equilibrium, standard techniques of statistical mechanics are defied. Especially challenging is dealing with non-well-mixed extended systems, where the topology and spatial arrangement of individuals strongly affect the long-time behavior. Our aim is to present novel analytical and numerical techniques that enable the accurate and efficient computation of rare event statistics in such systems, and allow the design of novel network topological controls. The purpose of this minisymposium is to expose the audience to recent progress in the field of large deviation theory in spatially-extended systems, and to bring together researchers developing new analytical and numerical techniques for analyzing stochastic population dynamics.

Organizer: Michael Assaf

Hebrew University of Jerusalem, Israel

1:15-1:40 Noise-Induced Rare Events in Population Dynamics: the Role of Spatial Degrees of Freedom

Michael Assaf, Hebrew University of Jerusalem, Israel

1:45-2:10 Making Rare Events Happen: Prediction and Control of Extinction and Switching in Heterogeneous Networks

Ira B. Schwartz and Jason Hindes, US Naval Research Laboratory, USA; Brandon Lindley, Ralph Wagner Associates, USA; Leah Shaw, College of William & Mary, USA

2:15-2:40 Epidemic Extinction in Adaptive Networks with Avoidance Rewiring

Leah Shaw, College of William & Mary, USA; Jason Hindes and Ira B. Schwartz, US Naval Research Laboratory, USA

2:45-3:10 How Do Cells Extract Information About the Direction of Signaling Molecule Gradients to Make Decisions?

Elijah Roberts, Johns Hopkins University, USA

continued in next column

Sunday, May 21

MS17

Chaotic Communications and Radar - Part I of II

1:15 PM-3:15 PM

Room:Maybird

For Part 2 see MS30

The field of chaotic communications has seen a revival in recent years thanks to new advances in matched filtering, synchronization, and signal processing. Many of the problems of radar are closely related to communications, so these advances in one of these fields feed advances in the other. The range of talks in this minisymposium will go from new techniques in using chaos to actual practical details of how to make chaos work in a communications system. A particular focus will be on what is gained by using chaos instead of some random broad band signal.

Organizer: Thomas L. Carroll

Naval Research Laboratory, USA

Organizer: Ned J. Corron

US Army RDECOM, USA

1:15-1:40 Chaotic Sequences for Synchronization and Communication

Thomas L. Carroll, Naval Research Laboratory, USA

1:45-2:10 Wireless Communication with Chaos

Hai-Peng Ren, Xi'an Jiaotong University, P.R. China; Chao Bai and Jun-Liang Yao, Xi'an University of Technology, China; Murilo Baptista, University of Aberdeen, United Kingdom; Celso Grebogi, King's College, University of Aberdeen, United Kingdom

2:15-2:40 Chaos Theory in Communications: Applications and Challenges

Georges Kaddoum, Ecole de Technologie Supérieure, Canada

2:45-3:10 Chaotic OFDM System for Secure Multi-User Communications

Henry Leung and Chatura Seneviratne, University of Calgary, Canada

Sunday, May 21

MS18

Excitability, Feedback and Collective Decision-Making Dynamics

1:15 PM-3:15 PM

Room:Magpie B

Excitability dynamics have been traditionally used to model the accumulation of evidence for decision-making in neural systems. These same dynamics are more recently being used to model the decision-making of a wide range of biological systems at varying scales and levels of biological complexity. This minisymposium will contribute to bridging the study of excitable dynamics of neural systems with the decision-making dynamics of groups of organisms, including foraging ant colonies and house-hunting honeybees. Dynamical analyses will be presented that help explain how decision-makers regulate their behavior in the presence of disturbances, how they tune their response to the value of alternatives, how they accommodate heterogeneity across the collective, and how they respond to a dynamic environment.

Organizer: Naomi E. Leonard

Princeton University, USA

Organizer: James Marshall

University of Sheffield, United Kingdom

1:15-1:40 Excitability and Feedback in Regulation of Foraging Harvester Ants

Renato Pagliara, Princeton University, USA; Deborah M. Gordon, Stanford University, USA; Naomi E. Leonard, Princeton University, USA

1:45-2:10 Models of Value-Sensitive Decision Making

Thomas Bose, Andreagiovanni Reina, and James A R Marshall, University of Sheffield, United Kingdom

2:15-2:40 Collective Behavior and Individual Variability: From Personalities to Heterospecific Interactions

Stamatios C. Nicolis, Université Libre de Bruxelles, Belgium

2:45-3:10 Evidence Accumulation in Dynamic Environments

Zachary P. Kilpatrick, University of Colorado Boulder, USA; Adrian Radillo and Kresimir Josic, University of Houston, USA; Alan Veliz-Cuba, University of Dayton, USA

Sunday, May 21

MS19

Nonlinear Dynamics of Mechanical Metamaterials - Part II of II

1:15 PM-3:15 PM

Room:Wasatch B

For Part 1 see MS7

The minisymposium will focus on experimental and theoretical advances in the field of nonlinear mechanical metamaterials such as granular crystals, coupled Helmholtz resonators, trusses or origami-based metamaterials. Such systems are able to sustain different types of nonlinear waves (solitary waves, breathers, shock waves, edge modes), and their dynamical properties are highly attractive for engineering applications, for example shock absorbtion or wave redirection. There is a clear need for interaction between experimentalists and theoreticians in the present context, due to the complexity of many strongly nonlinear effects observed in experiments. Moreover, due to the large (potentially infinite) number of possible configurations for mechanical metamaterials, exploratory analytical and numerical studies are fundamental in order to isolate the most promising experimental setups leading to appropriate innovative dynamical properties. The minisymposium will present recent advances in the field and foster collaborations between leading experts in different areas.

Organizer: Guillaume James

Inria Grenoble, France

Organizer: Anna Vainchtein

University of Pittsburgh, USA

1:15-1:40 Strongly Nonlinear Acoustic Metamaterials with Passive Self-Tuning and Wave Redirection Properties

Mohammed A. Hasan, University of California, San Diego, USA; Yuli Starosvetsky, Technion - Israel Institute of Technology, Israel; Leonid Manevitch, Russian Academy of Sciences, Russia; *Alexander Vakakis*, University of Illinois, USA

continued in next column

1:45-2:10 A Model for Nonlinear Acoustic Waves in a Non-uniform Lattice of Helmholtz Resonators

Jean-François Mercier, ENSTA ParisTech, France; Bruno Lombard, Laboratoire de Mécanique et d'Acoustique, France

2:15-2:40 Symmetry-Induced Dynamic Localization in Lattice Structures

Nathan Perchikov and Oleg Gendelman, Technion Israel Institute of Technology, Israel

2:45-3:10 Traveling Waves in Nonlinear Metamaterials: Granular Chains and Beyond

Haitao Xu, University of Minnesota, USA; Panayotis Kevrekidis, University of Massachusetts, USA

Sunday, May 21

MS20

Set Oriented and Transfer Operator Methods for Turbulent Flows - Part II of II

1:15 PM-3:15 PM

Room:Superior B

For Part 1 see MS8

Transfer operator methods are very effective tools for the global numerical analysis of complicated dynamical systems. Transfer operators are linear operators that describe the evolution of probability measures, densities, and observables under the action of the nonlinear dynamical system. Their spectral analysis reveals macroscopic structures that form a backbone of the large-scale dynamical behavior. This includes coherent sets, which are highly persistent, long-living structures, or dynamic modes. Transfer operators can be approximated in terms of the transition matrix of a finite-state Markov chain within a set oriented numerical approach. With increasing efficiency and computational power, these methods can now be successfully applied also to systems with a cascade of different scales, like it is the case for turbulence. Due to this, there has been much scientific interest directed towards the application of these tools in turbulence research, which is witnessed by recent public research programs (e.g. the 6-year Priority Program "Turbulent Superstructures" funded by the German Research Foundation (DFG)). The purpose of this minisymposium is to gather both scientists who are pushing the frontiers of turbulence research and those of set oriented numerics, with the aim of discussing the opportunities behind the application of these dynamical systems tools to turbulent systems.

Organizer: Peter Koltai

Freie Universitaet Berlin, Germany

Organizer: Kathrin Padberg-Gehle

Leuphana University Lueneburg, Germany

continued in next column

1:15-1:40 Quantifying the Influence of Lateral Boundaries on Turbulent Transport

Nicholas T. Ouellette, Yale University, USA

1:45-2:10 Fast Computation of Coherent Sets

Oliver Junge, Technische Universität München, Germany

2:15-2:40 Computation of the Koopman Spectrum in Complex Flows

Hassan Arbabi and Igor Mezic, University of California, Santa Barbara, USA

2:45-3:10 The Computation of Invariant Manifolds for Partial Differential Equations by Set Oriented Numerics

Michael Dellnitz and Adrian Ziessler, University of Paderborn, Germany

Sunday, May 21

MS21

Analytical and Numerical Advances in Multilayer and Multiplex Networks: Structure and Dynamics

1:15 PM-3:15 PM

Room:Superior A

Many complex systems in the real world consist of components that cannot function independently, but interact among them through different channels of connectivity and dependencies. Multilayer and multiplex networks explicitly incorporate multiple channels of connectivity in a system and constitute the natural mathematical setting for representing systems whose elements are interconnected through different kinds of connections (or levels); thus each level (channel, relationship, activity, category) is represented by a layer containing all the elements that have connections at that particular level. Notice that two elements may belong to two different layers if they are connected at more than one level. This minisymposium will present some of the most recent major analytical and numerical results achieved in the study of the structure and dynamics of multilayer and multiplex networks, summarizing some relevant applications in many different disciplines.

Organizer: Regino Criado

Universidad Rey Juan Carlos, Spain

Organizer: Zhen Wang

Kyushu University, Japan

1:15-1:40 Analysis of Chinese Airline Network As a Multilayer Network

Zhen Wang, Qingdao University, China

1:45-2:10 Inter-Layer Synchronization in Nonidentical Multilayer Networks

Irene Sendiña-Nadal and Inmaculada Leyva, Universidad Rey Juan Carlos, Spain; Ricardo Sevilla-Escoboza, Universidad de Guadalajara, Mexico; Ricardo Gutierrez, Weizmann Institute of Science, Israel; Javier Buldu, Universidad Politécnica de Madrid and Universidad Rey Juan Carlos, Madrid, Spain; Stefano Boccaletti, CNR, Italy

continued on next page

Sunday, May 21

MS21

Analytical and Numerical Advances in Multilayer and Multiplex Networks: Structure and Dynamics

1:15 PM-3:15 PM

continued

2:15-2:40 A Multiplex View of PageRank Through Biplex Markov Chains

Miguel Romance, Technical University of Madrid, Spain

2:45-3:10 Generalizing the Master Stability Function to Multilayer Networks

Charo I. del Genio, University of Warwick, United Kingdom

Sunday, May 21

MS22

Mathematical Pharmacology

1:15 PM-3:15 PM

Room:Wasatch A

Drug development is expensive and the number of drugs that is approved for therapeutic use, remains in decline. There is an increasing awareness that the high level of biological complexity of organisms, pathophysiological conditions, and our inability to capture those features, are major obstacles to design effective pharmacological therapies. Systems pharmacology is an emerging scientific area that aims to fill the gap between systems biology and pharmacology by integration of biological mechanisms in quantitative mechanistic models. This has brought up a diversity of challenges that still need to be addressed in order to improve drug development and therapeutics. These challenges include: - multiple scales and the integration between those scales - integration of different modelling approaches - bridging between highly mechanistic complex models and focused simpler models that capture the essence for drug development and therapeutics. Mathematics, especially mathematical analysis and modelling, has enormous potential to tackle those challenges. As such, a mathematical pharmacology approach has the potential to advance the field of pharmacology and ultimately to allow for improved rational design of new therapeutic interventions with maximal therapeutic effect and minimal adverse drug effects. This minisymposium will exhibit work in the area of mathematical pharmacology and focus on exploring and enhancing the role of mathematical models and approaches in pharmacology.

Organizer: Vivi Rottschafer
Leiden University, Netherlands

1:15-1:40 Modelling the Impact of Physicochemical Drug Properties on Drug Reservoirs in the Skin

Jane White, University of Bath, United Kingdom; Jennifer Jones, Rutgers University, USA; Begona Delgado-Charro, University of Bath, United Kingdom

1:45-2:10 Dimer Dynamics and Degenerate Transversally Intersecting Manifolds

Gianne Derks, Philip J. Aston, and Christine Gavin, University of Surrey, United Kingdom

2:15-2:40 Beyond Dose Predictions: How Mathematical Pharmacology Supports Drug Development from Target Identification to Clinical Outcomes

Angelean O. Hendrix, PAREXEL, USA

2:45-3:10 Modeling Lung Airway Liquid Dynamics for Hyperosmotic Treatment Design in Cystic Fibrosis

Robert S. Parker, Matthew Markovetz, and Timothy Corcoran, University of Pittsburgh, USA

continued in next column

Sunday, May 21

MS23

Modeling of Intracellular Transport and Cell Organization - Part II of II

1:15 PM-3:15 PM

Room:Magpie A

For Part 1 see MS11

Pattern formation through transport of molecules along cytoskeleton filaments is key in the proper development of a wide range of organisms. Mathematical models have become essential in understanding movement of particles as well as the dynamics of cytoskeleton structures in these biological systems. This minisymposium will provide an opportunity to connect dynamical systems and stochastic methods used to model both intracellular transport and the resulting spatial organization at the cell level. It will also highlight methods used to interpret experimental data in the context of cellular transport, as well as avenues for proposing new experimental designs.

Organizer: Bin Xu

University of Utah, USA

Organizer: Veronica M. Ciocanel

Brown University, USA

1:15-1:40 Spatial Modeling of Motor Attachment and Detachment

Peter R. Kramer and Abhishek Choudhary, Rensselaer Polytechnic Institute, USA

1:45-2:10 The Paradox of Codependence Among Antagonistic Motors in Intracellular Transport

Scott McKinley, Tulane University, USA

continued in next column

2:15-2:40 Formation of Pseudo-cleavage Furrow during Cell Polarization in C. Elegans

Betul Aras, Ohio State University, USA; Yongcheng Zhou, Colorado State University, USA; Adriana Dawes and *Ching-Shan Chou*, The Ohio State University, USA

2:45-3:10 Combining Computational Fluid Dynamics and Electron Tomography to Study the Mechanics of Kinetochore Microtubules

Ehssan Nazockdast and Sebastian Fürthauer, Courant Institute of Mathematical Sciences, New York University, USA; Stefanie Redemann and Thomas Müller-Reichert, Technische Universität Dresden, Germany; Michael Shelley, Courant Institute of Mathematical Sciences, New York University, USA

Sunday, May 21

MS24

Optimization Methods in Dynamical Systems

1:15 PM-3:15 PM

Room:White Pine

In order to obtain high level of performance with limited resources, optimization strategies are used in nature as well as in engineered systems. Therefore, we may gain more insights in the analysis and synthesis of such strategies by integrating methods from the fields of dynamical systems and optimal control. In this minisymposium, we bring together leading researchers from these two communities, where distinctively different methodologies have been adopted. The speakers will showcase the state-of-the-art analysis and synthesis tools by applying optimization in neural networks, humanoid robots and connected vehicles. They will also highlight the connections between optimal control, phase-plane diagrams, stability analysis and numerical continuation.

Organizer: Jin Ge

University of Michigan, Ann Arbor, USA

Organizer: Gabor Orosz

University of Michigan, Ann Arbor, USA

1:15-1:40 Optimal Control Re-Examined Using the Geometric Methods of Dynamical Systems

Jin Ge and Gabor Orosz, University of Michigan, Ann Arbor, USA

1:45-2:10 Automata Theory and Dynamic Programming

Ivan Papusha, University of Texas, USA; Jie Fu, Worcester Polytechnic Institute, USA; Min Wen, University of Pennsylvania, USA; Ufuk Topcu, University of Texas, USA; Richard Murray, California Institute of Technology, USA

2:15-2:40 A System-Level Approach to Controller Synthesis

Nikolai Matni, Yuh-Shyang Wang, and John Doyle, California Institute of Technology, USA

2:45-3:10 Learning Model Predictive Control for Iterative Tasks

Ugo Rosolia and Francesco Borrelli, University of California, Berkeley, USA

Sunday, May 21

Coffee Break

3:15 PM-3:45 PM

Room:Golden Cliff

MS25

Computer Assisted Proofs in Dynamical Systems - Part II of II

3:45 PM-5:45 PM

Room:Ballroom 1

For Part 1 see MS13

While topological and variational analysis provide strong general "existence" theorems for families/classes of problems, information about the shape of the solutions (e.g. the patterns they describe) can usually be obtained only with the help of a computer calculations. Indeed, our understanding of high and infinite dimensional nonlinear dynamical systems is largely based on numerical simulations, which provide much intuition but we have little or no rigorous control on the computational error. Computer assisted proofs of the existence of low dimensional dynamical structures, e.g. fixed points, periodic orbits, heteroclinic and homoclinic orbits, can be used as building blocks in global analysis, either using gluing methods from dynamical systems theory or via Morse-Conley-Floer theory. In this way local, rigorously verified, numerical solutions form the seeds of information from which additional global understanding can be gained. This minisymposium explores recent advances in computer assisted theorems for numerical integration, spatio-temporal periodic solutions, parameter continuation and bifurcations in both ordinary and partial differential equations as well as delay equations.

Organizer: Jonathan C. Jaquette
Rutgers University, USA

Organizer: Jan Bouwe Van Den Berg
VU University, Amsterdam, Netherlands

continued in next column

3:45-4:10 Advances on Wright's Conjecture: Counting and Discounting Periodic Orbits in a Delay Differential Equation

Jonathan C. Jaquette, Rutgers University, USA; Jean-Philippe Lessard, Universite Laval, Canada; Konstantin Mischaikow, Rutgers University, USA; Jan Bouwe Van Den Berg, VU University, Amsterdam, Netherlands

4:15-4:40 Validated Saddle-node Bifurcations and Applications to Lattice Dynamical Systems

Evelyn Sander and *Thomas Wanner*, George Mason University, USA

4:45-5:10 Rigorous Continuation of Periodic Orbits and Validation of Hopf Bifurcations

Elena Queirolo, Vrije Universiteit Amsterdam, The Netherlands

5:15-5:40 Algorithms for Processing the Labeled Conley Index

Rafael Frongillo, University of Colorado, USA

Sunday, May 21

MS26

Recent Developments in Data Assimilation - Part I of II

3:45 PM-5:45 PM

Room:Ballroom 2

For Part 2 see MS39

Data assimilation (DA) is the process by which observations are incorporated into a forecast system to obtain a suitable estimate of reality. Although it has classically been applied to global weather prediction, DA since been applied to math biology, efficacy of drug therapies, urban planning, and more. Nevertheless, a central issue in DA is balancing the high-dimensionality inherent in the models, the efficient exploitation of the available data, and reducing errors naturally contained in both the model and data. This minisymposium will serve to bridge the two communities of DA and analysis of partial differential equations (PDE) through problems in DA. We propose two sessions, each one focused on the research done by one of these two communities. The first session will consist of speakers in the area of analysis of PDE; they will address a certain DA algorithm based on feedback control, and some of its applications, ranging from numerical approximations to the context of incomplete observations. The second one will focus on the more applied area of DA, with speakers discussing about topics such as: back and forth nudging applied to geophysical flows; forecast sensitivity to observations; and balance control of the ensemble Kalman filter.

Organizer: Vincent R. Martinez
Tulane University, USA

Organizer: John Maclean
University of North Carolina, Chapel Hill, USA

Organizer: Cecilia F. Mondaini
Texas A&M University, USA

continued on next page

Sunday, May 21

MS26

Recent Developments in Data Assimilation - Part I of II

3:45 PM-5:45 PM

continued

3:45-4:10 Numerical Approximation of a Data Assimilation Algorithm by a Post-processing Galerkin Method

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

4:15-4:40 Determining the Global Dynamics of the 2D Navier-Stokes Equations by 1D ODE

Edriss S. Titi, Texas A&M University, USA and Weizmann Institute of Science, Israel; Ciprian Foias, Texas A&M University, USA; Michael S. Jolly and Dan Lithio, Indiana University, USA

4:45-5:10 Synchronization of Chaotic Dynamical Systems Using Time-Averaged Partial Observations of the Phase Space

Jordan Blocher, University of Nevada, Reno, USA; Vincent R. Martinez, Tulane University, USA; *Eric Olson*, University of Nevada, Reno, USA

5:15-5:40 Data Assimilation Algorithms for Geophysical Models and Charney's Conjecture

Aseel Farhat, University of Virginia, USA; Evelyn Lunasin, United States Naval Academy, USA; Edriss S. Titi, Texas A&M University, USA and Weizmann Institute of Science, Israel

Sunday, May 21

MS27

The Dynamics and Function of Neuronal Networks - Part I of II

3:45 PM-5:45 PM

Room:Ballroom 3

For Part 2 see MS40

The dynamics of neuronal networks provide rich information regarding the nature of neuronal computation and information processing in the brain. This minisymposium explores recent work in the modeling and analysis of neuronal dynamics and function, emphasizing implications on visual information processing, synchronization and oscillations, network connectivity, and variability from a single neuron to a neuronal network. The speakers will draw particular attention to new mathematical advances in characterizing the structure-function relationship for complex neuronal networks and techniques for understanding the biophysical mechanisms underlying experimentally observed phenomena.

Organizer: Songting Li

Courant Institute of Mathematical Sciences, New York University, USA

Organizer: Victor Barranca

Swarthmore College, USA

Organizer: Douglas Zhou

Shanghai Jiao Tong University, China

3:45-4:10 Distance-Dependent Edge-Correlations and Synchrony in Neuronal Networks

Duane Nykamp and Samantha Fuller, University of Minnesota, USA

4:15-4:40 Independent Noise Synchronizing Population Rhythms of Networks of Pulse-Coupled Oscillators

John Meng, Xize Xu, and Hermann Riecke, Northwestern University, USA

4:45-5:10 Granger Causality in Sparse Neuronal Network

Yangyang Xiao, New York University, USA

5:15-5:40 A Probability Polling State of Neuronal Systems Underlying Maximum Entropy Coding Principle

Douglas Zhou, Shanghai Jiao Tong University, China; Zhiqin John Xu, New York University, USA; David Cai, Shanghai Jiao Tong University, China and Courant Institute of Mathematical Sciences, New York University, USA

Sunday, May 21

MS28

Dynamics of Oscillator Populations: Patterns and Dynamics on the Way to Synchrony

3:45 PM-5:45 PM

Room:Primrose A

Ensembles of coupled oscillators can demonstrate, besides trivial regimes of full asynchrony and of full synchrony, nontrivial dynamical states of partial synchronization. Considerable progress has been made recently in developing analytical approaches for a characterization of nontrivial states of partial synchrony. In this minisymposium we will present both novel theoretical tools as well as surprising examples of collective behavior. The talks will discuss striking integrability properties of the Kuramoto phase oscillator network, as well as perturbation theory on top of this integrability, allowing one to find evolution of the integrals for ensembles close to the Kuramoto model. Further talks focus on nontrivial spiral patterns of partial synchrony due to spatial coupling, and on the interplay of phase locking with frequency anti-entrainment in a noise-driven Kuramoto ensemble.

Organizer: Rennie Mirollo

Boston College, USA

Organizer: Arkady Pikovsky

University of Potsdam, Germany

3:45-4:10 Interplay of Coupling and Common Noise at the Transition to Synchrony in Oscillator Populations

Arkady Pikovsky, University of Potsdam, Germany; Denis S. Goldobin, Russian Academy of Sciences, Russia; Michael Rosenblum, University of Potsdam, Germany; Anastasyia Pimenova, Institute of Continuous Media Mechanics, Perm, Russia

continued on next page

Sunday, May 21

MS28

Dynamics of Oscillator Populations: Patterns and Dynamics on the Way to Synchrony

3:45 PM-5:45 PM

continued

4:15-4:40 Connecting Hyperbolic Geometry to Kuramoto Oscillator Systems; New Classes of Gradient Phase Models and Completely Integrable Dynamics

Jan Engelbrecht, Boston College, USA

4:45-5:10 Frequency Spiral

Bertrand Ottino-Loffler, Cornell University, USA

5:15-5:40 Dynamics of Weakly Inhomogeneous Oscillator Populations: Perturbation Theory on Top of Watanabe–Strogatz Integrability

Vladimir Vlasov, Istituto Italiano di Tecnologia (IIT), Italy; Michael Rosenblum and Arkady Pikovsky, University of Potsdam, Germany

Sunday, May 21

MS29

Stochastic Dynamics

3:45 PM-5:45 PM

Room:Primrose B

Recent progress in dynamical systems with 'random' or 'stochastic' effects has shown that noise is often extremely important in the analysis of many models. In particular, for complex nonlinear systems, it is necessary to develop new analytical and numerical methods to treat stochastic models. The talks in this minisymposium present different results that all allow for a reduction of complexity of infinite-dimensional stochastic systems, like modulation equations, slow manifolds, homogenization, averaging and the transition from micro- to macro-scale. We aim at a transfer of recent techniques and methods developed in stochastic processes and stochastic differential equations to a broader dynamical systems audience. In particular, we bring together leading experts in the theory and applications of stochastic methods to also provide an outlook on the major challenges of reduced models for infinite-dimensional stochastic dynamics.

Organizer: Christian Kuehn
Technical University of Munich, Germany

Organizer: Dirk Blömker
Universitaet Augsburg, Germany

3:45-4:10 Stochastic Modulation Equations on Unbounded Domains

Dirk Blömker, Universitaet Augsburg, Germany; Guido Schneider, University of Stuttgart, Germany; Luigi A. Bianchi, TU Berlin, Germany

4:15-4:40 Stochastic Dynamics: Data-Driven Information Extraction via Effective Reduction

Jinqiao Duan, Illinois Institute of Technology, USA

4:45-5:10 Couple Periodic-patches of a Stochastic Microscale to Predict Emergent Macroscale Dynamics

Anthony J. Roberts, University of Adelaide, Australia

5:15-5:40 The Motion of a Droplet for the Stochastic Mass-conserving Allen-Cahn Equation

Peter W. Bates, Michigan State University, USA; Dimitra Antonopoulou, University of Chester, United Kingdom; Dirk Blömker, Universitaet Augsburg, Germany; Georgia Karali, University of Crete, Greece

continued in next column

Sunday, May 21

MS30

Chaotic Communications and Radar - Part II of II

3:45 PM-5:45 PM

Room:Maybird

For Part 1 see MS17

The field of chaotic communications has seen a revival in recent years thanks to new advances in matched filtering, synchronization, and signal processing. Many of the problems of radar are closely related to communications, so these advances in one of these fields feed advances in the other. The range of talks in this minisymposium will go from new techniques in using chaos to actual practical details of how to make chaos work in a communications system. A particular focus will be on what is gained by using chaos instead of some random broad band signal.

Organizer: Thomas L. Carroll

Naval Research Laboratory, USA

Organizer: Ned J. Corron

US Army RDECOM, USA

3:45-4:10 Recent Discoveries in Solvable Chaotic Systems

Marko S. Milosaviljevic, US Army RDECOM, USA

4:15-4:40 Nonlinear Dynamics in Optimal Communication Waveforms

Ned J. Corron, US Army RDECOM, USA; Jonathan Blakely, U.S. Army Aviation and Missile Research, Development, and Engineering Center, USA

4:45-5:10 A Demonstration Wireless Exact Solvable Chaotic Communication System

Keaton Rhea, Andrew Muscha, Remington Harrison, Frank Werner, and Robert Dean, Auburn University, USA; Darren Boyd, Marshall Space Flight Center, USA

5:15-5:40 Circuit Implementation of Generalized Projective Synchronization for Bistatic Radar Applications

Chandra S. Pappu, Union College, USA; Benjamin C. Flores, University of Texas at El Paso, USA

Sunday, May 21

MS31

Modal Decomposition of Networks and Structured Mechanical Systems

3:45 PM-5:45 PM

Room:Magpie B

Systems with large numbers of coupled dynamic components may feature intricacies such as component heterogeneity, nonlinearities, and unknown couplings between components. These may manifest themselves in complex behavior such as mode localization, resonances, energy transfer between modes, and multistability. Understanding these phenomena is crucial in order to ensure that the complex systems can perform required tasks efficiently while remain robust to disturbances. This section brings together leading experts on networks and structured mechanical systems and the talks will showcase the state-of-the-art mathematical tools in analyzing the dynamics of such complex systems. The methods will be demonstrated through real world applications like achieving consensus in a groups of robots, ensuring attenuation of disturbances in connected vehicle networks, and designing observers and controllers for multi-agent systems and continua.

Organizer: Sergei S. Avedisov

University of Michigan, Ann Arbor, USA

Organizer: Gabor Orosz

University of Michigan, Ann Arbor, USA

3:45-4:10 Nonlinear Dynamics of Vehicle Networks with Long Range Vehicle-to-vehicle Communication

Sergei S. Avedisov and Gabor Orosz, University of Michigan, Ann Arbor, USA

4:15-4:40 Emergent Task Differentiation on Network Filters

Mehdi Saghafi and *Harry Dankowicz,* University of Illinois at Urbana-Champaign, USA; Whitney Tabor, University of Connecticut, USA

continued in next column

4:45-5:10 A Delay-Based Controller Design Using Lambert W function in a Multi-Agent Consensus Dynamics

Adrian Ramirez, Min Hyong Koh, and Rifat Sipahi, Northeastern University, USA

5:15-5:40 Stability Charts for Continua Subjected to Delayed Feedback

Li Zhang, Nanjing University of Aeronautics and Astronautics, China; Gabor Stepan, Budapest University of Technology and Economics, Hungary

Sunday, May 21

MS32

Global Bifurcations and their Applications - Part I of II

3:45 PM-5:45 PM

Room:Wasatch B

For Part 2 see MS45

The session focuses on the topics related to global bifurcations which appear in the theoretical context and various applications (both in continuous and discrete time dynamical systems). It is well known that the stable and unstable manifolds of saddle and parabolic equilibria or fixed points are usually embedded into the phase space in a very complicated way, forming, in particular, homoclinic orbits or heteroclinic cycles. Moreover, small perturbations of these configurations may give rise to complex structures such as finite or infinite sets of periodic orbits, invariant tori, formation of Smale horseshoes, strange attractors, etc. Such dynamical systems have been intensively studied using analytical and numerical tools during the last 40 years. In this session research talks on homoclinic and heteroclinic bifurcations are welcome as well as talks covering the study of the structures of stable and unstable invariant manifolds.

Organizer: Ivan Ovsyannikov

University of Bremen, Germany

Organizer: Marina Gonchenko

University of Barcelona, Spain

3:45-4:10 Dynamics Near Cubic Homoclinic Tangencies in Symplectic Maps

Marina Gonchenko, University of Barcelona, Spain; Sergey Gonchenko, Lobachevsky State University of Nizhny Novgorod, Russia; Ivan Ovsyannikov, University of Bremen, Germany

4:15-4:40 Splitting of Separatrices at a Periodically Forced Hamiltonian-Hopf Bifurcation

Arturo Viero, University of Barcelona, Spain

4:45-5:10 Mixed Dynamics in Planar Reversible Diffeomorphisms

J. Tomas Lazaro, Universitat Politecnica de Catalunya, Spain

5:15-5:40 On Taken's Last Problem: Times Averages for Heteroclinic Attractors

Alexandre A. Rodrigues, University of Porto, Portugal

Sunday, May 21

MS33

Initiation and Suppression of Excitation Waves

3:45 PM-5:45 PM

Room:Superior B

The theory of excitation waves in nonlinear dissipative media play important role in many applications, notably for modelling electrical excitation propagation in heart and nerves. Much research is dedicated to long-term behaviour once the excitation waves have been initiated. However, for the applications just as important, if not more important, is the question of how the waves are initiated and/or terminated by external stimuli, noise, and heterogeneity. This minisymposium discusses mathematical theory, experiment, and computer modelling of transient regimes of initiation and suppression of excitation waves with a view for prevention and better control of cardiac arrhythmias.

Organizer: Irina Biktasheva

University of Liverpool, United Kingdom

Organizer: Seth Weinberg

Virginia Commonwealth University, USA

3:45-4:10 Fractional-Order Voltage Dynamics Suppresses Alternans and Promotes Spontaneous Activity in a Minimal Cardiomyocyte Model

Tien Comlekoglu and *Seth Weinberg*, Virginia Commonwealth University, USA

4:15-4:40 Semianalytical Approach to Criteria for Ignition of Excitation Waves

Burhan Bezekci, University of Exeter, United Kingdom; Ibrahim Idris, Bayero University, Nigeria; Radostin Simitev, University of Glasgow, Scotland, United Kingdom; *Vadim N. Biktashev*, University of Exeter, United Kingdom

4:45-5:10 Local Heterogeneities in Cardiac Systems Suppress Turbulence by Generating Multi-Armed Rotors

Oliver Steinbock and Zhihui Zhang, Florida State University, USA

5:15-5:40 Noise-Induced Effects on Spontaneous and Spiral Wave Activity of the Biopacemaker

Alireza Aghighi and Philippe Comtois, Université de Montréal, Canada

Sunday, May 21

MS34

Dynamics of Small Neuromorphic Networks (Biological and Biomimetic)

3:45 PM-5:45 PM

Room:Superior A

This minisymposium explores recent results in synchronization and more generally the dynamics of small experimental networks of biomimetic "neuronal cells" from the standpoint of dynamical systems. Fully synchronized states, chimeras (partially synchronized states), transients and intermediate states have all been observed. Three different systems are studied: neural activity in the rat neocortex, networks of electronic artificial neurons, and coupled chemical cells running the Belousov-Zhabotinsky reaction, the prototype excitable chemical reaction. Although these systems are different, useful skeleton models of their dynamics are strikingly similar. In particular, the generic Boissonade-De Kepper differential equation model for excitable chemical systems is a special case of the FitzHugh-Nagumo neuronal model. Recent results presented here find common features in the role of topology, connection strength and heterogeneity in synchronization, as well as differences arising from differences in cell-level dynamics. There are potential applications to understanding epilepsy, more generally as an experimental test-bed for analogs of brain dynamics, as well as to understanding the dynamics of current and future analog and digital neuromorphic computation. A combination of simulation, mathematical and experimental work will be presented.

Organizer: Harold M. Hastings

Hofstra University, USA

3:45-4:10 Neural Synchronization During Neocortical Seizures

Daisuke Takeshita, University of Helsinki, Finland; *Sonya Bahar,* University of Missouri, St. Louis, USA

continued on next page

Sunday, May 21

MS34

Dynamics of Small Neuromorphic Networks (Biological and Biomimetic)

3:45 PM-5:45 PM

continued

4:15-4:40 Engineering Reaction-Diffusion Networks with Properties of Neural Tissue

Seth Fraden, Thomas Litschel, and Michael M. Norton, Brandeis University, USA

4:45-5:10 Partially Synchronized States in Small Networks of Electrochemical Oscillators: Effect of Heterogeneities and Network Topology

Istvan Z. Kiss, Saint Louis University, USA

5:15-5:40 Order and Information Flow in an Array of Electronic Neurons

Mark Spano, Arizona State University, USA; Easwara Arumugam, Electrical Geodesics, Inc., USA

Sunday, May 21

MS35

Gene Regulatory Networks and Synthetic Biology

3:45 PM-5:45 PM

Room:Wasatch A

Synthetic biology and systems biology have benefited immensely from taking a quantitative, model-driven and theory-based approach, which facilitates the discovery of general design principles and the systematic bottom-up design of gene regulatory networks. Early synthetic circuits were implementations of the simplest nonlinear dynamical systems exhibiting bistability or oscillations. In recent years, the development and better characterization of a vast number of regulatory elements have enabled the successful construction of more and more complicated systems—from logic gates to counter circuits to pattern formation through cell-to-cell communication. Deterministic and stochastic modeling are also key to a deepened understanding of the fundamental mechanisms that ensure the reliable function in noisy cellular environments, and to managing the complexity of native systems in systems biology contexts. This minisymposium brings together scientists using dynamical systems approaches to understand, design and modify regulatory networks in single cells and at the population level, as well as their interaction with the environment.

Organizer: Philip Bittihn
University of California, San Diego, USA

Organizer: Lev S. Tsimring
University of California, San Diego, USA

3:45-4:10 Using Bistability, Oscillations and Slow-Fast Dynamics to Engineer Population Density Control and Stable Coexistence of Competitive Bacterial Strains

Philip Bittihn, University of California, San Diego, USA

continued in next column

4:15-4:40 Cooperation in Synthetic Bacterial Communities: Optimality, Fragility and Interaction Non-Additivity

Ting Lu, University of Illinois, USA

4:45-5:10 Excitable Toxin-Antitoxin Modules Coordinated Through Intracellular Bottlenecks

William H. Mather, Virginia Tech, USA

5:15-5:40 Dynamic Ligand Discrimination in the Notch Signaling Pathway

Sandy Nandagopal, California Institute of Technology, USA

Sunday, May 21

MS36

Exotic Bifurcations in Fluid and Granular Dynamics - Part I of II

3:45 PM-5:45 PM

Room:Magpie A

For Part 2 see MS49

An octet of expert researchers has been assembled to describe and analyze some fascinating bifurcations recently discovered in dynamical systems models related to fluid and granular flows. These bifurcations range from variations of familiar types to new varieties of spectacular complexity, many of which play key roles in determining the evolution of the dynamical systems in which they occur. Among the examples to be presented are those connected with walking droplets (pilot waves), vortex dynamics of viscous flows, traveling waves in fluids, granular mixing phenomena, coarse-grained swimmer interactions, billiards with soft boundaries, and slip deformations in fluid flows.

Organizer: Denis Blackmore

New Jersey Institute of Technology, USA

Organizer: Ivan C. Christov

Purdue University, USA

Organizer: Aminur Rahman

New Jersey Institute of Technology, USA

3:45-4:10 Bifurcations in Walking Droplet Dynamics

Aminur Rahman and Denis Blackmore, New Jersey Institute of Technology, USA

4:15-4:40 Traveling Waves in Fluids: Bifurcations with Respect to the Wave Speed

Ivan C. Christov, Purdue University, USA

4:45-5:10 Course-Grained Models for Interacting Flapping Swimmers

Anand Oza, Leif Ristroph, and Michael J. Shelley, Courant Institute of Mathematical Sciences, New York University, USA

5:15-5:40 The Annihilation of Periodic Points and Barriers to Transport by Discontinuous 'Slip' Deformations in a Fluid Flow

Lachlan Smith, Northwestern University, USA; Murray Rudman, Monash University, Australia; Daniel Lester, RMIT University, Australia; Guy Metcalfe, Monash University, Australia

Sunday, May 21

MS37

Energy Transport and Control in Nonlinear Systems - Part I of II

3:45 PM-5:45 PM

Room:White Pine

For Part 2 see MS50

Systems with essential nonlinearity, that cannot be assessed with the help of common perturbation approaches, are very interesting theoretically, as well as from viewpoint of numerous suggested applications. In the same time, such systems pose a number of challenges - theoretical, experimental, as well as computational The proposed minisymposium will focus on recent developments and challenges related to energy transfer and control of energy distribution in essentially nonlinear systems. Topics will include, but will not be limited to: - Dynamics of acoustic vacua. - Energy transport in non-smooth systems and granular media; - Passive nonlinear non-reciprocity; - Nonlinear phononics; - Applications of strong and non-smooth nonlinearities for efficient energy harvesting.

Organizer: Oleg Gendelman

Technion Israel Institute of Technology, Israel

Organizer: Alexander Vakakis

University of Illinois, USA

3:45-4:10 Energy Exchange in Strongly Nonlinear Systems: Canonical Formalism

Oleg Gendelman, Technion Israel Institute of Technology, Israel; Themistoklis Sapsis, Massachusetts Institute of Technology, USA

4:15-4:40 Resonance Energy Transfer Between Charged Particles and Electromagnetic Waves

Dmitri Vainchtein, Drexel University, USA; Anton Artemyev, University of California, Los Angeles, USA; Fan Wu, Central South University, China

continued in next column

4:45-5:10 High-amplitude Stationary Dynamics, Energy Transfer and Localization in Sine-lattice

Leonid Manevitch, Russian Academy of Sciences, Russia; Valeriy Smirnov, Semenov Institute of Chemical Physics, Russia

5:15-5:40 Realization of Nonlinear Resonances in Multiple Modes of a Microcantilever Polymer System

Keivan Asadi, Ohio State University, USA; Snehan Peshin and Junghoon Yeom, Michigan State University, USA; *Hanna Cho*, Ohio State University, USA

Intermission

5:45 PM-6:00 PM

Prize Presentations - Juergen Moser and J. D. Crawford

6:00 PM-6:15 PM

Room:Ballroom

Sunday, May 21

SP1

Juergen Moser Lecture - Emergent Behavior in Large Systems of Many Coupled Oscillators

6:15 PM-7:00 PM

Room:Ballroom

Chair: Mary Silber, University of Chicago, USA

Large systems of many coupled dynamical units are of crucial interest in a host of physical, biological and technological settings. Often the dynamical units that are coupled exhibit oscillatory behavior. The understanding and analysis of these large, complex systems offers many challenges. In this talk I will introduce this topic, give some examples, and describe a technique for analyzing a large class of problems of this type. The results I will discuss will reduce the complicated, high dimensional, microscopic dynamics of the full system to that or a low dimensional system governing the macroscopic evolution of certain 'order parameters'. This reduction is exact in the limit of large system size, i.e., N going to infinity, where N is the number of coupled units, and can be employed to discover and study all the macroscopic attractors and bifurcations of these systems.

Edward Ott
University of Maryland, USA

Monday, May 22

Registration

8:00 AM-6:15 PM

Room:Ballroom Foyer

MS38

Noise-Induced Transitions in Networks

8:30 AM-10:30 AM

Room:Ballroom 1

Networks often display a wide variety of dynamical behaviors involving, for example, coexisting stable states. The transient dynamics responsible for the transition between dynamic states are often driven by a combination of stochastic fluctuations and underlying nonlinear dynamics. Their behavior depends on network structure, node dynamics, coupling and separation of timescales. These noise- induced transient dynamics may be quite different from the long-term behavior of the noise-free system. However, analysis of such behavior is crucial to understanding complex network dynamics and their contemporary scientific applications including neuroscience and climate modelling, among others. This minisymposium will showcase a variety of novel approaches examining noise-induced transitions in network dynamics.

Organizer: Jennifer L. Creaser
University of Exeter, United Kingdom

8:30-8:55 Can Finite Size Effects in Networks Be Represented by Stochastic Mean-Field Dynamics?
Andreas Daffertshofer, Vrije Universiteit Amsterdam, The Netherlands

9:00-9:25 Designing Noisy Networks
Claire M. Postlethwaite, University of Auckland, New Zealand; Peter Ashwin, University of Exeter, United Kingdom

9:30-9:55 Large Deviations in Stochastic Hybrid Networks
Paul C. Bressloff, University of Utah, USA

10:00-10:25 Noise-Induced Optimal Dynamics in Self-Organizing Adaptive Networks
Christian Kuehn, Technical University of Munich, Germany

Monday, May 22

MS39

Recent Developments in Data Assimilation - Part II of II

8:30 AM-10:30 AM

Room:Ballroom 2

For Part 1 see MS26

Data assimilation (DA) is the process by which observations are incorporated into a forecast system to obtain a suitable estimate of reality. Although it has classically been applied to global weather prediction, DA has since been applied to math biology, efficacy of drug therapies, urban planning, and more. Nevertheless, a central issue in DA is balancing the high-dimensionality inherent in the models, the efficient exploitation of the available data, and reducing errors naturally contained in both the model and data. This minisymposium will serve to bridge the two communities of DA and analysis of partial differential equations (PDE) through problems in DA. We propose two sessions, each one focused on the research done by one of these two communities. The first session will consist of speakers in the area of analysis of PDE; they will address a certain DA algorithm based on feedback control, and some of its applications, ranging from numerical approximations to the context of incomplete observations. The second one will focus on the more applied area of DA, with speakers discussing about topics such as: back and forth nudging applied to geophysical flows; forecast sensitivity to observations; and balance control of the ensemble Kalman filter.

Organizer: Vincent R. Martinez
Tulane University, USA

Organizer: John Maclean
University of North Carolina, Chapel Hill, USA

Organizer: Cecilia F. Mondaini
Texas A&M University, USA

continued on next page

Monday, May 22

MS39

Recent Developments in Data Assimilation - Part II of II

8:30 AM-10:30 AM

continued

8:30-8:55 Forecast Sensitivity to Observations and Observation Impact for Data Assimilation Systems
Kayo Ide, University of Maryland, College Park, USA

9:00-9:25 Data Assimilation for Geophysical Fluids: Back and Forth Nudging (BFN) and Observers
Didier Auroux, University of Nice, France

9:30-9:55 The Bayesian Formulation and Well-posedness of Fractional Elliptic Inverse Problems
Daniel Sanz-Alonso, Brown University, USA

10:00-10:25 Multilevel Monte Carlo Methods for Data Assimilation
Kody Law, Oak Ridge National Laboratory, USA

Monday, May 22

MS40

The Dynamics and Function of Neuronal Networks - Part II of II

8:30 AM-10:30 AM

Room:Ballroom 3

For Part 1 see MS27

The dynamics of neuronal networks provide rich information regarding the nature of neuronal computation and information processing in the brain. This minisymposium explores recent work in the modeling and analysis of neuronal dynamics and function, emphasizing implications on visual information processing, synchronization and oscillations, network connectivity, and variability from a single neuron to a neuronal network. The speakers will draw particular attention to new mathematical advances in characterizing the structure-function relationship for complex neuronal networks and techniques for understanding the biophysical mechanisms underlying experimentally observed phenomena.

Organizer: Songting Li
Courant Institute of Mathematical Sciences, New York University, USA

Organizer: Victor Barranca
Swarthmore College, USA

Organizer: Douglas Zhou
Shanghai Jiao Tong University, China

8:30-8:55 Spatial Variation of Spike Initiation Threshold in Large Active Dendritic Arbors
William Kath, Northwestern University, USA

9:00-9:25 Modeling Within and Across Area Neuronal Variability in the Visual System
Chengcheng Huang, Douglas Ruff, Marlene Cohen, and Brent Doiron, University of Pittsburgh, USA

9:30-9:55 Distinct Roles of Interneurons in Hippocampal Network Oscillations
Songting Li, Courant Institute of Mathematical Sciences, New York University, USA; Douglas Zhou, Shanghai Jiao Tong University, China; David Cai, Shanghai Jiao Tong University, China and Courant Institute of Mathematical Sciences, New York University, USA; Jiamin Xu and Longnian Lin, East China Normal University, China

10:00-10:25 The Role of Localization and Center-Surround Structure in Compressive Sensory Signal Processing
Victor Barranca, Swarthmore College, USA

continued in next column

Monday, May 22

MS41

Using Reservoir Computers to Learn Dynamical Systems

8:30 AM-10:30 AM

Room:Primrose A

A reservoir computer is a recurrent artificial neural network that is well suited for learning complex dynamical systems. It operates in two different modes: an initial training phase where the computer parameters are adjusted so that it can reproduce the input waveforms with high accuracy; and a prediction phase, where the input waveforms from the dynamical system are turned off and output of the computer is fed back to its input. For the case of a chaotic system, the actual and predicted behaviors will eventually diverge, but the predicted trajectory continues to reside on the strange attractor of the original system. Thus, the reservoir computer actually learns the underlying dynamical system. The reservoir computer consists of an input layer that is randomly connected to a recurrent network (the reservoir) followed by an output layer that is connected to the reservoir. Here, the weights of the input nodes the reservoir link weights are randomly chosen and fixed before training. During the training phase, only the weights to the output layer are adjusted and then fixed. The training is a linear optimization problem and hence can be completed in a short time. This minisymposium will discuss the state-of-the-art in applying reservoir computers to problems of practical interest, efficient hardware implementations, and new mathematical results concerning how to optimize the reservoir computer prediction ability.

Organizer: Daniel J. Gauthier
Ohio State University, USA

Organizer: Edward Ott
University of Maryland, USA

continued in next column

8:30-8:55 Predicting Spatial-Temporal Dynamics Using Reservoir Computers
Edward Ott, Jaideep Pathak, Zhixin Lu, Brian Hunt, and Michelle Girvan, University of Maryland, USA

9:00-9:25 Nonlinear Dynamics of Reservoir Computing and Prediction
Brian R. Hunt, University of Maryland, USA

9:30-9:55 Qualitative Properties of Large Systems of Ordinary Differential Equations
Roger Brockett, Harvard University, USA; Daniel J. Gauthier, Ohio State University, USA

10:00-10:25 Reservoir Computing Using Autonomous Boolean Networks Realized on a Field-Programmable Gate Array
Daniel J. Gauthier, Daniel Canaday, and Aaron Griffith, Ohio State University, USA; Nicholas Haynes, Duke University, USA; Otti D'Huys, Aston University, United Kingdom

Monday, May 22

MS42

Nonlinear Aspects of Dynamical Systems Driven by Coulomb Interactions - Part I of II

8:30 AM-10:30 AM

Room:Primrose B

For Part 2 see MS55

Many novel clean energy devices are based on nanostructured soft ionic matter with examples including polyelectrolyte membranes, acceptor/donor polymer blends, or ionic liquids. Behavior in such systems is governed by competing short-range (e.g., steric or chemical) interactions and long- range Columbic interactions. Similar interactions govern the properties of biological ionic channels. These systems give rise to complex behavior, controlled by a very large parameter space. Dynamical systems tools and bifurcation theory are, thus, highly suitable for studying these systems. The minisymposium aims to survey developments of models and methods in the context of electrokinetics and/or electrochemical type systems, with a focus on their impacts to real life applications ranging from chemistry to biology.

Organizer: Nir Gavish
Technion - Israel Institute of Technology, Israel

8:30-8:55 The Steric Pnp-Ok Model
Nir Gavish, Technion - Israel Institute of Technology, Israel

9:00-9:25 Dynamics of Ions Control Most Biological Systems
Bob Eisenberg, Rush University Medical Center, USA

9:30-9:55 Energetic Variational Approaches in Transport of Ionic Particles
Chun Liu, Pennsylvania State University, USA

10:00-10:25 Individual Flux Study Via Steady-State Poisson-Nernst-Planck Systems: Effects from Boundary Conditions
Mingji Zhang, New Mexico Institute of Mining and Technology, USA

Monday, May 22

MS43

Multiscale Dynamics: Data-driven Characterization, Modeling, and Control - Part I of II

8:30 AM-10:00 AM

Room:Maybird

For Part 2 see MS56

Multiscale and intermittent phenomena as well as rare events are prevalent in many complex systems in science and engineering. Data-driven methods play a vital role in the characterization of these systems and are particularly appealing considering the immense developments in sensor technology and computing power in recent years. However, many techniques struggle to separate dynamics that are fast, slow or rare relative to the dominant scale. This symposium explores the challenges and innovations in data-driven methods for estimation, prediction and control of multiscale dynamics. We invite speakers working at the forefront of data-driven approaches, that include techniques such as dimensionality reduction, compressed sensing, machine learning, operator theoretic approaches, and control, to explore challenges and solutions for tackling multi- scale phenomena.

Organizer: Eurika Kaiser

University of Washington, USA

Organizer: Krithika Manohar

University of Washington, USA

8:30-8:55 The Data Mining of Sloppiness: Parameter Reduction for Complex Dynamical Systems

Antonios Zagaris, Wageningen University and Research Centre, The Netherlands; Ioannis Kevrekidis and William Holiday, Princeton University, USA

9:00-9:25 Sparse Sensor Placement for Multiscale Phenomena

Krithika Manohar, Eurika Kaiser, Steven Brunton, and Nathan Kutz, University of Washington, USA

9:30-9:55 Kernel Analog Forecasting and Its Applications

Zhizhen Zhao, University of Illinois, USA

Monday, May 22

MS44

Topographic Influences on Vegetation Patterns in Semi-arid Regions

8:30 AM-10:30 AM

Room:Magpie B

Regular spatial patterns in vegetation growth appear at a community scale in semi-arid ecosystems across the globe. Such patterns have been attributed to various kinds of positive feedback between the individual plants and water availability. Given the increasing availability of data from satellites and other sources, we are poised to develop more informed models of these potentially vulnerable ecosystems. As a first step, incorporating topographic information into modeling efforts has the potential to improve our understanding of the role that water transport plays in the vegetation dynamics.

Organizer: Punit R. Gandhi

Ohio State University, USA

Organizer: Sarah Iams

Harvard University, USA

8:30-8:55 How Does Topography Impact Vegetation Patterns?

Sarah Iams, Harvard University, USA; Andrew J. Bernoff, Harvey Mudd College, USA; Karna V. Gowda, Northwestern University, USA; Chad M. Topaz, Macalester College, USA; Mary Silber, University of Chicago, USA

9:00-9:25 Topography and Water Transport in Semi-Arid Ecosystems

Amilcare Porporato, Duke University, USA

9:30-9:55 Introducing Topographical Influences in the Extended-Klausmeier Vegetation Model

Robbin Bastiaansen, Arjen Doelman, and Martina Chirilus-Bruckner, Leiden University, Netherlands

10:00-10:25 Topographic Controls on Vegetation Patterns

Sara Bonetti and Amilcare Porporato, Duke University, USA

Monday, May 22

MS45

Global Bifurcations and their Applications - Part II of II

8:30 AM-10:30 AM

Room:Wasatch B

For Part 1 see MS32

The session focuses on the topics related to global bifurcations which appear in the theoretical context and various applications (both in continuous and discrete time dynamical systems). It is well known that the stable and unstable manifolds of saddle and parabolic equilibria or fixed points are usually embedded into the phase space in a very complicated way, forming, in particular, homoclinic orbits or heteroclinic cycles. Moreover, small perturbations of these configurations may give rise to complex structures such as finite or infinite sets of periodic orbits, invariant tori, formation of Smale horseshoes, strange attractors, etc. Such dynamical systems have been intensively studied using analytical and numerical tools during the last 40 years. In this session research talks on homoclinic and heteroclinic bifurcations are welcome as well as talks covering the study of the structures of stable and unstable invariant manifolds.

Organizer: Ivan Ovsyannikov

University of Bremen, Germany

Organizer: Marina Gonchenko

University of Barcelona, Spain

8:30-8:55 Birth of Discrete Lorenz Attractors in Homoclinic and Heteroclinic Tangencies

Ivan Ovsyannikov, University of Bremen, Germany

9:00-9:25 Complex Dynamics of Robust Pulse Generators in Reaction-Diffusion Systems

Takashi Teramoto, Asahikawa Medical University, Japan

9:30-9:55 The Geometry of Blenders in a Three-dimensional Hénon-like Family

Stefanie Hittmeyer, Bernd Krauskopf, and Hinke M. Osinga, University of Auckland, New Zealand; Katsutoshi Shinohara, Hitotsubashi University, Japan

10:00-10:25 Bifurcations of Degenerate Singular Cycles

Alexander Lohse, University of Hamburg, Germany; Alexandre A. Rodrigues, University of Porto, Portugal

Monday, May 22

MS46

Non-linear Dynamics in Endocrine Systems

8:30 AM-10:30 AM

Room:Superior B

A major biomedical challenge is to understand the dynamic behaviour of endocrine systems. In the pancreas, for example, beta cells must continuously monitor and control sugar levels by regulating insulin levels. Also, reproduction is tightly regulated by dynamic hormone signals that control spermatogenesis and the ovarian cycle in the gonads. Mathematical modelling has proven to be an important tool to understand the properties of these homeostatic systems where non-linearity, feedback regulation, modularity, and the interplay between organs (e.g. the brain and the periphery) play a critical role. This is crucial for understanding both healthy physiology and disease, in order to design better healthcare interventions. This minisymposium will bring together experts in mathematical modelling in various areas of endocrinology. Our aim is to identify current challenges and outline future directions in mathematical models of endocrine systems, emphasising the importance of model predictions for a dynamic understanding of these systems in healthcare.

Organizer: Eder Zavala
University of Exeter, United Kingdom

Organizer: Margaritis Voliotis
University of Exeter, United Kingdom

8:30-8:55 Information Transfer in Gonadotropin-Releasing Hormone (gnrh) Sensing and Signalling

Margaritis Voliotis and Krasimira Tsaneva-Atanasova, University of Exeter, United Kingdom; Craig McArdle, Amitesh Pratap, and Kathryn Garner, University of Bristol, United Kingdom

continued in next column

9:00-9:25 Rescuing Pulsatile Insulin Secretion by Wiggling Glucose

Richard Bertram, Joseph Mckenna, Raghuram Dumpa, Nikita Mukhitov, and Michael Roper, Florida State University, USA

9:30-9:55 An Integrated System Towards Artificial Pancreas and its Numerical Trials

Jiaxu Li, University of Louisville, USA

10:00-10:25 Centre Manifold Deformation in Impaired Ultradian Oscillations of Glucose Regulation

Benoit Huard, Maia Angelova, and Adam Bridgewater, Northumbria University, United Kingdom

Monday, May 22

MS47

Dynamical Systems Techniques in Navier-Stokes Flow Without Material Boundaries - Part I of II

8:30 AM-10:30 AM

Room:Superior A

For Part 2 see MS60

Homogeneous isotropic turbulence (HIT) is an idealized model of fluid turbulence away from material boundaries, consisting of the Navier-Stokes equation in a periodic (or infinite) domain and - usually - the divergence-free condition. Free of the effect of container walls or external forces, HIT is often coined as 'the core of the turbulence problem' (Sagaut & Cambon). A lot is known about the statistics of HIT at high Reynolds numbers, in particular about the cascade of kinetic energy from large to small scales. However, surprisingly little is known about the dynamics of and the transition to HIT of periodic flows at small and moderate Reynolds numbers, or about the dynamics of the cascade process. A number of interesting new ideas and results have appeared recently, such as the application of computational dynamical systems techniques in Large Eddy Simulations (LES), the computation of equilibria, travelling waves and unstable periodic orbits in two and three dimensional Kolmogorov flow, the occurrence of relaminarisation events in a particular model of HIT which show a statistical signature consistent with the escape from a chaotic saddle and the use of optimisation techniques to study regularity of solutions. In this session, we will try to give an overview of recent work in HIT and associated models such as LES, with an emphasis on the transition problem and the links between transitions, dynamics and the energy transfer process.

continued on next page

Monday, May 22

MS47

Dynamical Systems Techniques in Navier-Stokes Flow Without Material Boundaries - Part I of II

8:30 AM-10:30 AM

continued

Organizer: Moritz Linkmann
University of Rome II, Tor Vergata, Italy

Organizer: Lennaert van Veen
University of Ontario Institute of Technology, Canada

8:30-8:55 Recurrent Flow Analysis in Kolmogorov Flows
Dan Lucas, Cambridge University, United Kingdom; Gary Chandler and *Rich Kerswell*, University of Bristol, United Kingdom

9:00-9:25 Nonlinear Energy Transfers and Intermittent Energy Dissipation in Forced Shear Flows
Mohammad Farazmand and Themistoklis Sapsis, Massachusetts Institute of Technology, USA

9:30-9:55 Localized Turbulence in 2D Kolmogorov Flows
Yoshiki Hiruta and Sadayoshi Toh, Kyoto University, Japan

10:00-10:25 Statistics of Spatially-Periodic Turbulence Driven by Steady Forces
Susumu Goto, Osaka University, Japan; Lennaert van Veen, University of Ontario Institute of Technology, Canada

Monday, May 22

MS48

Dynamical Models of Plant Response to Threats

8:30 AM-10:30 AM

Room:Wasatch A

Recent investigations have revealed a wide variety of mechanisms by which plants defend against and respond to attacks by pathogens and insects. These systems provide novel opportunities for ecosystem models to describe the dynamics of how the defense mechanism mediates the insult, and to obtain insight into how the defenses have been selected and calibrated through evolution. Such quantitative understanding could aid in efforts to protect cultivated plant crops against pests. This minisymposium will feature presentations on topics on this theme ranging from plant resistance against viral infection to signaling and priming against insect herbivores via volatile chemical release.

Organizer: Peter R. Kramer
Rensselaer Polytechnic Institute, USA

Organizer: Karen M. Cumings
Rensselaer Polytechnic Institute, USA

8:30-8:55 Mathematical Models of RNA Interference in Plants
Konstantin Blyuss, University of Sussex, United Kingdom

9:00-9:25 Can Inducible Resistance in Plants Cause Herbivore Aggregations? Spatial Patterns in an Inducible Plant/Herbivore Model
Kurt Anderson, University of California, Riverside, USA; Brian Inouye and Nora Underwood, Florida State University, USA

9:30-9:55 Plant Compensatory Regrowth and Plant Resistance Effects on the Population Dynamics of Herbivores and Plants
Christopher Stieha and Brian Lerch, Case Western Reserve University, USA; Katja Poveda, Cornell University, USA; Karen Abbott, Case Western Reserve University, USA

10:00-10:25 Exploring Fitness Effects of Plant Defenses Against Insect Herbivores
Karen M. Cumings, Peter R. Kramer, and Bradford C. Lister, Rensselaer Polytechnic Institute, USA

Monday, May 22

MS49

Exotic Bifurcations in Fluid and Granular Dynamics - Part II of II

8:30 AM-10:30 AM

Room:Magpie A

For Part 1 see MS36

An octet of expert researchers has been assembled to describe and analyze some fascinating bifurcations recently discovered in dynamical systems models related to fluid and granular flows. These bifurcations range from variations of familiar types to new varieties of spectacular complexity, many of which play key roles in determining the evolution of the dynamical systems in which they occur. Among the examples to be presented are those connected with walking droplets (pilot waves), vortex dynamics of viscous flows, traveling waves in fluids, granular mixing phenomena, coarse-grained swimmer interactions, billiards with soft boundaries, and slip deformations in fluid flows.

Organizer: Denis Blackmore
New Jersey Institute of Technology, USA

Organizer: Ivan C. Christov
Purdue University, USA

Organizer: Aminur Rahman
New Jersey Institute of Technology, USA

8:30-8:55 Analysis of New Walking Droplet Bifurcations
Denis Blackmore and Aminur Rahman, New Jersey Institute of Technology, USA

9:00-9:25 Bifurcations in a Soft Billiard
Guy Metcalfe, Monash University, Australia

9:30-9:55 Topological Bifurcations of Vorticity
Morten Brons, Technical University of Denmark, Denmark; Morten Andersen and Jesper Schmidt Hansen, Roskilde University, Denmark; Matthias Heil, University of Manchester, United Kingdom

10:00-10:25 Surprisingly Persistent Structures Predicted by Piecewise Isometries
Richard M. Lueptow, Paul Park, Zafir Zaman, Mengqi Yu, Paul Umbanhowar, and Julio M. Ottino, Northwestern University, USA

Monday, May 22

MS50

Energy Transport and Control in Nonlinear Systems - Part II of II

8:30 AM-10:30 AM

Room:White Pine

For Part 1 see MS37

Systems with essential nonlinearity, that cannot be assessed with the help of common perturbation approaches, are very interesting theoretically, as well as from viewpoint of numerous suggested applications. In the same time, such systems pose a number of challenges - theoretical, experimental, as well as computational The proposed minisymposium will focus on recent developments and challenges related to energy transfer and control of energy distribution in essentially nonlinear systems . Topics will include, but will not be limited to: - Dynamics of acoustic vacua. - Energy transport in non-smooth systems and granular media; - Passive nonlinear non-reciprocity; - Nonlinear phononics; - Applications of strong and non-smooth nonlinearities for efficient energy harvesting.

Organizer: Oleg Gendelman
Technion Israel Institute of Technology, Israel

Organizer: Alexander Vakakis
University of Illinois, USA

8:30-8:55 Nonlinear Mechanisms of the 2D Energy Redirection and Absorption in Mechanical Systems Subject to the External Loading
Yuli Starosvetsky, Technion - Israel Institute of Technology, Israel

9:00-9:25 Tailoring Dispersion Characteristics in Next-Generation Metastructures
Alper Erturk, Georgia Institute of Technology, USA

continued in next column

9:30-9:55 Nonlinear Energy Transfers in Fluid-Structure Interaction of a Cylinder with An Internal Attachment
Antoine Blanchard and Lawrence Bergman, University of Illinois at Urbana-Champaign, USA; Alexander Vakakis, University of Illinois, USA

10:00-10:25 Extreme Control of Impulse Transmission by Cylindrical Phononic Crystals
Rajesh Chaunsali, Eunho Kim, Matthew Toles, and Jinkyu Yang, University of Washington, USA

Coffee Break

10:30 AM-11:00 AM

Room:Golden Cliff

Monday, May 22

IP2

Pattern Formation in the Drylands: Vegetation Patterns in Mathematical Models and in Satellite Images of the Horn of Africa

11:00 AM-11:45 AM

Room:Ballroom

Chair: Edgar Knobloch, University of California, Berkeley, USA

An awe-inspiring example of spontaneous pattern formation appears in the distribution of vegetation in some dry-land environments. Examples from Africa, Australia and the Americas reveal vegetation congregated in stripe-like bands, alternating with striking regularity with bands of bare soil. A typical length scale for such patterns is ~100 m; they may be readily surveyed in Google Maps. The typical time scale for pattern evolution, however, is ~100 years, so investigations of dynamics are a bit thwarted, with only a few early data points provided by aerial photographs from the 1950s. These ecosystems represent some of Earth's most vulnerable under threats to desertification, and ecologists have suggested that the patterns, easily monitored by satellites, may tell us something about a region's possible stage of collapse. This is an attractive idea, especially to us pattern formation researchers who want to work on problems that have potential impact. My talk consists of two parts. In the first, I describe how one proposed early warning sign, related to vegetation pattern morphology, can be framed mathematically in terms of an equivariant bifurcation problem, and then probed by a systematic analysis of models. In the second, I turn to investigations of image data, focusing on our preliminary studies of vegetation patterns in the Horn of Africa. The goal of this presentation is to highlight the potential for models to be confronted by data, and vice versa.

Mary Silber
University of Chicago, USA

Monday, May 22

Lunch Break

11:45 AM-1:15 PM

Attendees on their own

Mentoring Program

12:00 PM-1:00 PM

Room:Primrose A

Chair: Emily Stone, University of Montana, USA

The conference organizers are hosting a mentoring event for women grad students and post docs at the conference. The early career women will be matched with a mentor based loosely on research area. During a brown bag lunch held on Monday, the mentors and mentees will meet for introductions and conversation. We hope that this will facilitate more "vertical integration" at the conference, which in turn will strengthen the community of women academics and researchers in Applied Dynamical Systems.

An opportunity to participate in this event was provided during the registration process.

Monday, May 22

MS51

Novel Applications of Discrete Maps in Neuroscience

1:15 PM-3:15 PM

Room:Ballroom 1

Although discrete maps have long been a recognized tool for analyzing dynamics in neuroscience, recent work has extended both the kinds of models being investigated and the ways in which these maps are applied. Models under consideration describe dynamics at disparate spatial and temporal scales and include single neuron models, molecular networks, large neuronal networks, and firing rate models. In these high-dimensional systems, discrete maps are defined to represent key dynamical features of the full models, and analysis of bifurcations of these maps provides new ways of understanding bifurcations in the higher dimensional systems they represent. This session will present current results in the applications of maps arising in neuroscience.

Organizer: Cecilia Diniz Behn
Colorado School of Mines, USA

Organizer: Casey Diekman
New Jersey Institute of Technology, USA

1:15-1:40 A Map-Based Approach to Understanding Circadian Modulation of Sleep

Cecilia Diniz Behn and Kelsey Kalmbach, Colorado School of Mines, USA; Victoria Booth, University of Michigan, USA

1:45-2:10 Entrainment Maps: A New Tool for Understanding Properties of Circadian Oscillators

Casey Diekman and Amitabha Bose, New Jersey Institute of Technology, USA

2:15-2:40 Globally Attracting Synchrony in a Network of Oscillators with Strong Inhibitory Pulse Coupling

Carmen Canavier, Louisiana State University Health Sciences Center, USA; Ruben Tikidji-Hamburyan, George Washington University, USA

2:45-3:10 Farey Sequences in Periodically Forced 2-Dimensional Integrate-and-Fire Models

Albert Granados, Technical University of Denmark, Denmark; Gemma Huguet, Universitat Politecnica de Catalunya, Spain

Monday, May 22

MS52

Stochastic Analysis with Applications in Biology and Evolutionary Dynamics - Part I of II

1:15 PM-3:15 PM

Room:Ballroom 2

For Part 2 see MS65

Stochastic modeling of biological problems has become an extremely popular area of research. These new applications call for the development of new analysis techniques to interpret results and form hypotheses. The presentations in this minisymposium span a broad array of problems from this area with particular emphasis on applications of large deviations theory, evolutionary dynamics, and applied stochastic analysis for molecular dynamics and gene expression. The aim is to showcase the recent advances in the analytical and numerical techniques developed for stochastic dynamical systems and their impact on biological applications.

Organizer: Lora Billings
Montclair State University, USA

Organizer: Ilya Timofeyev
University of Houston, USA

1:15-1:40 Rare Events Reconstruction of Most Likely Evolutionary Paths for Bacterial Populations

Ilya Timofeev, Robert Azencott, and Brett Geiger, University of Houston, USA

1:45-2:10 Deterministic and Stochastic Effects in the Assembly of Multi-species Microbial Communities

Jeff Gore, Massachusetts Institute of Technology, USA

2:15-2:40 Large Deviations for Gaussian Processes with Delay

William Ott, University of Houston, USA

2:45-3:10 Gene Expression Dynamics with Stochastic Bursts: Exact Results for a Coarse-Grained Model

Charles R. Doering, University of Michigan, Ann Arbor, USA

Monday, May 22

MS53

Dynamics of Systems with Frictional Contact - Towards Sptially Extended Systems - Part I of II

1:15 PM-3:15 PM

Room:Ballroom 3

For Part 2 see MS66

There has been a recent resurgence of interest in the nonlinear dynamics of mechanical systems with frictional contact. Phenomena such as the Painleve paradox, set valued friction laws and extended models of stick-slip behaviour using rate-and-state friction laws have given rise to new problems within nonsmooth and multiple timescale dynamical systems. Example problems studied will include applications from gas turbine and automotive engineering, haptic sensors such as rats whiskers to the dynamics of DNA and other mollecular structures. A particular focus of this minisymposium will be the move away from theories of point stick-slip contact to dynamics associated with coupled tangential and normal degrees of freedom and spatially extended contact. Theory and applications will be discussed hand in hand.

Organizer: Alan R. Champneys

University of Bristol, United Kingdom

1:15-1:40 Overview of Models for Impact and Friction - Oblique and Spatially Extended Systems

Alan R. Champneys and Thbaut Putelat, University of Bristol, United Kingdom

1:45-2:10 On the Regularization of Impact Without Collision: The Painlevé Paradox and Compliance

S. John Hogan, University of Bristol, United Kingdom; Kristian U. Kristiansen, Technical University of Denmark, Denmark

2:15-2:40 Canards in Stiction: On Solutions of a Friction Oscillator by Regularization

Elena Bossolini, Morten Brons, and Kristian U. Kristiansen, Technical University of Denmark, Denmark

2:45-3:10 Dynamic Jamming Singularity of Mechanical Systems with Muliple Point Contacts

Peter L. Varkonyi, Budapest University of Technology and Economics, Hungary

Monday, May 22

MS54

Waves, Scales, and Balances in Geophysical Fluid Flow - Part I of II

1:15 PM-3:15 PM

Room:Primrose A

For Part 2 see MS67

Geophysical flows comprise a broad range of spatio-temporal scales and associated wave phenomena. Regime separation is often possible formally via multi-scale analysis into balanced motion, and waves. A variety of averaging and model reduction techniques are used to obtain effective equation for the larger scale motions. A full theoretical justification is often available for simple or idealized models only. General theoretical results remain a challenge, but help validate and improve current numerical weather and climate prediction models. In this minisymposium, recent advances in mathematical analysis of geophysical flow phenomena will be discussed, ranging from variational structures, multiscale systematics, to existence theorems and error estimation.

Organizer: Jens Rademacher

University of Bremen, Germany

Organizer: Marcel Oliver

Jacobs University Bremen, Germany

1:15-1:40 Optimal Balance via Adiabatic Invariance of Approximate Slow Manifolds

Marcel Oliver, Jacobs University Bremen, Germany

1:45-2:10 Multiscale Asymptotics for the Madden-Julian Oscillation and Tropical-extratropical Interactions

Shengqian Chen, University of Wisconsin, Madison, USA; Andrew Majda, Courant Institute of Mathematical Sciences, New York University, USA; *Samuel Stechmann*, University of Wisconsin, Madison, USA

continued in next column

2:15-2:40 A Quasi-Lagrangian Approach to Scalar Transport in Complex Flows

Larry Pratt, Woods Hole Oceanographic Institution, USA; Roy Barkan, University of California, Los Angeles, USA; Irina Rypina, Woods Hole Oceanographic Institution, USA

2:45-3:10 Nonuniqueness of Weak Solutions to the SQG Equation

Vlad C. Vicol, Princeton University, USA

Monday, May 22

MS55

Nonlinear Aspects of Dynamical Systems Driven by Coulomb Interactions - Part II of II

1:15 PM-3:15 PM

Room:Primrose B

For Part 1 see MS42

Many novel clean energy devices are based on nanostructured soft ionic matter with examples including polyelectrolyte membranes, acceptor/donor polymer blends, or ionic liquids. Behavior in such systems is governed by competing short-range (e.g., steric or chemical) interactions and long- range Columbic interactions. Similar interactions govern the properties of biological ionic channels. These systems give rise to complex behavior, controlled by a very large parameter space. Dynamical systems tools and bifurcation theory are, thus, highly suitable for studying these systems. The minisymposium aims to survey developments of models and methods in the context of electrokinetics and/or electrochemical type systems, with a focus on their impacts to real life applications ranging from chemistry to biology.

Organizer: Nir Gavish

Technion - Israel Institute of Technology, Israel

1:15-1:40 Self-assembled Structures in Copolymer-solvent Mixtures

Karl Glasner, University of Arizona, USA; Saulo Orizaga, University of Arizona, USA

1:45-2:10 Quenched Dynamics in the Symmetric Multicomponent Fch

Keith Promislow and Qiliang Wu, Michigan State University, USA

2:15-2:40 Self-Organized Patterns in Networks of Electrochemical Reactions

Michael Sebek and Istvan Z. Kiss, Saint Louis University, USA

2:45-3:10 Dynamics and Bifurcations in a Model for Organic Photovoltaic Cells

Alon Z. Shapira, Ben-Gurion University of the Negev, Israel; Nir Gavish, Technion - Israel Institute of Technology, Israel; Arik Yochelis, Ben Gurion University, Israel

Monday, May 22

MS56

Multiscale Dynamics: Data-driven Characterization, Modeling, and Control - Part II of II

1:15 PM-3:15 PM

Room:Maybird

For Part 1 see MS43

Multiscale and intermittent phenomena as well as rare events are prevalent in many complex systems in science and engineering. Data-driven methods play a vital role in the characterization of these systems and are particularly appealing considering the immense developments in sensor technology and computing power in recent years. However, many techniques struggle to separate dynamics that are fast, slow or rare relative to the dominant scale. This symposium explores the challenges and innovations in data-driven methods for estimation, prediction and control of multiscale dynamics. We invite speakers working at the forefront of data-driven approaches, that include techniques such as dimensionality reduction, compressed sensing, machine learning, operator theoretic approaches, and control, to explore challenges and solutions for tackling multi- scale phenomena.

Organizer: Eurika Kaiser

University of Washington, USA

Organizer: Krithika Manohar

University of Washington, USA

1:15-1:40 A Geometric Approach to Dynamical Multiscale Model-Order Reduction

Pierre F. Lermusiaux and Florian Feppon, Massachusetts Institute of Technology, USA

1:45-2:10 Data-driven Probability Density Function Equations for High-dimensional Stochastic Dynamical Systems

Daniele Venturi, University of California, Santa Cruz, USA

continued in next column

2:15-2:40 Model Order Reduction for Stochastic Dynamical Systems with Continuous Symmetries

Saviz Mowlavi and Themistoklis Sapsis, Massachusetts Institute of Technology, USA

2:45-3:10 Non-Intrusive Data Driven Reduced-Order Modeling Via Loewner Framework

Benjamin Peherstorfer, Massachusetts Institute of Technology, USA; *Serkan Gugercin,* Virginia Tech, USA; Karen E. Willcox, Massachusetts Institute of Technology, USA

Monday, May 22

MS57

Observing and Controlling Complex Networks

1:15 PM-3:15 PM

Room:Magpie B

A complex network is the result of couplings between dynamical units (more or less complex themselves and which can produce, already when isolated, more or less complex behaviors). Such complex networks can be identified in biological, environmental, social, economic systems but also in power grids, among others. The complexity of these networks make difficult their analysis because theoretically the number of variables to measure (and so the quantity of data to investigate) is quite large. There are many problems induced by these properties, among which: - Is there a reduced number of variables to measure which would allow a full observability of the network dynamics? - How are measured variables related to the coupling between the dynamical units? - Is it possible to get a global model from data produced by such a network? Has this global model a lower dimension than the original network? - How are the variable of a reduced model related to the variables providing a full observability of the network dynamics? - When a model structure is available for a given network, is it possible to estimate the parameter values (estimability/identificability)? - Is it possible to recover the dynamics of non-measured units? All these questions are related to observability and modeling of complex networks. Each contributed talk will address one or more of these questions, and should try to end by promoting an application of the discussed techniques on real data.

Organizer: Christophe Letellier
Normandie Université, France

1:15-1:40 Assessing the Observability of Complex Networks: A Nonlinear Theory
Christophe Letellier, Normandie Université, France

1:45-2:10 Inference of Dynamics from Network Observations
Timothy Sauer, George Mason University, USA - Physica D, Elsevier

2:15-2:40 Using Delay Coordinates for Quantifying Estimability of Model Parameters and State Variables from Observed Time Series
Ulrich Parlitz, Jan Schumann-Bischoff, and Stefan Luther, Max Planck Institute for Dynamics and Self-Organization, Germany

2:45-3:10 Coupling Optimization Between Dynamical Units Using Ansatz Library and Global Modelling of Complex Network
Claudia Lainscsek, Salk Institute for Biological Studies, USA; Mark Spano, Arizona State University, USA; Christophe Letellier, Normandie Université, France; Terrence Sejnowski, Salk Institute for Biological Studies, USA

continued in next column

Monday, May 22

MS58

Waves and Patterns

1:15 PM-3:15 PM

Room:Wasatch B

This minisymposium presents new advances in the theory of nonlinear waves and patterns for a range of model equations, posed on both discrete and continuous spatial domains.

Organizer: Hermen Jan Hupkes
University of Leiden, The Netherlands

1:15-1:40 Wave Propagation in Models of mRNA Localization
Veronica M. Ciocanel, Bjorn Sandstede, and Kimberly Mowry, Brown University, USA

1:45-2:10 Nondegeneracy of Antiperiodic Standing Waves for Fractional Nonlinear Schrödinger Equations
Kyle Claassen and Mathew Johnson, University of Kansas, USA

2:15-2:40 Traveling Waves in Diatomic Fermi-Pasta-Ulam-Tsingou Lattices
Timothy E. Faver and Doug Wright, Drexel University, USA

2:45-3:10 The Maslov Index and the Spectra of Second Order Elliptic Operators
Selim Sukhtaiev, University of Missouri, USA

Monday, May 22

MS59

Dynamical Systems with Large Transients

1:15 PM-3:15 PM

Room:Superior B

Chaotic transients play a fundamental role in many dynamical systems particularly when their duration is so long that the possibly regular dynamics which is finally the attractor would not be reached in a reasonable time interval. It is shown that such dynamics is a typical property of high-dimensional systems such as fluid dynamical systems as well as the climate system. The aim of this minisymposium is to discuss methods how to identify and characterize such long transients, and how to elucidate their impact on the overall dynamics.

Organizer: Ksenia Guseva
University of Oldenburg, Germany

Organizer: James A. Yorke
University of Maryland, USA

1:15-1:40 Probing the Edge of Chaos in Fluid Dynamics
James A. Yorke, University of Maryland, USA

1:45-2:10 State Space Structures of Decaying Shear Turbulence
Tobias M. Schneider, École Polytechnique Fédérale de Lausanne, Switzerland

2:15-2:40 Melancholia States in the Climate System
Valerio Lucarini and Tamas Bodai, University of Hamburg, Germany

2:45-3:10 Inertial Particles in Turbulence: Long Transients Due to the History Force
Ksenia Guseva, University of Oldenburg, Germany; Anton Daitche, University of Münster, Germany; Ulrike Feudel, University of Oldenburg, Germany; Tamas Tel, Eötvös Loránd University, Hungary

Monday, May 22

MS60

Dynamical Systems Techniques in Navier-Stokes Flow without Material Boundaries - Part II of II

1:15 PM-3:15 PM

Room:Superior A

For Part 1 see MS47

Homogeneous isotropic turbulence (HIT) is an idealized model of fluid turbulence away from material boundaries, consisting of the Navier-Stokes equation in a periodic (or infinite) domain and - usually - the divergence-free condition. Free of the effect of container walls or external forces, HIT is often coined as 'the core of the turbulence problem' (Sagaut & Cambon). A lot is known about the statistics of HIT at high Reynolds numbers, in particular about the cascade of kinetic energy from large to small scales. However, surprisingly little is known about the dynamics of and the transition to HIT of periodic flows at small and moderate Reynolds numbers, or about the dynamics of the cascade process. A number of interesting new ideas and results have appeared recently, such as the application of computational dynamical systems techniques in Large Eddy Simulations (LES), the computation of equilibria, travelling waves and unstable periodic orbits in two and three dimensional Kolmogorov flow, the occurrence of relaminarisation events in a particular model of HIT which show a statistical signature consistent with the escape from a chaotic saddle and the use of optimisation techniques to study regularity of solutions. In this session, we will try to give an overview of recent work in HIT and associated models such as LES, with an emphasis on the transition problem and the links between transitions, dynamics and the energy transfer process.

Organizer: Moritz Linkmann
University of Rome II, Tor Vergata, Italy

Organizer: Lennaert van Veen
University of Ontario Institute of Technology, Canada

1:15-1:40 Extreme Growth of Enstrophy in Incompressible Flows
Diego Ayala, McMaster University, Canada

1:45-2:10 Energy Flux Enhancement via Triad Fourier Phase Dynamics in PDEs
Brendan Murray and Miguel Bustamante, University College Dublin, Ireland; Michele Buzzcotti and Luca Biferale, University of Rome II, Tor Vergata, Italy

2:15-2:40 Computer Assisted Proof for the Navier-Stokes Equations: Existence of Periodic Orbits in a Taylor-Green Flow
Maxime Breden, Ecole Normale Superieure Paris-Saclay, France and Universite Laval, Canada; Jan-Philippe Lessard, Universite de Laval, Quebec, Canada; Jan Bouwe Van Den Berg, VU University, Amsterdam, Netherlands; Lennaert van Veen, University of Ontario Institute of Technology, Canada

2:45-3:10 The Onset of Turbulence in Large Eddy Simulation of Box Turbulence
Lennaert van Veen, University of Ontario Institute of Technology, Canada; Tatsuya Yasuda, Imperial College London, United Kingdom; Genta Kawahara and Susumu Goto, Osaka University, Japan

continued in next column

Monday, May 22

MS61

Challenges and Opportunities of Equation-free Modeling for Biological Systems

1:15 PM-3:15 PM

Room:Wasatch A

Data-driven, equation-free techniques are gaining substantial traction in the analysis and modeling of complex systems. These techniques construct models on measurement data directly, making them well suited to describe systems for which the governing equations are either partially known or heuristically posited. In the life sciences, complex systems without a standard set of governing equations include neuroscience, infectious disease spread, metabolic/regulatory networks, and ecological networks. With the rapidly declining costs of sensors and storage space, datasets of escalating size are being gathered from these domains. Equation-free techniques enable the analyses of these large-scale, high-dimensional datasets and characterize them as nonlinear, parameterized and multi-scale biological systems. This minisymposium brings together leading experts who are integrating ideas from equation-free techniques with data from a wide range of biological domains. The presentations will lead to broad discussion of the challenges and opportunities in applying these data-driven dynamical modeling techniques to understanding biological systems.

Organizer: Joshua L. Proctor

Institute for Disease Modeling, USA

Organizer: Bingni W. Brunton

University of Washington, USA

1:15-1:40 On Equation-Free Modeling for Large-Scale Infectious Disease Data

Joshua L. Proctor, Institute for Disease Modeling, USA

continued in next column

1:45-2:10 Empirical Dynamics: An Equation-Free Approach for Understanding the Nonlinear Complex Systems Found in Nature

George Sugihara, University of San Diego, USA

2:15-2:40 Data-Driven Discovery of Dynamical System Models for Biological Networks Using Sparse Selection and Information Criteria

Niall M. Mangan, Nathan Kutz, and Steven Brunton, University of Washington, USA; Joshua L. Proctor, Institute for Disease Modeling, USA

2:45-3:10 Data-Driven Models of Large-Scale, High-Dimensional Neural Recordings

Bingni W. Brunton, University of Washington, USA

Monday, May 22

MS62

Dynamics of Coupled Networks and their Applications

1:15 PM-3:15 PM

Room:Magpie A

Coupled networks with various topologies are present in many complex biological systems, engineering, neuroscience, physics, lasers, and energy systems. Depending on the particular topology and the type of coupling, such systems can exhibit a variety of different dynamical regimes, including partial and total synchronisation, as well as the appearance of chimera states. A major challenge in the analysis of such systems is the development of tractable and computationally efficient mathematical models that can provide a comprehensive description of network dynamics. Of particular importance to applications is identifying how individual parameters characterising the network topology and the coupling affect long-term collective behaviour. The speakers of this minisymposium will present the latest developments in modelling and mathematical analysis of coupled networks arising in different applications areas.

Organizer: Yuliya Kyrychko

University of Sussex, United Kingdom

1:15-1:40 Coherence-Resonance Chimeras in a Neural Network

Anna Zakharova, Institute of Theoretical Physics, Berlin, Germany

1:45-2:10 Heteroclinic Switching Between Chimeras

Christian Bick, University of Oxford, United Kingdom

2:15-2:40 Flexible Information Processing in Complex Networks

Christoph Kirst, Rockefeller University, USA

2:45-3:10 Analysis of Cryptocurrencies Networks Using Google Trends Data

Aleksandra Ross, University of Sussex, United Kingdom

Monday, May 22

MS63

Recent Advances in Stochastic Analysis on Non-equilibrium Systems

1:15 PM-3:15 PM

Room:White Pine

Non-equilibrium systems such as the systems under external forces or time dependent systems that lack a stationary distributions are naturally arising in the real physics, chemistry, biology, and ocean and atmospheric science. There have been rapid advances in researching of non-equilibrium systems for the last decades of years, either from theoretic or practical viewpoints. The object of this minisymposium is to bring together a group of experts to showcase several new aspects of stochastic analysis on non-equilibrium systems and their applications, with the aim of transferring new interdisciplinary techniques in spectral analysis, probabilistic dynamics and statistical mechanics and providing an glimpse on the future challenges of this area.

Organizer: Yiwei Zhang

Huazhong University of Science & Technology, China

Organizer: Jinqiao Duan

Illinois Institute of Technology, USA

1:15-1:40 The Emergent Levy Behavior of Stochastic Burst Phenomenon in Single-cell Gene Expression

Chen Jia and Michael Zhang, University of Texas at Dallas, USA; Hong Qian, University of Washington, USA

1:45-2:10 Analysis and Simulation of Multiscale Stochastic Intracellular Bio-chemical Reacting Networks

Di Liu, Michigan State University, USA

2:15-2:40 Synchronization and Survival of Connected Bacterial Populations

Shreyas Gokhale and Arolyn Conwill, Massachusetts Institute of Technology, USA; Tanvi Ranjan, Harvard University, USA; Jeff Gore, Massachusetts Institute of Technology, USA

2:45-3:10 Mathematical Modelling of Organelle Transport in Living Cells

Congping Lin, Huazhong University of Science & Technology, China

Monday, May 22

Coffee Break

3:15 PM-3:45 PM

Room:Golden Cliff

MS64

Emerging Models of Resilience

3:45 PM-5:45 PM

Room:Ballroom 1

This minisymposium brings dynamical approaches for quantifying resilience together with broader issues of modeling resilience in socio-ecological systems. Resilience arises as an important concept in fields as diverse as natural resource management, medicine, and economics. Often described as a system's ability to absorb change and disturbance while maintaining its basic structure and function, resilience might be desirable (e.g. resilience of a fishery to harvests) or something to be overcome (e.g. resilience of a disease in the face of treatment). As qualitative frameworks for thinking about resilience mature, quantitative tools are just developing. With rising interest in quantifying resilience, dynamical systems provides a natural framework for devising and comparing potential measures. Simple quantities such as the width of an attractor basin or distance to a threshold in state space might capture resilience to isolated disturbances, while the distance to a bifurcation in parameter space can indicate resilience to parameter changes. At a different extreme, expected escape time under a stochastic diffusion process has been used to describe resilience to continual random perturbation. By contrast, in this minisymposium we focus on systems that are shaped by discrete, repeated shocks. We present novel tools for exploring resilience to disturbances such as climate extremes and recurrent fires, and consider implications for resource management.

Organizer: Katherine Meyer

University of Minnesota, USA

continued in next column

3:45-4:10 Emerging Models of Resilience: Introduction

Katherine Meyer, University of Minnesota, USA

4:15-4:40 Information, Order and the Resilience of Living Natural and Human Systems

James Wilson, University of Maine, USA; Carl P. Simon, University of Michigan, USA

4:45-5:10 A Flow-Kick Framework for Exploring Resilience

Alanna Hoyer-Leizel, Mount Holyoke College, USA; Sarah Iams, Harvard University, USA; Ian Klasky, Victoria Lee, and Stephen Ligtenberg, Bowdoin College, USA; Katherine Meyer, University of Minnesota, USA; *Mary Lou Zeeman,* Bowdoin College and Cornell University, USA

5:15-5:40 Emergence and Resilience of a New Alternative State in the Gulf of Maine

Steven Dudgeon, California State University, Northridge, USA; Peter Petraitis, University of Pennsylvania, USA

Monday, May 22

MS65

Stochastic Analysis with Applications in Biology and Evolutionary Dynamics - Part II of II

3:45 PM-5:45 PM

Room:Ballroom 2

For Part 1 see MS52

Stochastic modeling of biological problems has become an extremely popular area of research. These new applications call for the development of new analysis techniques to interpret results and form hypotheses. The presentations in this minisymposium span a broad array of problems from this area with particular emphasis on applications of large deviations theory, evolutionary dynamics, and applied stochastic analysis for molecular dynamics and gene expression. The aim is to showcase the recent advances in the analytical and numerical techniques developed for stochastic dynamical systems and their impact on biological applications.

Organizer: Lora Billings

Montclair State University, USA

Organizer: Ilya Timofeyev

University of Houston, USA

3:45-4:10 Metastability and Intrinsic Extinction Risk in Finite, Interacting Populations

Sebastian Schreiber, University of California, Davis, USA

4:15-4:40 A Kinetic Theory of Birth, Death, and Fission of Age-Structured Populations

Tom Chou, University of California, Los Angeles, USA; Chris Greenman, University of East Anglia, United Kingdom

4:45-5:10 Modeling the Dynamics of Interacting Particles by Means of Stochastic Networks

Maria K. Cameron, University of Maryland, USA

5:15-5:40 Stochastic Population Models: The Dynamics of Invasion and Extinction

Lora Billings, Eric Forgoston, and Garrett Nieddu, Montclair State University, USA

Monday, May 22

MS66

Dynamics of Systems with Frictional Contact - Towards Sptially Extended Systems - Part II of II

3:45 PM-5:15 PM

Room:Ballroom 3

For Part 1 see MS53

There has been a recent resurgence of interest in the nonlinear dynamics of mechanical systems with frictional contact. Phenomena such as the Painleve paradox, set valued friction laws and extended models of stick-slip behaviour using rate-and-state friction laws have given rise to new problems within nonsmooth and multiple timescale dynamical systems. Example problems studied will include applications from gas turbine and automotive engineering, haptic sensors such as rats whiskers to the dynamics of DNA and other mollecular structures. A particular focus of this minisymposium will be the move away from theories of point stick-slip contact to dynamics associated with coupled tangential and normal degrees of freedom and spatially extended contact. Theory and applications will be discussed hand in hand.

Organizer: Alan R. Champneys

University of Bristol, United Kingdom

3:45-4:10 Nonlinear Dynamic Response Predictions of Aeroengine Components with Frictional Interfaces

Norbert Hoffmann, Christophe Schwingschakl, and Loic Salles, Imperial College London, United Kingdom

4:15-4:40 Frictional Instabilities and Squeak in Soft Contacts

Daniele Dini, Imperial College London, United Kingdom

4:45-5:10 The Rats Whiskers - Transduction of Stick-Slip Dynamics Via a Tapered Rod

Maysam Oldazimi and Cornelius Schwartz, University of Tübingen, Germany; Thbaut Putelat, University of Bristol, United Kingdom

Monday, May 22

MS67

Waves, Scales, and Balances in Geophysical Fluid Flow - Part II of II

3:45 PM-5:15 PM

Room:Primrose A

For Part 1 see MS54

Geophysical flows comprise a broad range of spatio-temporal scales and associated wave phenomena. Regime separation is often possible formally via multi-scale analysis into balanced motion, and waves. A variety of averaging and model reduction techniques are used to obtain effective equation for the larger scale motions. A full theoretical justification is often available for simple or idealized models only. General theoretical results remain a challenge, but help validate and improve current numerical weather and climate prediction models. In this minisymposium, recent advances in mathematical analysis of geophysical flow phenomena will be discussed, ranging from variational structures, multiscale systematics, to existence theorems and error estimation.

Organizer: Jens Rademacher

University of Bremen, Germany

Organizer: Marcel Oliver

Jacobs University Bremen, Germany

3:45-4:10 Averaging, Large Deviations, and Stochastic Parameterization in a Slow-fast two-box Ocean Model

Ian Grooms and William Barham, University of Colorado Boulder, USA

4:15-4:40 Inertial Particles in a Vortical flow: Dynamics and Data

Chris Jones, University of North Carolina, Chapel Hill, USA; Colin Guider, University of North Carolina at Chapel Hill, USA

4:45-5:10 Toward Understanding the Multi-Scale Coupling in Global Oceanic Flows

Hussein Aluie and Mahmoud Sadek, University of Rochester, USA; Matthew Hecht, Los Alamos National Laboratory, USA; Geoffrey Vallis, University of Exeter, United Kingdom

Monday, May 22

MS68

Recent Advances in Slow-Fast Dynamics - Part I of II

3:45 PM-5:45 PM

Room:Primrose B

For Part 2 see MS81

Multiple timescales are prominent in a number of application areas, in particular in neuroscience. Mathematical models that incorporate multiple timescales can reproduce many experimentally observed neuronal rhythms, such as spiking, bursting, amplitude-modulated bursting and mixed-mode oscillations, to name a few. This two-part minisymposium will present recent work on slow-fast dynamics in ODEs and spatially-extended systems. In these examples, phenomena such as canard solutions and delayed bifurcations are found to organise non-trivial dynamics that can be related to various neuronal behaviors of single neurons, coupled neurons and populations of neurons.

Organizer: Daniele Avitabile

University of Nottingham, United Kingdom

Organizer: Mathieu Desroches

Inria Paris-Rocquencourt, France

Organizer: Vivien Kirk

University of Auckland, New Zealand

3:45-4:10 Three-Timescale Dynamics: Canards and Spike Adding

Mathieu Desroches, Inria Paris-Rocquencourt, France; Vivien Kirk, University of Auckland, New Zealand

4:15-4:40 Faux Canards and Folded Saddles

John Mitry, University of Sydney, Australia

4:45-5:10 Synchronisation of Weakly Coupled Canard Oscillators

Elif Koksal Ersoz, INRIA Paris, France

5:15-5:40 Canards in a Minimal Piecewise-linear Square-wave Burster

Soledad Fernández-García, University of Sevilla, Spain

Monday, May 22

MS69

Advances in Infectious Disease Modeling - Part I of II

3:45 PM-5:45 PM

Room:Maybird

For Part 2 see MS82

Infectious diseases are spreading geographically faster now than ever before, posing a continuing threat to daily life. Mathematical modeling has become an important tool in investigating infections, providing key insights into infection dynamics and spread at both the within-host and epidemiological scales. The primary goal of this minisymposium is to provide a platform for discussion of mathematical models of infectious disease dynamics and provide a broad perspective on the strengths, and weaknesses, of disease modeling.

Organizer: Alun Lloyd

North Carolina State University, USA

Organizer: Jan Medlock

Oregon State University, USA

3:45-4:10 After the Honeymoon, the Divorce: Unexpected Outcomes of Disease Control Measures

Alun Lloyd, Brandon Hollingsworth, and Fred Gould, North Carolina State University, USA; Kenichi Okamoto, Yale University, USA

4:15-4:40 Effectiveness of Unaids Targets and Hiv Vaccination Across 127 Countries

Jan Medlock, Oregon State University, USA; Abhishek Pandey, Clemson University, USA; Alyssa S. Parpia, Amber Tang, Laura A. Skrip, and Alison P. Galvani, Yale University, USA

4:45-5:10 Spatial and Social Interactions Drive Transmission Dynamics in Ant Colonies

Shweta Bansal and Ewan Colman, Georgetown University, USA

5:15-5:40 Rationally Time-shifting Risk in Response to Zika

Timothy Reluga, Pennsylvania State University, USA

Monday, May 22

MS70

Conceptual and Predictive Models in Ecology

3:45 PM-5:45 PM

Room:Magpie B

Mathematical Ecology has a long history dating back to the early twentieth century. In 1980, the National Science Foundation established a set of Long Term Ecological Research (LTER) sites now able to document and analyze environmental change over long time periods and diverse ecosystems. For thirty-five years the data collected at these sites has been used to develop and refine both conceptual and predictive mathematical models. This minisymposium presents some recent developments from two of the LTER sites: Konza Prairie in Kansas and Cedar Creek Ecosystem Science Reserve in Minnesota.

Organizer: Richard McGehee

University of Minnesota, USA

Organizer: Erik Van Vleck

University of Kansas, USA

3:45-4:10 Stability of Tree-Grass Interactions under Woody Encroachment

Nathaniel A. Brunsell and Erik Van Vleck, University of Kansas, USA; Jesse Nippert, Kansas State University, USA; Maged Nosshi, University of Kansas, USA; Zak Ratajczak, University of Virginia, USA

4:15-4:40 Unifying Ecological Models for Understanding and Prediction

Clarence Lehman, University of Minnesota, USA

4:45-5:10 Toward a Mathematical Theory of Resilience

Richard McGehee and Katherine Meyer, University of Minnesota, USA

5:15-5:40 Parameter Estimation for Land-Surface Models

Erik Van Vleck and Nathaniel A. Brunsell, University of Kansas, USA

Monday, May 22

MS71

Nonsmooth Dynamics: Applications and Novel Insights

3:45 PM-5:45 PM

Room:Wasatch B

The insights provided by nonsmooth dynamical systems theory continues to find relevance in an expanding range of applications, from the microscopic mechanics of gene regulatory networks to global socio-economic decision making. This rapid progress has been facilitated by increasingly rigorous analytical results and the ongoing discovery of new phenomena. Nonsmooth dynamics concerns systems of differential equations possessing discontinuous jumps in their vector fields, which can model, for example: switches, stability changes, or abrupt jumps in parameters. This session will present some of the new ways in which nonsmooth dynamics is being put to use in applications at the forefront of modern mathematical modeling, the fresh insights provided by the discovery of novel phenomena, and the possibilities it opens for original methods of control.

Organizer: David J. Simpson

Massey University, New Zealand

Organizer: Simon C. Webber

University of Bristol, United Kingdom

3:45-4:10 Pausing: Revealing Time Indeterminacy in Piecewise Smooth Systems

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

4:15-4:40 Coherent Behaviour in Non-Smooth Neural Networks

Kyle Wedgwood, University of Exeter, United Kingdom; Daniele Avitabile, University of Nottingham, United Kingdom; Joshua Davis, University of Nottingham, Malaysia; Stephen Coombes, University of Nottingham, United Kingdom

4:45-5:10 Interconnection and Multiple-Investment Strategies in Energy Markets

Gerard Olivar, Universidad Nacional de Colombia, Colombia; Johnny Valencia Calvo, Tecnologico de Antioquia, Colombia; Oscar Emilio Molina Diaz, Universidad del Quindio, Colombia

5:15-5:40 Desynchronising Collections of Oscillators by Using Two-Fold Singularities

David J. Simpson, Massey University, New Zealand; Mike R. Jeffrey, University of Bristol, United Kingdom

continued in next column

Monday, May 22

MS72

Theory and Applications of Delay Differential Equations - Part I of II

3:45 PM-5:45 PM

Room:Superior B

For Part 2 see MS85

Delay differential equations are mathematical models of many important real-world processes whose evolution depend on their past states. Although these equations have been successfully used to describe epidemiological, physiological and engineering problems, to name but a few areas of applications, the majority of the formulated models are restricted to one point delay. This symposium focuses on recently developed models employing multiple, distributed and state-dependent delays, and on the sophisticated geometric and computational tools that are essential in their analysis.

Organizer: Gabor Kiss

University of Bristol, United Kingdom

Organizer: Karel Kenens

Hasselt University, Belgium

3:45-4:10 Nicholson Blowflies Dynamics in a Heterogenous Environment for Juveniles

Gabor Kiss, University of Bristol, United Kingdom

4:15-4:40 Delay-Induced Dynamics in An El Niño Southern Oscillation Model: A Bifurcation Analysis

Andrew Keane, Bernd Krauskopf, and Claire M. Postlethwaite, University of Auckland, New Zealand

4:45-5:10 Poincaré-Bendixson-Type Theorems for Equations with State-Dependent Delay

Benjamin Kennedy, Gettysburg College, USA

5:15-5:40 Stability in a Neural Network with Distributed-Delay Coupling

Yuliya Kyrychko, University of Sussex, United Kingdom

Monday, May 22

MS73

Mathematical Analysis of Classical and Asynchronous Network Dynamical Systems - Part I of II

3:45 PM-5:45 PM

Room:Superior A

For Part 2 see MS86

Many real-world systems consist of a set of interacting units or nodes that may be described using a network structure: the time evolution of a node's state depends on the states of nodes connected to it by an edge. The characteristics of the underlying network influence the dynamics, whether the network is regular, as in a lattice or all-to-all network, or heterogeneous, as in scale free networks. In recent years, much progress has been made to describe how collective phenomena emerge in this kind of systems. At the same time, there are many examples of inherently nonsmooth real-world networks: links are added and deleted, nodes may evolve independently of each other, stop and then restart after finite time. Smart grids are one example: loads are balanced to maintain network function as consumers and generators are switched in and out dynamically. Here, asynchronous and temporal networks provide approaches to understand network dynamics and its function for a large class of real-world networks. The first part of the minisymposium will focus on results and applications for classical network dynamical systems that describe how the network structure and symmetries constrain network dynamics and influence the emergence of collective behavior such as synchronization. The second part aims to link such results to recent mathematical advances in the understanding of the local and global dynamics of asynchronous and temporal networks and applications.

continued in next column

Organizer: Matteo Tanzi
Imperial College London, United Kingdom

Organizer: Christian Bick
University of Oxford, United Kingdom

Organizer: Eddie Nijholt
Vrije Universiteit Amsterdam, The Netherlands

3:45-4:10 Maps Coupled in Networks. The Interplay Between Structure and Dynamics

Tiago Pereira, University of Sao Paulo, Brazil

4:15-4:40 Generation of Stable Traveling Waves in Unidirectional Chains of Idealized Neural Oscillators

Stanislav M. Mintchev, The Cooper Union, USA; Bastien Fernandez, Université Paris-Diderot, France

4:45-5:10 Meanfield Coupling of Expanding Circle Maps

Peter Balint and *Fanni Mincsovicsne Selley*, Budapest University of Technology and Economics, Hungary

5:15-5:40 Hidden Symmetry in Coupled Cell Networks

Eddie Nijholt and Bob Rink, Vrije Universiteit Amsterdam, The Netherlands; Jan Sanders, Free University Amsterdam, Netherlands

Monday, May 22

MS74

Recent Developments in Continuum Models for Nonlinear Optics and Nonequilibrium Gas Dynamics

3:45 PM-5:45 PM

Room:Wasatch A

We present some recent developments in continuum models for nonlinear optics and nonequilibrium gas dynamics. The first speaker will report on the propagation of solitons in the Maxwell-Bloch equations with nonzero boundary conditions. The second speaker will address some aspects of integrability, turbulence, and effective linearization of the nonlinear Schroedinger equation. The last two speakers will talk about the theory and numerical implementation of a model for the nonequilibrium diffusive gas dynamics.

Organizer: Rafail Abramov
University of Illinois, Chicago, USA

Organizer: Gregor Kovacic
Rensselaer Polytechnic Institute, USA

3:45-4:10 Dynamics of Optical Pulses Riding on a Background, An Exact Approach

Gregor Kovacic, Rensselaer Polytechnic Institute, USA; Gino Biondini, State University of New York, Buffalo, USA; Daniel Kraus and Sitai Li, State University of New York, Buffalo, USA; Ildar R. Gabitov, University of Arizona, USA

4:15-4:40 Effective Dispersion and Linearization in Wave-Like Systems

Madison Wyatt, Katelyn J. Leisman, Michael Schwarz, Peter R. Kramer, and Gregor Kovacic, Rensselaer Polytechnic Institute, USA; David Ca, Shanghai Jiao Tong University, China; Maxwell Jenquin and Alexander Mayer, Rensselaer Polytechnic Institute, USA

4:45-5:10 A Model for Diffusive Gas Dynamics Away from Thermodynamic Equilibrium

Rafail Abramov, University of Illinois, Chicago, USA

5:15-5:40 An Openfoam Implementation of the Nonequilibrium Diffusive Gas Dynamics Model: Testing and Validation

Jasmine T. Otto, University of Ilinois at Chicago, USA

Monday, May 22

MS75

Explosive Transitions in the Structure and in the Dynamics of Complex Networks

3:45 PM-5:45 PM

Room:Magpie A

Percolation and synchronization are two well studied phase transitions. A classic result is that these transitions are of the second-order type, i.e. continuous and reversible. Recently, however, explosive phenomena have been reported in complex networks' structure and dynamics, which rather remind first-order (discontinuous and irreversible) transitions. Explosive percolation corresponds to an abrupt emergence of a large-scale connectivity on a network while explosive synchronisation refers to a sudden increase in the coherence of the networks' dynamics. The two phenomena have stimulated investigations and debates, attracting attention in many relevant fields (social dynamics, brain dynamics, power grids, ...). So far, various substantial contributions and progresses (including experimental verifications) have been made, which have provided insights on what structural and dynamical properties are needed for inducing such abrupt transformations, as well as have greatly enhanced our understanding of phase transitions in networked systems. Our minisymposium has the intention of providing an overview on the main existing results on both phenomena and pointing out possible directions for future research and applications, together with describing novel dynamical phenomena that emerge at the onset of explosiveness.

Organizer: Irene Sendina-Nadal
Rey Juan Carlos University, Spain

Organizer: Stefano Boccaletti
CNR, Italy

Organizer: Juan A. Almendral
Universidad Rey Juan Carlos, Spain

continued in next column

3:45-4:10 Anomalous Critical and Supercritical Phenomena in Explosive Percolation

Raissa D'Souza, University of California, Davis, USA

4:15-4:40 Recent Advances in Explosive Percolations and their Applications

Byungnam Kahng, Seoul National University, Korea

4:45-5:10 Mechanism of Explosive Synchronization in Networked Oscillators

Xiyun Zhang, Boston University, USA

5:15-5:40 Bellerophon States: Coexistence of Quantized, Time Dependent, Clusters in Globally Coupled Oscillators

Hongjie Bi, East China Normal University, China; Xin Hu, Chinese Academy of Sciences, China; *Stefano Boccaletti*, CNR, Italy; Xingang Wang, National University of Singapore, Singapore; Yong Zou, Zonghua Liu, and Shuguang Guan, East China Normal University, China

Monday, May 22

MS76

Data-driven Analysis and Modeling of Real-world Dynamical Systems

3:45 PM-5:45 PM

Room:White Pine

Identifying patterns in complex systems from the physical world is a challenge across science and engineering. As opposed to toy problems, whose behavior is relatively simple by design, complexity at the scale observed in real-world datasets can be difficult or even impossible to capture within models defined in the absence of such data. Therefore, analysis of real-world datasets may offer a deeper understanding of such complex systems, which in turn may provide insights into modeling of their salient behavior. Nevertheless, data-driven analyses pose numerous challenges, including visualization of high-dimensional data, computational limitations in processing high volume data, and identification of meaningful low-dimensional descriptions from the same. This minisymposium brings together four studies of real-world datasets that use the mathematical tools in complex and dynamical systems to extract and analyze patterns in real-world datasets. Datasets span a broad range of scales from motion traces of animal groups, to social negotiations underlying the democratic process, to atmospheric-level fluid flows. This minisymposium intends to present state-of-the-art research focusing on the analysis and modeling of real-world dynamical systems, whose understanding may be useful in applications beyond science, mathematics, and engineering.

Organizer: Nicole Abaid
Virginia Tech, USA

Organizer: Sachit Butail
Northern Illinois University, USA

continued on next page

Monday, May 22

MS76

Data-driven Analysis and Modeling of Real-world Dynamical Systems

3:45 PM-5:45 PM

continued

3:45-4:10 Interactional Dynamics of Same-Sex Marriage Legislation in the United States

Subhradeep Roy and Nicole Abaid, Virginia Tech, USA

4:15-4:40 A Persistent Homology Approach Towards a Thermodynamic Description of Insect Swarms

Michael Sinhuber and Nicholas T. Ouellette, Stanford University, USA

4:45-5:10 Lagrangian Coherent Structures as Sub-mesoscale Transport Barriers in Amospheric Flows

Peter Nolan, Virginia Polytechnic Institute and State University, USA

5:15-5:40 Speed Modulated Social Influence in Evacuating Pedestrian Crowds

Sachit Butail, Northern Illinois University, USA; Abhishek Bhatia, Indian Institute of Technology, Delhi, India; Elham Mohammadi, Northern Illinois University, USA

Intermission

5:45 PM-6:00 PM

Monday, May 22

IP3

Random Long Time Dynamics for Large Systems of Interacting Oscillators

6:00 PM-6:45 PM

Room:Ballroom

Chair: Barbara Gentz, University of Bielefeld, Germany

A considerable amount of effort has been put into understanding large scale dynamics of interacting particles or, more generally, interacting «units» (like cells or individuals). This large scale limit, leading often to a partial differential equation, is in most cases taken under the assumption of finite time horizon. This of course raises the crucial issue of the relevance of long time dynamics for the limit PDE when dealing with the long time dynamics of the original system, which is made of a finite number of particles or units. This issue has been successfully tackled for stochastic systems (the large scale limit is in this case a law of large numbers) for the cases in which deviations from this limit can only be due to very rare events (Large Deviations). The net result is that the deviations from the limit behavior can be observed only on time scales that are huge (for example, the exponential of number of particles/ units in the system). However, in several natural instances deviations happen on a much shorter time scale. After discussing this important issue and its practical relevance in a general framework, I will focus on mean field synchronization models for which 1. we can sharply trace the time scale of validity of the deterministic large scale PDE; 2. we can describe in detail what happens after this time scale. The talk is based on papers written by subsets of the following authors: Lorenzo Bertini, Eric Luçon, Christophe Poquet, & myself.

Giambattista Giacomin

Université Paris VII - Denis Diderot, France

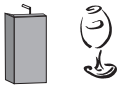
Intermission

6:45 PM-7:00 PM

Monday, May 22

SIAG/DS Business Meeting

7:00 PM-8:00 PM



Room:Ballroom

Complimentary beer and wine will be served.

Tuesday, May 23

Registration

8:00 AM-4:15 PM

Room:Ballroom Foyer

Tuesday, May 23

MS77

Computes Shoots and Leaves: Alan Turing, Phyllotaxis and Beyond - Part I of II

8:30 AM-10:30 AM

Room:Ballroom 1

For Part 2 see MS90

Phyllotaxis is the arrangement of leaves around plant stems, and has intrigued mathematicians as a seemingly simple example of robust self-organisation in biology. Although the mathematical study of phyllotaxis certainly did not begin with Alan Turing, it captivated him, as many others before and since, and his work on mathematical models for phyllotaxis remains relatively unknown compared to his 1952 paper The Chemical Basis of Morphogenesis. This minisymposium will explore Turing's lesser-known (and highly original) historical contributions, modern mathematical models for phyllotaxis, the behaviour found in data collected from large-scale surveys of real sunflowers, and the relation with other plant growth phenomena such as root hairs.

Organizer: Jonathan Dawes
University of Bath, United Kingdom

Organizer: Jonathan Swinton
Deodands LTD, United Kingdom

8:30-8:55 After 1952: Alan Turing's Later Work on Pattern Formation
Jonathan Dawes, University of Bath, United Kingdom

9:00-9:25 Patterns in the Starch-Iodine Reaction
Derek Handwerk, Colorado State University, USA

9:30-9:55 Phyllotaxis: The Hows Rather Than the Whys
Alan Newell, University of Arizona, USA

10:00-10:25 On How Turing Triggers Biochemical Spot Dynamics in a Plant Root Hair Initiation Model
Victor F. Brena-Medina, University of Bristol, United Kingdom; Michael Ward, University of British Columbia, Canada

Tuesday, May 23

MS78

Topological Data Analysis of Time Series from Dynamical Systems - Part I of II

8:30 AM-10:30 AM

Room:Ballroom 2

For Part 2 see MS91

Topological data analysis (TDA) seeks to describe shape—for example, the number of components, holes, and cycles—of data from sources as diverse as spatiotemporal models and functional networks to signals from mechanical devices. Speakers will explore novel applications ranging from voter networks to pattern formation, the theory and implementation of TDA, the classification dynamical regimes, the selection of appropriate ranges of sampling rates and scales, and address computational limitations due to memory and processing power. Common themes include the unique challenges for TDA if it is to take into account the temporal structure of time series from complex dynamics.

Organizer: Nicole Sanderson
University of Colorado, USA

Organizer: James D. Meiss
University of Colorado Boulder, USA

Organizer: Elizabeth Bradley
University of Colorado Boulder, USA

8:30-8:55 Topological Data Analysis of Stochastic Collective Motion
Chad M. Topaz, Macalester College, USA

9:00-9:25 Combinatorial Approximation and Discrete-Time Dynamics
Sarah Day, College of William & Mary, USA

9:30-9:55 Classification of Pattern-Forming Systems Using Persistence
Rachel Neville and Patrick Shipman, Colorado State University, USA

10:00-10:25 Witness Complexes for Time Series Analysis
Nicole Sanderson, University of Colorado, USA

Tuesday, May 23

MS79

Koopman Operator Techniques in Dynamical Systems: Theory - Part I of II

8:30 AM-10:30 AM

Room:Ballroom 3

For Part 2 see MS92

In many data-driven applications involving dynamical systems, operator-theoretic techniques allow efficient representations of high-dimensional time series, forecasting of observables and probability measures, and control. Modern techniques construct discrete approximations to operators such as the Koopman and Perron-Frobenius operators using ideas from harmonic analysis, machine learning, and other fields, with the nonlinear geometries of data often playing an important role. The goal of this minisymposium is to bring together operator theoretic and geometric perspectives, and to explore new approaches to data driven modeling based on these ideas.

Organizer: Ryan Mohr
University of California, Santa Barbara, USA

Organizer: Dimitrios Giannakis
Courant Institute of Mathematical Sciences, New York University, USA

8:30-8:55 Extensions of Koopman Operator Theory: Stochastic Dynamical Systems and Partial Differential Equations

Igor Mezic, University of California, Santa Barbara, USA

9:00-9:25 Reconstruction of the Koopman Operator's Spectral Measure from Data

Ryan Mohr, University of California, Santa Barbara, USA

9:30-9:55 Manifold Learning with Contracting Observers for Data-Driven Dynamical Systems Analysis

Tal Shnitzer and *Ronen Talmon*, Technion Israel Institute of Technology, Israel; Jean-Jacques Slotine, Massachusetts Institute of Technology, USA

10:00-10:25 On the Asymptotics of Flows and Koopman Semigroups

Viktoria Kuehner, University of Tuebingen, Germany

Tuesday, May 23

MS80

Dynamical Systems Approaches to Tipping Points: Theory and Applications - Part I of II

8:30 AM-10:30 AM

Room:Primrose A

For Part 2 see MS93

This session aims to give an overview of recent developments in the application of dynamical systems to the theory of tipping points. On one end of the spectrum, low-dimensional and conceptual models have provided a useful framework for understanding different mechanisms that can induce tipping, such as bifurcations, noise, and rapid changes of input or parameters. On another end, of practical importance is the ability to predict critical transitions through identification of early warning signals. Results from both of these research areas will be presented in this session, with applications ranging from cardiac systems to climate modeling and ecosystem behavior.

Organizer: Anna M. Barry
University of Auckland, New Zealand

Organizer: Esther Widiasih
University of Hawaii, West Oahu, USA

8:30-8:55 Non Smooth Tipping from Paleoclimate

Esther Widiasih, University of Hawaii, West Oahu, USA

9:00-9:25 Sequential Escapes for Network Dynamics

Jennifer L. Creaser, Peter Ashwin, and Krasimira Tsaneva-Atanasova, University of Exeter, United Kingdom

9:30-9:55 Rate-Induced Tipping Through Hopf Bifurcations in Fast/Slow Systems

Jonathan Hahn, University of Minnesota, USA

10:00-10:25 Noise-induced Transitions between Alternative Stable Periodic Orbits of a Periodically-forced System: Is there a Preferred Phase for Tipping?

Yuxin Chen, Northwestern University, USA; Mary Silber, University of Chicago, USA; John Gemmer, Wake Forest University, USA; Alexandria Volkening, Brown University, USA

Tuesday, May 23

MS81

Recent Advances in Slow-Fast Dynamics - Part II of II

8:30 AM-10:30 AM

Room:Primrose B

For Part 1 see MS68

Multiple timescales are prominent in a number of application areas, in particular in neuroscience. Mathematical models that incorporate multiple timescales can reproduce many experimentally observed neuronal rhythms, such as spiking, bursting, amplitude-modulated bursting and mixed-mode oscillations, to name a few. This two-part minisymposium will present recent work on slow-fast dynamics in ODEs and spatially-extended systems. In these examples, phenomena such as canard solutions and delayed bifurcations are found to organise non-trivial dynamics that can be related to various neuronal behaviors of single neurons, coupled neurons and populations of neurons.

Organizer: Daniele Avitabile
University of Nottingham, United Kingdom

Organizer: Mathieu Desroches
Inria Paris-Rocquencourt, France

Organizer: Vivien Kirk
University of Auckland, New Zealand

8:30-8:55 Ducks in Space: From Nonlinear Absolute Instability to Noise-sustained Structures

Edgar Knobloch, University of California, Berkeley, USA - Nonlinearity, Institute of Physics

9:00-9:25 Spatio-temporal Canards in Neural Field Models

Daniele Avitabile, University of Nottingham, United Kingdom

9:30-9:55 A Robust Neural Integrator Based on the Interactions of Three Time Scales

Bard Ermentrout, University of Pittsburgh, USA

10:00-10:25 Role of Gap Junctions in a Neuron Astrocyte Network Model

David H. Terman, The Ohio State University, USA

Tuesday, May 23

MS82

Advances in Infectious Disease Modeling - Part II of II

8:30 AM-10:30 AM

Room:Maybird

For Part 1 see MS69

Infectious diseases are spreading geographically faster now than ever before, posing a continuing threat to daily life. Mathematical modeling has become an important tool in investigating infections, providing key insights into infection dynamics and spread at both the within-host and epidemiological scales. The primary goal of this minisymposium is to provide a platform for discussion of mathematical models of infectious disease dynamics and provide a broad perspective on the strengths, and weaknesses, of disease modeling.

Organizer: Alun Lloyd

North Carolina State University, USA

Organizer: Jan Medlock

Oregon State University, USA

8:30-8:55 Skipping a Pill to Prevent Drug Resistance?

Jessica M. Conway, Pennsylvania State University, USA

9:00-9:25 Targeting the Achilles Heel of HIV Reservoir Persistence

Joshua Schiffer, Fred Hutchinson Cancer Research Center, USA

9:30-9:55 Modeling Combination Therapies Using Latency Reversing Agents and Immunotherapeutics to Cure Hiv

Ruian Ke, North Carolina State University, USA

10:00-10:25 Spatial Models of HCV Infection: From the Liver to the Whole Body

Ruy M. Ribeiro, Los Alamos National Laboratory, USA

Tuesday, May 23

MS83

Data-based Modeling of Cardiac Dynamics

8:30 AM-10:30 AM

Room:Magpie B

Cardiac arrhythmias like atrial and ventricular fibrillation are significant health problems, and many efforts are being directed at using data to improve the modeling of these diseases in ways that ultimately can be applied clinically to improve patient health. This minisymposium will span advances in data-driven mathematical and computational modeling of arrhythmias as well as steps toward impactful applications. On the modeling side, topics such as incorporating data into simulations, novel techniques for data acquisition, and advanced numerical techniques will be discussed. Applications will include patient-specific arrhythmia modeling, validation, and novel tools for diagnosis and therapy.

Organizer: Ulrich Parlitz

Max Planck Institute for Dynamics and Self-Organization, Germany

Organizer: Elizabeth M. Cherry

Rochester Institute of Technology, USA

8:30-8:55 Incorporating Data into Models of Cardiac Electrical Dynamics

Elizabeth M. Cherry and Darby Cairns, Rochester Institute of Technology, USA; Nicholas LaVigne, Cornell University, USA; Nathan Holt, Rochester Institute of Technology, USA; Flavio H. Fenton, Georgia Institute of Technology, USA; Matthew J. Hoffman, Rochester Institute of Technology, USA

9:00-9:25 Reconstruction of Cardiac Dynamics from Cardiac Deformation Mechanics

Jan Christoph, Max-Planck-Institute for Dynamics and Self-Organization, Germany; Stefan Luther, Max Planck Institute for Dynamics and Self-Organization, Germany

continued in next column

9:30-9:55 Cardiac Re-Entry Evolution in MRI-based Models of the Heart

Irina Biktasheva, University of Liverpool, United Kingdom; Vadim N. Biktashev, University of Exeter, United Kingdom; Arun Holden, University of Leeds, United Kingdom; Sanjay R. Kharche, University of Exeter, United Kingdom; Eleftheria Pervolaraki, University of Leeds, United Kingdom; Girish Ramlugun, Auckland BioEngineering Institute, New Zealand; Gunnar Seemann, Karlsruhe Institute of Technology, Germany; Bruce smaill, Auckland BioEngineering Institute, New Zealand

10:00-10:25 Cardiac Response to Low-Energy Field Pacing Challenges the Standard Theory of Defibrillation

Arkady Pertsov, SUNY Upstate Medical University, USA

Tuesday, May 23

MS84

Oscillators and Networks with Switching Parameters

8:30 AM-10:30 AM

Room:Wasatch B

This minisymposium focuses on a largely unexplored area such as mathematical analysis and modeling of dynamical systems and networks whose coupling or internal parameters switch periodically or stochastically. Examples to be discussed in this minisymposium include piecewise-smooth models of bipedal walking and their interaction with a ground structure, network models of self-propelled particles, and effects of link losses and delays on the dynamics of switching networks.

Organizer: Igor Belykh
Georgia State University, USA

Organizer: Maurizio Porfiri
Polytechnic Institute of New York University, USA

8:30-8:55 Bistable Gaits and Wobbling Induced by Pedestrian-Bridge Interactions

Igor Belykh and Russell Jeter, Georgia State University, USA; Vladimir Belykh, Lobachevsky State University of Nizhny Novgorod, Russia

9:00-9:25 Spotting Leaders in Groups of Self-propelled Particles

Violet Mwaffo, New York University, USA; Maurizio Porfiri, Polytechnic Institute of New York University, USA

9:30-9:55 A Consensus Dynamics with Delay-Induced Instability can Self-Regulate for Stability via Agent Regrouping

Rifat Sipahi and *Min Hyong Koh*, Northeastern University, USA

10:00-10:25 Synchronization and Pinning Control of Smooth and Piecewise-smooth Networks with Noise

Giovanni Russo, IBM Research, Ireland; Mario Di Bernardo, University of Bristol, United Kingdom

Tuesday, May 23

MS85

Theory and Applications of Delay Differential Equations - Part II of II

8:30 AM-10:30 AM

Room:Superior B

For Part 1 see MS72

Delay differential equations are mathematical models of many important real- world processes whose evolution depend on their past states. Although these equations have been successfully used to describe epidemiological, physiological and engineering problems, to name but a few areas of applications, the majority of the formulated models are restricted to one point delay. This symposium focuses on recently developed models employing multiple, distributed and state-dependent delays, and on the sophisticated geometric and computational tools that are essential in their analysis.

Organizer: Gabor Kiss
University of Bristol, United Kingdom

Organizer: Karel Kenens
Hasselt University, Belgium

8:30-8:55 Feedback Stabilizability with Time-Delayed Feedback

Jan Sieber, University of Exeter, United Kingdom

9:00-9:25 Gevrey Properties for Center Manifolds of Delay Differential Equations

Karel Kenens, Hasselt University, Belgium

9:30-9:55 Delay Equations for Epidemic Models with Waning Immunity

Yukihiko Nakata, Shimane University, Japan

10:00-10:25 Constant, Distributed and State Dependent Delays in Models of Waning and Boosting of Immunity

Gergely Rost, University of Szeged, Hungary

Tuesday, May 23

MS86

Mathematical Analysis of Classical and Asynchronous Network Dynamical Systems - Part II of II

8:30 AM-10:30 AM

Room:Superior A

For Part 1 see MS73

Many real-world systems consist of a set of interacting units or nodes that may be described using a network structure: the time evolution of a node's state depends on the states of nodes connected to it by an edge. The characteristics of the underlying network influence the dynamics, whether the network is regular, as in a lattice or all-to-all network, or heterogeneous, as in scale free networks. In recent years, much progress has been made to describe how collective phenomena emerge in this kind of systems. At the same time, there are many examples of inherently nonsmooth real-world networks: links are added and deleted, nodes may evolve independently of each other, stop and then restart after finite time. Smart grids are one example: loads are balanced to maintain network function as consumers and generators are switched in and out dynamically. Here, asynchronous and temporal networks provide approaches to understand network dynamics and its function for a large class of real-world networks. The first part of the minisymposium will focus on results and applications for classical network dynamical systems that describe how the network structure and symmetries constrain network dynamics and influence the emergence of collective behavior such as synchronization. The second part aims to link such results to recent mathematical advances in the understanding of the local and global dynamics of asynchronous and temporal networks and applications.

continued on next page

Tuesday, May 23

MS86

Mathematical Analysis of Classical and Asynchronous Network Dynamical Systems - Part II of II

8:30 AM-10:30 AM

Continued

Organizer: Matteo Tanzi
Imperial College London, United Kingdom

Organizer: Christian Bick
University of Oxford, United Kingdom

Organizer: Eddie Nijholt
Vrije Universiteit Amsterdam, The Netherlands

8:30-8:55 Functional Asynchronous Networks
Michael Field, Rice University and Imperial College London, United Kingdom; Christian Bick, University of Oxford, United Kingdom

9:00-9:25 Synchronization in On-off Stochastic Networks: Windows of Opportunity
Russell Jeter, Georgia State University, USA; Olga Golovneva, New York University Polytechnic, USA; Maurizio Porfiri, Polytechnic Institute of New York University, USA; Igor Belykh, Georgia State University, USA

9:30-9:55 Piecewise-Smooth Networks
Mario Di Bernardo, University of Bristol, United Kingdom

10:00-10:25 Community Change-point Detection in Time-dependent Networks
Michael Schaub, Massachusetts Institute of Technology, USA; Leto Peel, Université Catholique de Louvain, Belgium

Tuesday, May 23

MS87

Modelling, Dynamics and Coordination of Human Behavior

8:30 AM-10:30 AM

Room:Wasatch A

Modelling human movement and understanding how coordination emerges in human groups is attracting attention from different disciplines in Science and Engineering. It is for example important to model crowd dynamics, devise algorithms for human-robot coordination and even for the diagnosis and therapy of social disorders. The goal of this minisymposium is to bring together experts from different disciplines to present their latest results on the analysis of human movement and coordination ranging from Social Psychology, to dance and collective crowd behavior. After a first introductory talk on the problem of modelling human motion, speakers will discuss their latest research results putting emphasis on open problems, challenges and future perspectives.

Organizer: Francesco Alderisio
University of Bristol, United Kingdom

Organizer: Mario di Bernardo
University of Bristol, United Kingdom

8:30-8:55 Modelling Movement and Coordination in the Mirror Game: From Dyads to Groups
Francesco Alderisio and Gianfranco Fiore, University of Bristol, United Kingdom; Robin Salesse and Benoit Bardy, University of Montpellier, France; Mario Di Bernardo, University of Bristol, United Kingdom

9:00-9:25 Behavioral Dynamics of Collective Crowd Behavior
William Warren, Brown University, USA

9:30-9:55 Using Evolutionary Dynamics to Model Structured Improvisational Dance
Kayhan Ozcimder and Biswadip Dey, Princeton University, USA; Alessio Franci, Universidad Nacional de Mexico, Mexico; Rebecca J. Lazier, Daniel Trueman, and Naomi E. Leonard, Princeton University, USA

10:00-10:25 Embedded Dynamics of Multiagent Activity and Social Coordination
Maurice Lamb, Patrick Nalepka, Rachel W. Kallen, and Michael J. Richardson, University of Cincinnati, USA

continued in next column

Tuesday, May 23

MS88

Multiple Time Scales in Biological Systems

8:30 AM-10:00 AM

Room:Magpie A

Evolutionary change in interacting populations, biochemical reactions or pharmacodynamics (i.e., the study of the effects of drugs) are examples of complex biological phenomena. As a result, the resulting systems of equations describing such systems are often high-dimensional and incorporate multiple time scales. Because of the ability to reduce dimensionality and account for time separation between interacting processes, fast-slow dynamical systems provide a powerful way of analyzing biological systems, using techniques such as geometric singular perturbation theory. However, it is not clear whether results obtained by assuming extremely slow/fast processes persist when the separation of time scales is small. In addition, accurate information of the inherent time scales in biological systems can be difficult to obtain. In this minisymposium, we discuss the above-mentioned biological applications, where fast-slow structures arise and are exploited, and how they can be used to answer challenging biological questions.

Organizer: Sofia H. Piltz
University of Michigan, USA

Organizer: Frits Veerman
University of Edinburgh, United Kingdom

8:30-8:55 Rapid Evolution in Plankton Populations: A Slow-Fast Model
Frits Veerman, University of Edinburgh, United Kingdom

9:00-9:25 Predicting the Shapes of Eco-Evolutionary Predator-Prey Cycles Using Fast-Slow Dynamical System Theory: Fast Evolution and Slow Ecology, Vice Versa, and Everything in Between
Michael Cortez, Utah State University, USA

9:30-9:55 Applications of Timescale Analysis to Mathematical Models in Toxicology
John P. Ward, Loughborough University, United Kingdom

Tuesday, May 23

MS89

Geometric Mechanics and Applications

8:30 AM-10:30 AM

Room:White Pine

This minisymposium will focus on the application of geometric methods to dynamical systems with a mechanical origin. The geometric viewpoint provides a unified and systematic framework to address a broad range of issues, including control, numerical integration, and qualitative dynamics, for both classical and quantum systems. In particular, topics represented include quantum control, dynamics Gaussian wave packet, and variational principles for constrained field theories. This minisimposium will provide a unique opportunity for mathematicians, applied mathematicians, and engineers to explore the common interests and collaborate in the field of geometric approach to mechanics.

Organizer: Vakhtang Putkaradze
University of Alberta, Canada

8:30-8:55 Quantum Control and the Geometry of Flag Manifolds
Anthony M. Bloch, University of Michigan, USA

9:00-9:25 Lagrange-Dirac Systems for Nonequilibrium Systems
Hiroaki Yoshimura, Waseda University, Japan

9:30-9:55 The Siegel Upper Half Space, Symplectic Reduction, and Gaussian Wave Packet Dynamics
Tomoki Ohsawa, University of Texas at Dallas, USA

10:00-10:25 Hamel's Formalism for Constrained Field Theories
Dmitry Zenkov, North Carolina State University, USA

Coffee Break

10:30 AM-11:00 AM

Room:Golden Cliff

Tuesday, May 23

IP4

Computational Approach Elucidating the Mechanisms of Cardiovascular Diseases

11:00 AM-11:45 AM

Room:Ballroom

Chair: Yasumasu Nishiura, WPI Advanced Institute for Materials Research, Japan

Cardiovascular diseases such as aortic aneurysms and aortic dissections persist as life-threatening hazards. Patient-specific simulations are now common in biomedical engineering. Although they are extremely useful for grasping the flow/stress distributions and for patient-specific treatment planning, they remain insufficient to elucidate the general mechanisms of a targeted disease. Several mathematical viewpoints should play important roles in this context. For instance, we introduce a geometrical characterization of blood vessels, which vary widely among individuals. Differences in the vessel morphology can produce different flow characteristics, stress distributions, and ultimately different outcomes. Therefore, the characterization of the morphologies of these vessels poses an important clinical question. Through close collaboration with medical doctors, these analyses can yield greater understanding leading to better risk assessments.

Hiroshi Suito
Tohoku University, Japan

Lunch Break

11:45 AM-1:15 PM

Attendees on their own

Tuesday, May 23

MS90

Computes Shoots and Leaves: Alan Turing, Phyllotaxis and Beyond - Part II of II

1:15 PM-3:15 PM

Room:Ballroom 1

For Part 1 see MS77

Phyllotaxis is the arrangement of leaves around plant stems, and has intrigued mathematicians as a seemingly simple example of robust self-organisation in biology. Although the mathematical study of phyllotaxis certainly did not begin with Alan Turing, it captivated him, as many others before and since, and his work on mathematical models for phyllotaxis remains relatively unknown compared to his 1952 paper The Chemical Basis of Morphogenesis. This minisymposium will explore Turing's lesser-known (and highly original) historical contributions, modern mathematical models for phyllotaxis, the behaviour found in data collected from large-scale surveys of real sunflowers, and the relation with other plant growth phenomena such as root hairs.

Organizer: Jonathan Dawes
University of Bath, United Kingdom

Organizer: Jonathan Swinton
Deodands LTD, United Kingdom

1:15-1:40 Beyond Wave-Pinning; Dynamical Mechanisms for Cell Polarity and Interdigitation
Nicolas Verschueren Van Rees and Alan R. Champneys, University of Bristol, United Kingdom

1:45-2:10 Fibonacci Phyllotaxis: Models, Data and Alan Turing
Jonathan Swinton, Deodands LTD, United Kingdom

2:15-2:40 Self-Organization and Pattern Formation in Auxin Flux
Christian Mazza, University of Fribourg, Switzerland

2:45-3:10 Phyllotaxis: Pattern Formation on Manifolds
Matt Pennybacker, University of New Mexico, USA

Tuesday, May 23

MS91

Topological Data Analysis of Time Series from Dynamical Systems - Part II of II

1:15 PM-3:15 PM

Room:Ballroom 2

For Part 1 see MS78

Topological data analysis (TDA) seeks to describe shape—for example, the number of components, holes, and cycles—of data from sources as diverse as spatiotemporal models and functional networks to signals from mechanical devices. Speakers will explore novel applications ranging from voter networks to pattern formation, the theory and implementation of TDA, the classification dynamical regimes, the selection of appropriate ranges of sampling rates and scales, and address computational limitations due to memory and processing power. Common themes include the unique challenges for TDA if it is to take into account the temporal structure of time series from complex dynamics.

Organizer: Nicole Sanderson
University of Colorado, USA

Organizer: James D. Meiss
University of Colorado Boulder, USA

Organizer: Elizabeth Bradley
University of Colorado Boulder, USA

1:15-1:40 The Conley Index for Sampled Dynamical Systems
Marian Mrozek, Jagiellonian University, Krakow, Poland

1:45-2:10 Applications of Persistence to Time Series Analysis
Elizabeth Munch, University of Albany - State University of New York, USA

2:15-2:40 The Topological "Shape" of Brexit and Time-Dependent Functional Networks
Mason A. Porter, University of California, Los Angeles, USA; Heather Harrington, University of Oxford, United Kingdom; Bernadette Stolz, University of Oxford, Canada

2:45-3:10 Topological Analysis of Mapper and Multiscale Mapper
Tamal Dey, Ohio State University, USA

Tuesday, May 23

MS92

Koopman Operator Techniques in Dynamical Systems: Theory - Part II of II

1:15 PM-3:15 PM

Room:Ballroom 3

For Part 1 see MS79

In many data-driven applications involving dynamical systems, operator-theoretic techniques allow efficient representations of high-dimensional time series, forecasting of observables and probability measures, and control. Modern techniques construct discrete approximations to operators such as the Koopman and Perron-Frobenius operators using ideas from harmonic analysis, machine learning, and other fields, with the nonlinear geometries of data often playing an important role. The goal of this minisymposium is to bring together operator theoretic and geometric perspectives, and to explore new approaches to data driven modeling based on these ideas.

Organizer: Ryan Mohr
University of California, Santa Barbara, USA

Organizer: Dimitrios Giannakis
Courant Institute of Mathematical Sciences, New York University, USA

1:15-1:40 Extraction and Prediction of Coherent Patterns in Fluid Flows Via Space-Time Koopman Analysis
Dimitrios Giannakis, Courant Institute of Mathematical Sciences, New York University, USA

1:45-2:10 Optimally Time Dependent Modes for the Description of Finite-Time Instabilities in Infinite Dimensional Dynamical Systems
Themistoklis Sapsis, Massachusetts Institute of Technology, USA

2:15-2:40 Dmd-Galerkin Approximation for Nonlinear Dynamical Systems
Alessandro Alla, Florida State University, USA

2:45-3:10 Fast and Reliable Extraction of Coherent Features from Models and Data using the Dynamic Laplace Operator
Gary Froyland, University of New South Wales, Australia

Tuesday, May 23

MS93

Dynamical Systems Approaches to Tipping Points: Theory and Applications - Part II of II

1:15 PM-3:15 PM

Room:Primrose A

For Part 1 see MS80

This session aims to give an overview of recent developments in the application of dynamical systems to the theory of tipping points. On one end of the spectrum, low-dimensional and conceptual models have provided a useful framework for understanding different mechanisms that can induce tipping, such as bifurcations, noise, and rapid changes of input or parameters. On another end, of practical importance is the ability to predict critical transitions through identification of early warning signals. Results from both of these research areas will be presented in this session, with applications ranging from cardiac systems to climate modeling and ecosystem behavior.

Organizer: Anna M. Barry

University of Auckland, New Zealand

Organizer: Esther Widiasih

University of Hawaii, West Oahu, USA

1:15-1:40 Bifurcations in the Dynamic Budyko Model with Diffusive Heat Transport

James Walsh, Oberlin College, USA

1:45-2:10 Predictability of Critical Transitions

Sarah Hallerberg, Max Planck Institute for Dynamics and Self-Organization, Germany; Christian Kuehn, Technical University of Munich, Germany; Nahal Sharafi and Xiaozu Xhang, Max Planck Institute, Germany

2:15-2:40 Partial Eclipse of the Heart: Early Warning Signs from Sparse Observations

Andrew Roberts, Cornell University, USA

2:45-3:10 Dynamics and Resilience of Vegetation Bands in the Horn of Africa: Comparing Observation and Modeling

Karna V. Gowda, Northwestern University, USA; Sarah Iams, Harvard University, USA; Mary Silber, University of Chicago, USA

Tuesday, May 23

MS94

Recent Advances in Characterization of Nonautonomous Dynamical Transport - Part I of II

1:15 PM-3:15 PM

Room:Primrose B

For Part 2 see MS100

Quantifying fluid transport is of importance at all scales, ranging from microfluidic to geophysical. From the dynamical systems perspective, material particles are advected by unsteady velocity fields; therefore, particle trajectories are solutions to nonautonomous dynamical systems. While simulated models readily admit techniques that use both velocity fields and particle trajectories, experiments and field observations rarely produce concurrent velocity fields and particle trajectories and often focus only on either velocities or trajectories. Difficulties of characterizing transport in nonautonomus systems in a data-compatible manner have led to the ongoing development of many mathematical and computational tools for quantifying and optimizing transport. This minisymposium highlights recent developments in these directions, drawing on quite diverse perspectives: nonautonomous dynamics, topological methods, model- and data-driven methods, control theory, with applications in mechanics, oceanography, planetary science, and image processing.

Organizer: Marko Budisic

Clarkson University, USA

Organizer: Sanjeeva Balasuriya

University of Adelaide, Australia

continued in next column

1:15-1:40 Coherency in Braids of Trajectories As a Machine-Learning Problem

Marko Budisic, Clarkson University, USA; Jean-Luc Thiffeault, University of Wisconsin, Madison, USA

1:45-2:10 Winding Angle Distribution of 2D Brownian Motion with Vortical Flow

Huanyu Wen, University of Wisconsin, Madison, USA

2:15-2:40 Trajectory Encounter Number As a Diagnostic of Mixing Potential in Fluid Flows

Irina Rypina and Larry Pratt, Woods Hole Oceanographic Institution, USA

2:45-3:10 Weakly Three-Dimensional Transport by Vortices in SQG Flows

Stefan Llewellyn Smith and Cecily Taylor, University of California, San Diego, USA

Tuesday, May 23

MS95

Extreme Events: Generation, Prediction, and Tipping

1:15 PM-3:15 PM

Room:Maybird

Extreme events are considered to be rare events characterized by a large impact on a particular system which is measured in terms of some observable or order parameter. The aim of this minisymposium is to discuss recent advances in mechanisms of generation and termination of extreme events as well as their prediction in dynamical systems represented by models as well as observational data. Additionally extreme events are examined as causes of tipping. The system classes covered by this minisymposium are relevant to different applications in nature. Special emphasis is given to multistable systems, power grids, laser systems, excitable units coupled with multiple delays and the climate system.

Organizer: Ulrike Feudel
University of Oldenburg, Germany

1:15-1:40 Tipping Due to Extreme Events
Ulrike Feudel and Lukas Halekotte, University of Oldenburg, Germany; James A. Yorke, University of Maryland, USA

1:45-2:10 Predicting Extreme Optical Pulses in Laser Systems
Cristina Masoller, Universitat Politecnica de Catalunya, Spain

2:15-2:40 Extreme Value Analysis in Dynamical Systems: Two Case Studies
Tamas Bodai, University of Hamburg, Germany

2:45-3:10 Extreme Events in Coupled Systems with Different Delays
Arindam Saha and Ulrike Feudel, University of Oldenburg, Germany

Tuesday, May 23

CP1

1:15 PM-3:15 PM

Room:Magpie B

Chair: James M. Kunert-Graf, University of Washington, USA

1:15-1:30 The Importance of Assortativity to Improve Dynamical Robustness in Complex Networks
Juan A. Almendral, Universidad Rey Juan Carlos, Spain; Takeyuki Sasai, Kai Morino, and Gouhei Tanaka, University of Tokyo, Japan; Kazuyuki Aihara, JST/University of Tokyo, Japan

1:35-1:50 Convergence of the Spectral Radii for Random Directed Graphs with Community Structure
David Burstein, Swarthmore College, USA

1:55-2:10 Spatiotemporal Feedback and Network Structure Drive and Encode *C. Elegans* Locomotion
James M. Kunert-Graf, University of Washington, USA; Joshua L. Proctor, Institute for Disease Modeling, USA; Steven Brunton and Nathan Kutz, University of Washington, USA

2:15-2:30 Invariant Subspaces for Pair-Coupled Networks
James Swift, Northern Arizona University, USA

2:35-2:50 Nonlinear Control of a Repulsively-Coupled Triad Network with Multiple Attractors
Michael M. Norton, Camille Girabawe, Thomas Litschel, and Seth Fraden, Brandeis University, USA

2:55-3:10 Control of Complex Network Dynamics and Synchronization by Symbolic Regression
Markus W Abel, Universität Potsdam, Germany; Julien Gout and Markus Quade, University of Potsdam, Germany; Robert K. Niven, The University of New South Wales, Australia; Kamran Shafi, University of New South Wales, Australia

Tuesday, May 23

CP2

1:15 PM-2:55 PM

Room:Wasatch B

Chair: Emily F. Stone, University of Montana, USA

1:15-1:30 Dynamic Mode Decomposition of Resting State Eeg Data - a Dynamical Systems Approach to Identifying Epilepsy Characteristics
Karin Mora, Michael Dellnitz, Solveig Vieluf, and Claus Reinsberger, University of Paderborn, Germany

1:35-1:50 Topological Changes in Chaotic Neuron Models
Sergio Serrano and Roberto Barrio, University of Zaragoza, Spain; Marc Lefranc, PHLAM - Universite de Lille, France; Angeles Martinez, University of Zaragoza, Spain

1:55-2:10 Effect of Neuromodulation on Connectivity Properites at Hippocampal Synapses
Emily F. Stone and Elham Bayat-Mokhtari, University of Montana, USA

2:15-2:30 Transient Chaos and Switching Behavior in Two Synaptically Coupled Layers of Morris-Lecar Neurons
Renate A. Wackerbauer and Harrison Hartley, University of Alaska, Fairbanks, USA

2:35-2:50 Synchronization of Reaction Diffusion Neural Networks Via Passivity Theory and Its Direct Application to Image Encryption
Prakash Mani, Indian Institute of Technology, India; Lakshmanan Shanmugam, Deakin University, Australia

Tuesday, May 23

CP3

1:15 PM-2:55 PM

Room:Superior B

Chair: Punit R. Gandhi, Ohio State University, USA

1:15-1:30 Hidden Structures of Information Transport Underlying Spiral Wave Dynamics

Hiroshi Ashikaga, Johns Hopkins University, USA; Ryan G. James, University of California, Davis, USA

1:35-1:50 Spectrum of Singularities in Gravito-Capillary Waves: A Phillips' Spectrum Proxy

Claudio Falcon, Universidad de Santiago de Chile, Chile; Gustavo Castillo, Universidad de Chile, Chile

1:55-2:10 Slanted Snaking of Localized Faraday Waves

Punit R. Gandhi, Ohio State University, USA; Bastian, Isidora Araya, and Marcel Clerc, Universidad de Chile, Chile; Claudio Falcon, Universidad de Santiago de Chile, Chile; Edgar Knobloch, University of California, Berkeley, USA

2:15-2:30 Stretching and Speed in Excitable Advection-Reaction-Diffusion Systems

Douglas H. Kelley, University of Rochester, USA

2:35-2:50 Analysis of Pattern Emergence in Turing Systems with Inhomogeneity in Reaction Term

Michal Kozak and Vaclav Klika, Czech Technical University, Prague, Czech Republic; Eamonn Gaffney, University of Oxford, United Kingdom

Tuesday, May 23

CP4

1:15 PM-3:15 PM

Room:Superior A

Chair: Michael Allshouse, Massachusetts Institute of Technology, USA

1:15-1:30 Angular Dynamics of Non-Spherical Particles Settling in Turbulence

Bernhard Mehlig, University of Gothenburg, Sweden

1:35-1:50 Lagrangian Chaos and Transport in Geophysical Fluid Flows

Maleafisha Stephen Tladi, University of Limpopo, South Africa

1:55-2:10 Internal Wave Bolus Detection and Analysis by Lagrangian Clustering

Michael Allshouse, Massachusetts Institute of Technology, USA

2:15-2:30 Numerical Simulation of Immiscible and Miscible Component-Based Co2-Oil-Rock Interaction to Enhance Oil Recovery in Heterogeneous Reservoirs

Watheq J. Al-Mudhafar and Dandina N. Rao, Louisiana State University, USA

2:35-2:50 Understanding the Geometry of Transport: Diffusion Maps for Lagrangian Trajectory Data Unravel Coherent Sets.

Ralf Banisch, Freie Universität Berlin, Germany; Peter Koltai, Freie Universitaet Berlin, Germany

2:55-3:10 Lagrangian Chaos in a Differentially-Heated Three-Dimensional Cavity

Sebastian Contreras Osorio, Michel Speetjens, and Herman Clercx, Eindhoven University of Technology, Netherlands

Tuesday, May 23

CP5

1:15 PM-3:15 PM

Room:Wasatch A

Chair: Simone Bianco, IBM Research, USA

1:15-1:30 Dynamical Properties of Viral Defective Interfering Particles

Simone Bianco, IBM Research, USA; Igor Rouzine, University of California, San Francisco, USA

1:35-1:50 Impact of Heart Tissue Anisotropy and Ischemic Heterogeneities on Unpinning and Termination of Pinned Spirals: Insights from Simulations.

Edda Boccia, Stefan Luther, and Ulrich Parlitz, Max Planck Institute for Dynamics and Self-Organization, Germany

1:55-2:10 Transovarial Transmission in Vector-Borne Relapsing Diseases

Cody Palmer, University of Louisiana, USA; Erin Landguth and Tammi Johnson, University of Montana, USA

2:15-2:30 Global Stability of Zika Virus Mathematical Model with Recurrence Based on Treatment

Ram Singh, Baba Ghulam Shah Badshah University, India

2:35-2:50 Geometric Analysis of Fast-Slow Models for Stochastic Gene Expression

Frits Veerman and Nikola Popovic, University of Edinburgh, United Kingdom; Carsten Marr, Helmholtz Zentrum München, Germany

2:55-3:10 Dynamic Responses of a Steroidogenic Regulatory Network to Physiological Perturbations

Eder Zavala, University of Exeter, United Kingdom; Francesca Spiga, University of Bristol, United Kingdom; Jamie Walker, University of Exeter, United Kingdom; Zidong Zhao and Stafford Lightman, University of Bristol, United Kingdom; John Terry, University of Exeter, United Kingdom

Tuesday, May 23

CP6

1:15 PM-3:15 PM

Room:Magpie A

Chair: Spencer A. Smith, Mount Holyoke College, USA

1:15-1:30 Homotopy Method for Characterizing Topological Chaos in Three Dimensions

Spencer A. Smith, Mount Holyoke College, USA; Joshua Arenson and Kevin A. Mitchell, University of California, Merced, USA

1:35-1:50 When Chaos Meets Hyperchaos: a Computer-Assisted Proof on the 4D Rossler Model

Roberto Barrio, Angeles Martinez, and Sergio Serrano, University of Zaragoza, Spain; Daniel Wilczak, Jagiellonian University, Krakow, Poland

1:55-2:10 Bounding Time Averages Rigorously Using Semidefinite Programming

David Goluskin, Columbia University, USA

2:15-2:30 Pseudorandom Number Generation Using Chaotic True Orbits of the Bernoulli Map on Algebraic Integers

Asaki Saito, Future University-Hakodate, Japan; Akihiro Yamaguchi, Fukuoka University, Japan

2:35-2:50 The Search for the Smallest Chimera

Tomasz Kapitaniak, Technical University of Lodz, Poland

2:55-3:10 Chimeras and Chaotic Mean Field Dynamics in Two Populations of Phase Oscillators with Heterogeneous Phase-Lag

Erik A. Martens, Max Planck Institute for Dynamics and Self-Organization, Germany; Christian Bick, University of Oxford, United Kingdom; Mark J. Panaggio, Northwestern University, USA

Tuesday, May 23

CP7

1:15 PM-3:15 PM

Room:White Pine

Chair: Korana Burke, University of California, Davis, USA

1:15-1:30 Phase Space Transport in Hydrogen in Crossed Fields: Role of the Local Surface of Section

Korana Burke, University of California, Davis, USA; Kevin A. Mitchell, University of California, Merced, USA

1:35-1:50 Internal Transport Barriers in Plasmas with Reversed Plasma Flow

Ibere L. Caldas and Rafael Ferro, University of Sao Paulo, Brazil

1:55-2:10 Whole-Building Fault Detection: A Scalable Approach Using Spectral Methods

Michael Georgescu, Ecorithm, Inc., USA

2:15-2:30 Numerical Study of Mixed Convection Effects in a Ventilated Room with Different Locations of Thermosolutal Block

Neha Gupta and Ameeya Nayak, Indian Institute of Technology Roorkee, India

2:35-2:50 Newton-Krylov Continuation for Annular Electroconvection

Greg Lewis and Jamil Jabbour, University of Ontario Institute of Technology, Canada; Mary Pugh and Stephen Morris, University of Toronto, Canada

2:55-3:10 Rotating Stall in Turbomachinery Compressors: a Dynamical Systems Approach

Carlos Martel, Universidad Politécnica de Madrid, Spain

Coffee Break

3:15 PM-3:45 PM

Room:Golden Cliff

Tuesday, May 23

MS96

Spatiotemporally Complex Patterns

3:45 PM-5:45 PM

Room:Ballroom 1

The intriguing features of patterns observed in isotropic and anisotropic media driven far from equilibrium through external forces have motivated a wide range of experimental and theoretical studies. This minisymposium brings together experimentalists and theorists studying spatiotemporally complex patterns. Mathematical methods include amplitude and phase equations and topological data analysis.

Organizer: Patrick Shipman
Colorado State University, USA

Organizer: Gerhard Dangelmayr
Colorado State University, USA

Organizer: Iuliana Oprea
Colorado State University, USA

3:45-4:10 The Phase Structure of Grain Boundaries

Joceline Lega, University of Arizona, USA

4:15-4:40 Time-Dependent Spatiotemporal Chaos in Pattern-Forming Systems with Two Length Scales

Alastair M. Rucklidge, Priya Subramanian, and Jennifer Castelino, University of Leeds, United Kingdom

4:45-5:10 How to Wake the Homoclinic Snake on the Surface of a Ferrofluid

Reinhard Richter, University of Bayreuth, Germany

5:15-5:40 Spatiotemporal Dynamics in the Space of Persistence Diagrams

Francis Motta, Duke University, USA

Tuesday, May 23

MS97

Rare Extreme Phenomena in Dynamical Systems - Part I of II

3:45 PM-5:45 PM

Room:Ballroom 2

For Part 2 see MS110

Rare, extreme events are widespread in natural and engineering systems, with well-known examples such as ocean rogue waves, extreme weather patterns and shock waves in power grids. Over the last few years, the dynamical systems community has made several important contributions to the understanding, prediction and control of rare extreme phenomena. These efforts have led to the development of novel methods tailored specifically towards tackling extreme events. These methods rely on various mathematical tools such as probability and information theory, invariant manifold theory, uncertainty quantification and network theory. This minisymposium aims to feature the recent developments in the field and to explore the potential contributions each approach can make to the others.

Organizer: Mohammad Farazmand

Massachusetts Institute of Technology, USA

Organizer: Themistoklis Sapsis

Massachusetts Institute of Technology, USA

3:45-4:10 No Equations, No Parameters No Variables - Data and the Reconstruction of Normal Forms for Parametrically Dependent Dynamical Systems

Ioannis Kevrekidis, Princeton University, USA

4:15-4:40 Rogue Waves and Large Deviations in the Nonlinear Schroedinger Equation with Random Initial Data

Eric Vanden-Eijnden and Tobias Grafke, Courant Institute of Mathematical Sciences, New York University, USA; Giovanni Dematteis, New York University, USA

continued in next column

4:45-5:10 The Extreme Weather-Causing Patterns of the Midlatitudes

Pedram Hassanzadeh, Rice University, USA

5:15-5:40 Predicting the Intraseasonal Precipitation Monsoon Through a Low-Order Nonlinear Stochastic Model with Intermittency

Nan Chen, A Majda, Sabeerali Thelliyil, and Ajaya Ravindran, New York University, USA

Tuesday, May 23

MS98

Computational Psychiatry: Mechanisms, Diagnosis, and Treatment of Depressive Disorders

3:45 PM-5:45 PM

Room:Ballroom 3

This minisymposium will highlight recent research into mathematical psychiatry, focusing on psychological stress response and depressive disorders. The quantitative study of psychiatric disorders is a relatively undeveloped area of mathematical research. The "high dimensionality" of the problem and the qualitative clinical features used for diagnosis makes quantitative predictive analyses challenging. The purpose of this minisymposium is to bring together researchers who mathematically conceptualize depressive disorders at different levels. The goal is to motivate ideas and mathematical approaches that connect the more detailed physiological models with the more conceptualized caricatures of depressive disorder.

Organizer: Tom Chou

University of California, Los Angeles, USA

Organizer: Maria D'Orsogna

California State University, Northridge, USA

3:45-4:10 A Multiple Timescale Model of H-P-A Axis Dynamics: Onset, Timing, and Exposure Therapy of Stress Disorders

Lae Un Kim, University of California, Los Angeles, USA; Maria D'Orsogna, California State University, Northridge, USA; Tom Chou, University of California, Los Angeles, USA

4:15-4:40 Modeling Neural Circuit Dysfunction in Schizophrenia: Effects of Disrupted Excitation-Inhibition Balance

John Murray, Yale University, USA

4:45-5:10 Bipolar Disorder Dynamics: Multiscale Mathematical Approaches for Translational Benefits

Michael Bonsall, University of Oxford, United Kingdom

5:15-5:40 Using Mathematical Models of Biological Processes in Genome-wide Association Studies of Psychiatric Disorders

Amy Cochran, University of Michigan, USA

Tuesday, May 23

MS99

Complex Oscillations in Multiple-time-scale Problems: Theory and Applications

3:45 PM-5:45 PM

Room:Primrose A

Differences in time scales are manifested in many areas of applications; well-known examples are chemical reactions, neuronal excitability and lasers. These phenomena exhibit complex oscillations such as spikes, bursts and mixed-mode oscillations, which can be modeled by multiple-time-scale systems. Approaches from both theory and numerical methods have been used to understand the mechanisms for complex oscillations arising in such systems. The aim of this minisymposium is to bring together experts from theory, numerical methods and applications to discuss contemporary ideas and open problems in the field of dynamical systems with multiple-time scales.

Organizer: Jose Mujica

University of Auckland, New Zealand

Organizer: Cris Hasan

University of Auckland, New Zealand

3:45-4:10 Complex Dynamics in a Conceptual Model of El Niño

John Guckenheimer, Cornell University, USA

4:15-4:40 Generic Torus Canards and a Novel Class of Bursting Rhythms

Theodore Vo, Boston University, USA

4:45-5:10 Timescales and Mechanisms of Sigh-like Bursting and Spiking in Models of Rhythmic Respiratory Neurons

Yangyang Wang, Ohio State University, USA; Jonathan E. Rubin, University of Pittsburgh, USA

5:15-5:40 Complex Action Potential Firing in Developing Inner Hair Cells

Krasimira Tsaneva-Atanasova, University of Exeter, United Kingdom; Daniele Avitabile, University of Nottingham, United Kingdom; Harun Baldemir, University of Exeter, United Kingdom

Tuesday, May 23

MS100

Recent Advances in Characterization of Nonautonomous Dynamical Transport - Part II of II

3:45 PM-5:45 PM

Room:Primrose B

For Part 1 see MS94

Quantifying fluid transport is of importance at all scales, ranging from microfluidic to geophysical. From the dynamical systems perspective, material particles are advected by unsteady velocity fields; therefore, particle trajectories are solutions to nonautonomous dynamical systems. Simulated models readily admit techniques that use both velocity fields and particle trajectories. However, experiments and field observations rarely produce concurrent velocity fields and particle trajectories and often focus only on either velocities or trajectories. As a result of difficulties of characterizing, quantifying, and optimizing transport in nonautonomus systems in a data-compatible manner has led to the ongoing development of many mathematical and computational tools. This minisymposium highlights recent developments in these directions, drawing on quite diverse perspectives: nonautonomous dynamics, topological methods, model- and data-driven methods, control theory, with applications in mechanics, oceanography, planetary science, and image processing.

Organizer: Marko Budisic

Clarkson University, USA

Organizer: Sanjeeva Balasuriya

University of Adelaide, Australia

3:45-4:10 Unsteadily Manipulating Internal Flow Barriers

Sanjeeva Balasuriya, University of Adelaide, Australia

4:15-4:40 The Detection of Lagrangian Transport Structures in a Coral Reef Atoll: A Field Experiment

Margaux Filippi, Massachusetts Institute of Technology, USA; Alireza Hadjighasem, ETH-Zentrum, Switzerland; Matt Rayson and Gregory Ivey, University of Western Australia, Australia; Thomas Peacock, Massachusetts Institute of Technology, USA

4:45-5:10 Phase Space Structures in Velocity Space for Gliding and Falling Bodies

Gary K. Nave, Isaac Yeaton, and Shane D. Ross, Virginia Tech, USA

5:15-5:40 Go With the Flow, on Jupiter and Snow, Coherence From Video Data Without Trajectories

Erik Bollt and Abd Alrahman R. Almomani, Clarkson University, USA

continued in next column

Tuesday, May 23

MS101

Applications and Numerical Methods in Nonautonomous Systems

3:45 PM-5:45 PM

Room:Maybird

Nonautonomous systems are used for modeling in a range of applications, including conceptual climate and ecological models and weather. Approaches to nonautonomous systems include analytic and numerical techniques for stability theory (pullback attractors, finite time Lyapunov exponents), as well as data assimilation with time- dependent feedbacks. This minisymposium brings together researchers within these various areas of expertise to present possible connections between methods and applications.

Organizer: Alanna Hoyer-Leitzel

Mount Holyoke College, USA

Organizer: Alice Nadeau

University of Minnesota, USA

3:45-4:10 Connections Between Rate-Induced Tipping and Nonautonomous Stability Theory

Alanna Hoyer-Leitzel, Mount Holyoke College, USA; *Alice Nadeau,* University of Minnesota, USA; Andrew Roberts, Cornell University, USA; Andrew J. Steyer, University of Kansas, USA

4:15-4:40 A Nonautonomous Spectral Stability Theory for Ordinary Differential Initial Value Problem Solvers

Andrew J. Steyer and Erik Van Vleck, University of Kansas, USA

4:45-5:10 Continuous Data Assimilation for Geophysical Flows Employing Only Surface Measurements

Michael S. Jolly, Indiana University, USA

5:15-5:40 Early-Warning Indicators for Rate-Induced Tipping

Paul Ritchie, University of Exeter, United Kingdom

Tuesday, May 23

MS102

Differential Equations with State-dependent Delay

3:45 PM-5:45 PM

Room:Magpie B

If some of the arguments in an otherwise ordinary differential equations are delayed, the state space of the system becomes infinite-dimensional. If, in addition, the delay depends on the state, several common assumptions needed for classical dynamical systems theory, such as smooth dependence of the semiflow on initial conditions, are violated. The minisymposium will present advances in underlying theory, numerical methods and analysis, and practical applications where this type of dynamical systems occur as models.

Organizer: Jan Sieber

University of Exeter, United Kingdom

Organizer: Tony R. Humphries

McGill University, Canada

3:45-4:10 Modelling Myelopoiesis with State-Dependent Delay Differential Equations

Tony R. Humphries, McGill University, Canada

4:15-4:40 A Differential Equation with State-Dependent Delay Describing Stem Cell Maturation - Stability and Oscillations

Philipp Getto, University of Szeged, Hungary; Dimitri Breda, University of Udine, Italy; Gergely Rost, University of Szeged, Hungary; Francesca Scarabel, University of Helsinki, Finland; Tibor Krisztin and Istvan Balazs, University of Szeged, Hungary; Yukihiko Nakata, Shimane University, Japan

4:45-5:10 Lyapunov-Razumikhin Techniques for State-Dependent Delay Differential Equations

Felicia Magpantay, University of Manitoba, Canada

5:15-5:40 Resonance Phenomena in a Delay Differential Equation with Two State Dependent Delays

Renato Calleja, Universidad Nacional Autónoma de México, Mexico; Bernd Krauskopf, University of Auckland, New Zealand

Tuesday, May 23

MS103

Recent Results on Traveling Waves in Systems of PDEs - Part I of II

3:45 PM-5:45 PM

Room:Wasatch B

For Part 2 see MS116

This minisymposium will focus on recent results in the area of of traveling waves and related structures, obtained by either numerical or analytic techniques. Existence, stability, dynamic properties, and bifurcations of these special solutions will be addressed.

Organizer: Anna Ghazaryan

Miami University, USA

Organizer: Stephane Lafortune

College of Charleston, USA

Organizer: Vahagn Manukian

Miami University Hamilton, USA

3:45-4:10 Computation and Stability of Waves in Second Order Evolution Equations

Wolf-Juergen Beyn, Universität Bielefeld, Germany; Simon Dieckmann and Christian Doeding, Bielefeld University, Germany

4:15-4:40 Defect Induced Target Waves in Reaction Diffusion Systems

Gabriela Jaramillo, University of Arizona, USA

4:45-5:10 Spectral Stability of Solutions to the Vortex Filament Hierarchy

Stephane Lafortune and Thomas Ivey, College of Charleston, USA

5:15-5:40 Stability of PT Symmetric Ground States for Schrodinger and Klein-Gordon Equations in Higher Space Dimensions

Milena Stanislavova, University of Kansas, Lawrence, USA

Tuesday, May 23

MS104

Dynamical Systems Approaches to Geophysical Extreme Events

3:45 PM-5:45 PM

Room:Superior B

The dynamical extremes are well-known objects in dynamical systems theory because they are associated to special states of the system. In simple set-ups, they have been already recognized by the work of Poincaré. Since its work, several contributions have allowed to study these rare recurrences of states in dynamical systems arising in geophysical applications. These dynamical extremes are special because they correspond to the unstable fixed points of the equations that generate the attractor. Recent works have developed metrics from dynamical system theory to study such extremes by determining the relevant properties of the attractor such as the dimensions and the persistence of the trajectory at each point. In this minisymposium, we intend to gather together different experts in dynamical systems theory, statistical mechanics, climate dynamics and multivariate extreme value theory to tackle problems in dynamic geophysical extreme events..

Organizer: Yuzuru Sato

Hokkaido University, Japan

Organizer: Davide Faranda

CNRS / LSCE, France

3:45-4:10 Dynamical Proxies of North Atlantic Predictability and Extremes

Davide Faranda, CNRS / LSCE, France

4:15-4:40 The Extremal Index for the AR(1) Process: Finite Size Considerations

Nicholas Moloney, London Mathematical Laboratory, United Kingdom

4:45-5:10 Extreme Value Theory in Dynamical Systems

Sandro Vaienti, Centre de Physique Théorique - CNRS, France

5:15-5:40 Stochastic Bifurcation in Random Logistic Maps

Yuzuru Sato, Hokkaido University, Japan

Tuesday, May 23

MS105

Dynamics and Complexity in the Auditory Sensing System - Part I of II

3:45 PM-5:45 PM

Room:Superior A

For Part 2 see MS118

The auditory system displays remarkable mechanical sensitivity and frequency discrimination. These attributes have been shown to rely on an amplification process, which requires both biochemical and mechanical feedback loops, and leads to spatially localized oscillations inside the cochlea. In general, the origin of oscillatory localization can range from passive to dissipative mechanisms; however, specific mechanisms of cochlear amplification remain a puzzle. The goal of this minisymposium is to survey the development of theory of hearing and to scrutinize the connections between these models and experiments, at scales ranging from individual hair cells to the spatially extended cochlea.

Organizer: Arik Yochelis

Ben Gurion University, Israel

Organizer: Dolores Bozovic

University of California, Los Angeles, USA

3:45-4:10 Nonlinear Dynamics of Inner Ear Hair Cells

Dolores Bozovic, Justin Faber, Yuki Quinones, and S. W. F. Meenderink, University of California, Los Angeles, USA; Michael Levy, Weizmann Institute of Science, Israel

4:15-4:40 Signal Detection by Active, Noisy Oscillators on the Brink of Self-Oscillation

Daibhid O Maoileidigh, Joshua Salvi, and AJ Hudspeth, Rockefeller University, USA

4:45-5:10 Nonlinear Micromechanics of the Organ of Corti in the Low-Frequency Region of the Cochlea

Tobias Reichenbach and Nikola Ciganovic, Imperial College London, United Kingdom; Rebecca Warren and Batu Keceli, University of Linköping, Sweden; Stefan Jacob, Karolinska Institutet, Sweden; Anders Fridberger, University of Linköping, Sweden

5:15-5:40 Symmetries and Asymmetries in Cochlear Mechanics

Christopher Shera, University of Southern California, USA

Tuesday, May 23

MS106

Nonlinear Dynamics in Optics - Part I of II

3:45 PM-5:45 PM

Room:Wasatch A

For Part 2 see MS119

Nonlinear dynamical systems find their applications in many areas of optics. This minisymposium is devoted to the recent progress that has been made in the modeling of optical phenomena including topics such as Maxwell-Bloch Equations, Delay Differential Equations of a semiconductor laser, Nonlinear modal interactions in micro-ring cavities, PT-symmetric systems, Light-Matter Interaction dynamics, Computational aspects of high oscillations and more.

Organizer: Alexey Sukhinin

University of Vermont, USA

Organizer: Dmitry Rachinskiy

University of Texas at Dallas, USA

3:45-4:10 Nonlinear Dynamics of Parity-tme (PT) Symmetric Lasers

Alexey Sukhinin and Jianke Yang, University of Vermont, USA

4:15-4:40 Bifurcation of Nonlinear Bound States from Eigenvalues and from Spectral Intervals in PT-symmetric Systems

Tomas Dohnal, Technische Universität Dortmund, Germany; Dmitry Pelinovsky, McMaster University, Canada; Petr Siegl, University of Bern, Switzerland

4:45-5:10 Faster and More Accurate Computations for Certain Highly Oscillatory Wave Problems

Qin Sheng, Baylor University, USA

5:15-5:40 Long-time Dynamics and Interaction of Ultrashort Light Pulses

Michail Todorov, Technical University of Sofia, Bulgaria

Tuesday, May 23

MS107

Advanced Data-driven Techniques and Numerical Methods in Koopman Operator Theory - Part I of II

3:45 PM-5:45 PM

Room:Magpie A

For Part 2 see MS120

The Koopman operator governs the evolution of "observable-functions" of the state space, thereby offering an alternative framework to describe complex, nonlinear dynamical systems. It turns a nonlinear system into a linear (but infinite-dimensional) system that can be studied through spectral properties (e.g. eigenvalues, eigenfunctions, and so-called Koopman modes). Moreover, this framework has a direct connection to data-driven requirements for analysis and design of complex dynamics emerging in real-world applications. Thus, Koopman operator theory yields efficient data-driven techniques and numerical methods such as dynamic mode decomposition. These have a broad spectrum of applications, as diverse as fluid mechanics, power systems engineering, network inference, and control engineering. This minisymposium aims to report on new developments of this frontier field in dynamical systems and to discuss them with the audience of SIAM Conference on Dynamical Systems (DS). The topics developed in the session are data-driven techniques for system identification and time-series analysis (1,2), analysis of chaotic systems (3), numerical approximation of spectral densities (4), reduced-order modeling (5), nonlinear modal decompositions (6,7), and data-driven embeddings (8). The set of the topics is illustrated by the diversity of the eight speakers, which are invited from multiple parts of the world. This diversity is suitable for a highly international conference like DS.

Organizer: Yoshihiko Susuki
Osaka Prefecture University, Japan

Organizer: Alexandre Mauroy
University of Liege, Belgium

continued in next column

3:45-4:10 Network Identification Based on Koopman Operator Theory
Alexandre Mauroy, University of Liege, Belgium

4:15-4:40 Koopman Operator Framework for Nonlinear Time Series Analysis
Amit Surana, United Technologies Research Center, USA

4:45-5:10 Hankel Alternative View Of Koopman (Havok) Analysis of Chaotic Systems
Steven Brunton and Bingni W. Brunton, University of Washington, USA; Joshua L. Proctor, Institute for Disease Modeling, USA; Eurika Kaiser and Nathan Kutz, University of Washington, USA

5:15-5:40 A Toolbox for Computing Spectral Properties of Dynamical Systems
Nithin Govindarajan, University of California, Santa Barbara, USA

Tuesday, May 23

MS108

Vortices in Excitable Media: Theory and Experiment

3:45 PM-5:45 PM

Room:White Pine

Spiral and scroll waves are the most common types of solutions characterizing the dynamics of two- and three-dimensional excitable media. This minisymposium presents recent theoretical and experimental developments in the field with the focus on the role of wave interaction with intrinsic and extrinsic perturbations and the effects of heterogeneities in the medium on the spiral/scroll wave dynamics.

Organizer: Roman Grigoriev
Georgia Institute of Technology, USA

Organizer: Vadim N. Biktashev
University of Exeter, United Kingdom

3:45-4:10 The Role of Conduction Block in Spiral Breakup and Merger
Roman Grigoriev and Christopher Marcotte, Georgia Institute of Technology, USA

4:15-4:40 Filament Tension and Phase Locking of Meandering Scroll Waves
Hans Dierckx, Ghent University, Belgium

4:45-5:10 Periodic Sequence of Stabilized Wave Segments in Excitable Media
Vladimir Zykov and Eberhard Bodenschatz, Max Planck Institute for Dynamics and Self-Organization, Germany

5:15-5:40 Scroll Wave Drift and Interaction in Excitable Systems with Height Variations
Dayton Syme and Oliver Steinbock, Florida State University, USA

Dinner Break

5:45 PM-8:30 PM

Attendees on their own

SIADS Editorial Board Meeting

6:30 PM-8:30 PM

Room:Aerie Restaurant (Mountain Private Dining Room)

Tuesday, May 23

PP1

Poster Session and Dessert Reception

8:30 PM-10:30 PM

Room:Ballroom

Entropy and Dynamical Systems

Raymond Addabbo, Vaughn College of Aeronautica and Technology, USA; Denis Blackmore, New Jersey Institute of Technology, USA

Neuronal Motifs - Multistability Using Hybrid Computational Approaches

Sunitha Basodi, Krishna Pusuluri, and Andrey Shilnikov, Georgia State University, USA

Computing the Optimal Path in Stochastic Dynamical Systems

Martha Bauver, Lora Billings, and Eric Forgoston, Montclair State University, USA

Gabaergic Synaptic Mechanisms in Information Transmission

Elham Bayat-Mokhtari and Emily F. Stone, University of Montana, USA

Contrasting Epidemic Control in Ordinary and Delay Differential Equations

Adrienna Bingham, The College of William & Mary, USA; Leah Shaw, College of William & Mary, USA

Chaotic Advection in the Alboran Sea: Lagrangian Analysis of Transport Processes in and Out of the Western Alboran Gyre

Genevieve Brett, Massachusetts Institute of Technology, USA; Larry Pratt and Irina Rypina, Woods Hole Oceanographic Institution, USA

A Novel Speech-Based Diagnostic Test for Parkinson's Disease Integrating Machine Learning with Application Development for Cloud Deployment

Pooja Chandrashekar, Harvard University, USA

Synchronization of Electrically Coupled Hybrid Neuron Models

Thomas Chartrand, Timothy Lewis, and Mark Goldman, University of California, Davis, USA

continued in next column

Hybrid Statistical and Mechanistic Model Guides Mobile Health Intervention for Chronic Pain

Sara Clifton and Daniel Abrams, Northwestern University, USA; Chaeryon Kang, University of Pittsburgh, USA; Jessica Li, University of California, Los Angeles, USA; Qi Long, University of Pennsylvania, USA; Nirmish Shah, Duke University, USA

Bifurcation Theory and Phase-Lag Variance in 3-Node Neural Networks

Jarod Collens, Deniz Alacam, Aaron Kelly, Drake Knapper, and Andrey Shilnikov, Georgia State University, USA

On a Mathematical Model for the Multiplex Line Graph

Regino Criado, Julio Flores, and Alejandro García del Amo, Universidad Rey Juan Carlos, Spain; Miguel Romance, Technical University of Madrid, Spain; Eva Barrena, Universidad de Granada, Spain; Juan A. Mesa, Universidad de Sevilla, Spain

A Robust Torus Used to Control Chaos in Wave-Particle Interactions

Meirielen C. De Sousa, Universidade de Sao Paulo, Brazil; Ibere L. Caldas, University of Sao Paulo, Brazil

Lyapunov-Type Inequalities for α-Th Order Fractional Differential Equations with $2 \alpha \geq 3$ and Fractional Boundary Conditions

Sougata Dhar and Qingkai Kong, Northern Illinois University, USA

Breaking the Vicious Limit Cycle: Addiction Relapse-Recovery As a Fast-Slow Dynamical System

Jacob P. Duncan and Kimberly Orlando, Saint Mary's College, USA

A Mathematical Model of Parallel Quorum Sensing

Gaoyang Fan and Paul C. Bressloff, University of Utah, USA

Computing Stable Manifolds of a Saddle Slow Manifold

Saeed Farjami and Hinke M. Osinga, University of Auckland, New Zealand; Vivien Kirk, University of Auckland, New Zealand

continued in next column

Stability of Vortex Solitons for Even-Dimensional Focusing NLS

Wen Feng and Milena Stanislavova, University of Kansas, USA

Bifurcation Analysis of a Central Pattern Generator Microcircuit in the Xenopus Tadpole Spinal Cord

Andrea Ferrario, Roman M. Borisyuk, and Robert Merrison-Hort, Plymouth University, United Kingdom

Hiding the Squid

Aaron Fishman and Jonathan Rossiter, University of Bristol, United Kingdom; Martin Homer, University of Bristol, United Kingdom

Cascades of Saddle Periodic Orbits and Their Manifolds Close to a Homoclinic Flip Bifurcation.

Andrus A. Giraldo, Bernd Krauskopf, and Hinke M. Osinga, University of Auckland, New Zealand

Parameterization Method for Parabolic Pdes

Jorge L. Gonzalez, Jason Mireles-James, and Necibe Tuncer, Florida Atlantic University, USA

Computing the Unstable Manifolds of Delay Differential Equations

Chris M. Groothedde, VU University, Amsterdam, Netherlands

Diffusion and Drift in Volume-Preserving Maps

Nathan Guillery and James D. Meiss, University of Colorado Boulder, USA

Streamwise Localization of Traveling Wave Solutions in Channel Flow

Daniel Gurevich, Georgia Institute of Technology, USA; Joshua Barnett, Georgia State University, USA; Roman Grigoriev, Georgia Institute of Technology, USA

Dynamics of Delay Logistic Difference Equation in the Complex Plane

Sk Sarif Hassan, University of Petroleum and Energy Studies, India

Beyond Ensemble Averaging in Turbulent Combustion

Malik Hassanaly and Venkat Raman, University of Michigan, USA

continued on next page

The Parametrization Method for Center Manifolds

Wouter A. Hetebrij, VU University, Amsterdam, Netherlands

Time Series Analysis of Tropically Linear Systems

James Hook, University of Bath, United Kingdom

Graph Automorphisms and Dynamical Patterns in Complex Networks

Ian M. Hunter, Fraden Lab, USA; Seth Fraden and Michael M. Norton, Brandeis University, USA; REMI Boros, Fraden Lab, USA; Thomas Litschel, Brandeis University, USA

Synchronization and Clustering of Stochastically-Driven Mixed-Mode Oscillators

Avinash J. Karamchandani, James Graham, and Hermann Riecke, Northwestern University, USA

Coupling Sample Paths to the Partial Thermodynamic Limit in Stochastic Chemical Reaction Networks

Ethan Levien and Paul C. Bressloff, University of Utah, USA

28 Models Later: Best Practices for Modeling the Zombie Apocalypse with Real Data

Ian McGahan, Utah State University, USA

Fractional Order Compartment Models

Anna V. Mcgann, Christopher N. Angstmann, Bruce I. Henry, John Murray, James Nichols, and Austen Erickson, University of New South Wales, Australia

Interjump Statistics of State-Dependent Jump-Diffusion Processes

Christopher E. Miles and James P. Keener, University of Utah, USA

Amplitude and Frequency for a Nonlinear Oscillator by Homotopy Analysis Method

Jonathan Mitchell, Stephen F. Austin State University, USA

Spatially Localized Comb-like Turing Patterns Embedded in Hopf Oscillations

Paulino Monroy, Universidad Nacional Autónoma de México, Mexico; Arik Yochelis, Ben Gurion University, Israel

continued in next column

Information Processing Based on Mutually Delay-Coupled Optoelectronic Oscillators

Keisuke Nagatoshi, Kazutaka Kanno, and Masatoshi Bunsen, Fukuoka University, Japan

Investigation of Disease Invasion Using a Stochastic SIR$_{\mathcal{K}}$ Model

Garrett Nieddu, Lora Billings, and Eric Forgoston, Montclair State University, USA

Finite-Time Attractors and Clustering of Inertial Particles in Fluid Flows

David Oettinger and George Haller, ETH Zürich, Switzerland

Chaos and Global Bifurcations in the Rock-Scissors-Paper Bimatrix Game

Cezary Olszowiec, Imperial College London, United Kingdom

Activity Patterns of Neuronal Network with Voltage-Sensitive Piecewise Smooth Coupling

Choongseok Park, North Carolina A&T State University, USA; Jonathan E. Rubin, University of Pittsburgh, USA

Adaptive Neuronal Networks in Olfaction: Mechanism of Network Evolution and Information Processing

Jaesuk Park and Hongyu Meng, Northwestern University, USA; Martin Wiechert, University of Berne, Switzerland; Hermann Riecke, Northwestern University, USA

Quantifying the Role of Folding in Nonautonomous Flows: the Unsteady Double Gyre

Kanaththa G. Priyankara and Erik Bollt, Clarkson University, USA; Sanjeeva Balasuriya, University of Adelaide, Australia

Prediction of Dynamical Systems by Symbolic Regression

Markus Quade, University of Potsdam, Germany; Markus W Abel, Universität Potsdam, Germany; Kamran Shafi, University of New South Wales, Australia; Robert K. Niven, The University of New South Wales, Australia; Bernd Noack, Technical University Braunschweig, Germany

Ensemble-Based Topological Entropy Computation

Eric Roberts, Kevin A. Mitchell, and Suzanne Sindi, University of California, Merced, USA

continued in next column

Optimal Regularization for Prediction in Nonlinear Dynamical Inverse Problems

Paul Rozdeba, University of California, San Diego, USA

Center Manifolds Via Lyapunov-Perron

Emily Schaal and Yu-Min Chung, College of William & Mary, USA

Using the Atomic Force Microscope to Measure Stiffness at the Nano-Scale

Namid Shatil, University of Bristol, United Kingdom; Martin Homer, University of Bristol, United Kingdom; Loren Picco and Oliver Payton, University of Bristol, United Kingdom

Cone-Dynamical Discriminants: Decoding Neural Velocity

Matthew Singh and ShiNung Ching, Washington University, St. Louis, USA

Effects of Time-Delay in a Model of Motor Coordination

Piotr Slowinski and Krasimira Tsaneva-Atanasova, University of Exeter, United Kingdom; Bernd Krauskopf, University of Auckland, New Zealand

Predicting Financial Stock Crashes Using Ghost Singularities

Damian T. Smug and Peter Ashwin, University of Exeter, United Kingdom; Didier Sornette, ETH Zürich, Switzerland

Stability of Entrainment in Coupled Oscillators

Jordan Snyder, University of California, Davis, USA; Anatoly Zlotnik and Aric Hagberg, Los Alamos National Laboratory, USA

Time-Variant Estimation of Connectivity

Linda Sommerlade, University of Aberdeen, United Kingdom; Claude Wischik, TauRx Therapeutics Ltd., Singapore; Bjoern Schelter, University of Aberdeen, United Kingdom

Dynamical Characterizations of Complex Behavior in Consensus Networks with Stochastic Link Failures

Xin Su and Theodore Pavlic, Arizona State University, USA

continued on next page

Information Theoretical Noninvasive Damage Detection in Bridge Structures

Amila N. Sudu Ambegedara, Jie Sun, Kerop Janoyan, and Erik Bollt, Clarkson University, USA

3D Super-Lattice Solutions in Reaction-Diffusion Systems

Timothy K. Callahan and *Rebecca Tobin*, Embry-Riddle Aeronautical University, USA

Topological Complexity of the Greenberg-Hastings Cellular Automata

Dennis Ulbrich, Jens Rademacher, and Marc Keßeböhmer, University of Bremen, Germany

A Mathematical Model for Post-Replicative DNA Methylation Dynamics

Kiersten Utsey and James P. Keener, University of Utah, USA

Balancing with Different Sensory Delays

Balazs Varszegi and Tamas Insperger, Budapest University of Technology and Economics, Hungary

Study of Some Nonlocal Transport Equations: Application to Stochastic Neural Dynamics

Romain Veltz, Inria Sophia Antipolis, France

Resource-Transport Dynamics Induces Criticality in Networks of Excitable Nodes

Yogesh Virkar, University of Colorado Boulder, USA; Woodrow Shew, University of Arkansas, USA; Juan G. Restrepo, University of Colorado Boulder, USA; Edward Ott, University of Maryland, USA

Hamiltonian Structure and Stability Results for Idealised Flows on a Three Dimensional Periodic Domain

Joachim Worthington, University of Sydney, Australia

Bifurcations in the Piecewise-Linear Standard Nontwist Map

Alexander Wurm, Western New England University, USA

Weak-Noise-Induced Transitions with Inhibition and Modulation of Neural Spiking Dynamics

Emar Marius Yamakou and Juergen Jost, Max Planck Institute for Mathematics in the Sciences, Germany

continued in next column

Demographic Noise Slows Down Cycles of Dominance in Ecological Models

Qian Yang, University of Bath, United Kingdom

A Stable Numerical Algorithm for Calculating the Rate of Exponential Forgetting in HMM

Xiaofeng Ye, Yian Ma, and Hong Qian, University of Washington, USA

Interactions of Solitary Pulses of *E. Coli* in a One-Dimensional Nutrient Gradient

Glenn S. Young, Pennsylvania State University, USA; Mahmut Demir, Yale University, USA; Hanna Salman, Bard Ermentrout, and Jonathan E. Rubin, University of Pittsburgh, USA

Non-Cooperative Games with Cost of Information

Andrew Belmonte and *Matthew Young*, Pennsylvania State University, USA

Lateral Inhibition Networks in Rat Olfactory Bulb

Daniel R. Zavitz, Alla Borisyuk, Matt Wachowiak and Isaac Youngstrom, University of Utah, USA

An Investigation of a Structured Fisher's Equation with Applications in Biochemistry

John Nardini, University of Colorado Boulder, USA; D. M. Bortz, University of Colorado, USA

Wednesday, May 24

Registration

8:00 AM-4:15 PM

Room:Ballroom Foyer

Wednesday, May 24

MS109

The Motion of Interfaces and Free Boundaries in Interdisciplinary Science

8:30 AM-10:30 AM

Room:Ballroom 1

The natural world exhibits many nonlinear phenomena characterized by the separation of and interaction between regions with different behavior. The motion of the interface or boundary between these regions is frequently more important than the underlying dynamics within the region itself. Examples occur in widely disparate fields, such as in the growth of tumors or in the spread of instability and radicalization. This minisymposium will bring together researchers with expertise in conservation laws, singularly perturbed systems, and modeling to discuss their understanding of interfacial flows and the insights that this understanding brings to interdisciplinary science.

Organizer: Scott McCalla

Montana State University, USA

Organizer: James von Brecht

California State University, Long Beach, USA

8:30-8:55 Fisher-Kpp Invasion Fronts on Homogeneous Trees and Random Networks

Matt Holzer, George Mason University, USA; Aaron Hoffman, Franklin W. Olin College of Engineering, USA

9:00-9:25 Contagion Shocks in a Model of Panicking Crowds

Martin Short, Georgia Institute of Technology, USA

9:30-9:55 On the Evolution of Cancerous Cells

Konstantina Trivisa, University of Maryland, USA

10:00-10:25 Travelling Wave Solutions for a Model of Tumour Invasion

Peter van Heijster, Queensland University of Technology, Australia; Lotte Sewalt, Leiden University, Netherlands; Kristen Harley, Queensland University of Technology, Australia; Sanjeeva Balasuriya, University of Adelaide, Australia

Wednesday, May 24

MS110

Rare Extreme Phenomena in Dynamical Systems - Part II of II

8:30 AM-10:30 AM

Room:Ballroom 2

For Part 1 see MS97

Rare, extreme events are widespread in natural and engineering systems, with well-known examples such as ocean rogue waves, extreme weather patterns and shock waves in power grids. Over the last few years, the dynamical systems community has made several important contributions to the understanding, prediction and control of rare extreme phenomena. These efforts have led to the development of novel methods tailored specifically towards tackling extreme events. These methods rely on various mathematical tools such as probability and information theory, invariant manifold theory, uncertainty quantification and network theory. This minisymposium aims to feature the recent developments in the field and to explore the potential contributions each approach can make to the others.

Organizer: Mohammad Farazmand

Massachusetts Institute of Technology, USA

Organizer: Themistoklis Sapsis

Massachusetts Institute of Technology, USA

8:30-8:55 Trajectory Stratification for Rare Event Simulation

Jonathan Weare, University of Chicago, USA

9:00-9:25 Identification and Protection Against Critical Contingencies in Power Systems

Konstantin Turitsyn, Massachusetts Institute of Technology, USA

9:30-9:55 Optimal Experimental Design for Extreme Event Statistics in Nonlinear Dynamical Systems

Mustafa Mohamad and Themistoklis Sapsis, Massachusetts Institute of Technology, USA

10:00-10:25 Predicting Extreme Events for Passive Scalar Turbulence in Two-Layer Baroclinic Flows through Reduced-Order Stochastic Models

Di Qi and A Majda, New York University, USA

Wednesday, May 24

MS111

Data-driven Modeling and Prediction of Dynamical Systems - Part I of II

8:30 AM-10:30 AM

Room:Ballroom 3

For Part 2 see MS124

An emerging problem in computational science is to build effective models of dynamical processes using various types of data, and to use such models to make statistical predictions of complex dynamics. This is especially useful when a first-principles model is either unavailable or too complex to be practical. Recent progress in this area has made use of diverse ideas from dynamical systems, nonequilibrium statistical mechanics, and stochastic processes. The purpose of this minisymposium is to bring together researchers developing different data-driven modeling approaches, as well as those working on applications to computational science, data assimilation, and uncertainty quantification.

Organizer: Kevin K. Lin

University of Arizona, USA

Organizer: John Harlim

Pennsylvania State University, USA

8:30-8:55 Data-Driven Modeling and the Mori-Zwanzig Formalism

Fei Lu, Lawrence Berkeley National Laboratory, USA; *Kevin K. Lin*, University of Arizona, USA; Alexandre Chorin, University of California, Berkeley, USA

9:00-9:25 Dimension Reduction for Systems with Slow Relaxation

Shankar C. Venkataramani, University of Arizona, USA; Raman Venkataramani, Seagate Technology International, USA; Juan M. Restrepo, Oregon State University, USA

9:30-9:55 Data-Driven Parameterization of the Generalized Langevin Dynamics for Bio-Molecules

Xiantao Li, Pennsylvania State University, USA

10:00-10:25 Renormalization and Stability of Coarse-Grained Models

Panos Stinis, Pacific Northwest National Laboratory, USA

Wednesday, May 24

MS112

Advances in Stochastic Dynamics and Applications - Part I of II

8:30 AM-10:30 AM

Room:Primrose A

For Part 2 see MS125

Dynamical systems in biosciences and geosciences are often under the influences of stochastic fluctuations. Examples from modeling gene regulation as well as from the cryosphere physics have shown that various processes or mechanisms are inherently driven by stochastic events. For better understanding of these randomly influenced systems the quantitative biology and climatology have been guided by new modeling-based stochastic dynamical systems (SDS). The stochastic fluctuations have been considered under assumptions of Gaussian (Brownian) and non-Gaussian (Levy) distributions. Given a SDS, stochastic stability, mechanism of transition to equilibrium, non-equilibrium structures such as meta-stable states are perhaps the most important features to understand since its play an important role in the structural evolution of the biological and geological systems. To quantify dynamical behavior of SDS are often considered deterministic quantities such as moments for solution paths, probability density functions, mean exit time, escape probability and random invariant manifolds. These techniques are being used in analyzing biophysical and geophysical mechanisms. This minisymposium brings together researchers with diverse but related background suitable to study stochastic dynamics. It is an effort to give the scientific community a flavor of the most important stochastic approaches relevant to systems in biology and meteorology.

Organizer: Yayun Zheng

Huazhong University of Science & Technology, China

continued in next column

8:30-8:55 Tipping Point Analysis of Dynamical Systems, with Applications in Geophysics and Environmental Sciences

Valerie N. Livina, National Physical Laboratory, United Kingdom

9:00-9:25 Stochastic Dynamics of Near-Surface Winds over Land

Adam Monahan, University of Victoria, Canada

9:30-9:55 Metastable Phenomena in a Dynamical System with a Discontinuous Vector Field: Case of Amazonian Vegetation Model

Larissa I. Serdukova, Huazhong University of Science & Technology, China

10:00-10:25 Unstable Behavior in Capitalistic Economic Systems

Jim Brannan, Clemson University, USA

Wednesday, May 24

MS113

Model Reduction and Nonlinear Vibrations in Engineering Applications

8:30 AM-10:30 AM

Room:Primrose B

This minisymposium surveys recent advances in model reduction, model identification and model analysis for nonlinear mechanical systems. These advances firm up the intuitive notion of model reduction into an exact reduction process for high-dimensional, non-autonomous mechanical problems. The surveyed approaches include geometric singular perturbation theory; nonstandard invariant manifold results on spectral submanifolds; data-driven model reduction to invariant sets; explicit and rigorous model-reduction to low-dimensional manifolds in infinite-dimensional mechanical systems; and stochastic analysis of random perturbations to periodically forced nonlinear oscillator systems. The talks will cover a broad family of applications, ranging from theoretical models to experimental data.

Organizer: Robert Szalai

University of Bristol, United Kingdom

8:30-8:55 Nonlinear Model Identification and Spectral Submanifolds for Multi-Degree-of-Freedom Mechanical Vibrations

Robert Szalai, University of Bristol, United Kingdom

9:00-9:25 Exact Model Reduction by a Slow-Fast Decomposition of Multi-Degree-of-Freedom Vibrations

George Haller and Sten Ponsioen, ETH Zürich, Switzerland

9:30-9:55 Model Reduction to Spectral Submanifolds for Forced Beams: An Infinite-Dimensional Analysis

Florian Kogelbauer, ETH Zürich, Switzerland

10:00-10:25 Random Perturbations of Periodically Driven Nonlinear Oscillators: Homogenization and Large Deviations

Navaratnam Sri Namachchivaya, University of Illinois at Urbana-Champaign, USA; Nishanth Lingala, UIUC, USA; Ilya Pavlyukevich, Friedrich Schiller Universität Jena, Germany

Wednesday, May 24

MS114

Nonlocal Behavior in Biological Applications

8:30 AM-10:30 AM

Room:Maybird

This minisymposium will focus on examples of biological and chemical systems which are driven by nonlocal interactions. These include neural field models, biological aggregation models, and an example from an amphiphilic morphology model that accepts a nonlocal system. By considering the challenges and techniques used to analyze the resulting integro-differential equations, the aim is to provide a forum for cross-fertilization of ideas between the different fields.

Organizer: Paul Carter

Brown University, USA

Organizer: Gabriela Jaramillo

University of Arizona, USA

8:30-8:55 Traveling Waves and Breathers in An Excitatory-Inhibitory Neural Field

Stefanos Folias, University of Alaska, Anchorage, USA

9:00-9:25 Biological Aggregation Driven by Social and Environmental Factors: A Nonlocal Model and Its Degenerate Cahn-Hilliard Approximation

Andrew J. Bernoff, Harvey Mudd College, USA; Chad M. Topaz, Macalester College, USA

9:30-9:55 Patterns and Waves in a Spatially-Extended Neural Field Model

Jeremy D. Harris, University of Pittsburgh, USA

10:00-10:25 Compositional Evolution of Quasi-bilayers in the Symmetric Two-component Functionalized Cahn-Hilliard Equation

Qiliang Wu and Keith Promislow, Michigan State University, USA

Wednesday, May 24

MS115

Multiscale Modeling of Infectious Disease Dynamics: State-of-art and Challenges

8:30 AM-10:30 AM

Room:Magpie B

Successful transmission of infectious diseases involves completion of life-cycle steps at multiple scales of biological organization, i.e. the intracellular scale, the in-host scale, and the population, or epidemic, scale. At each of these scales, pathogens undergo rapid population and evolutionary changes. It has been well established that mathematical models can effectively describe and predict epidemic outcomes; they are extensively employed in disease outbreak analysis and evaluation of epidemic control measures. Models are also used to investigate disease dynamics in a host, and with the increasing availability of sequencing, transcriptomic and proteomic data, more insights on dynamics in-host and at the intracellular levels are being gained via modeling than ever before. However, in order to leverage knowledge gained at these lower levels to understand and make precise predictions about the impacts of a genetic mutation, for example, on the dynamics at the population level, models that attempt to connect the dynamics between scales are badly needed. This connection poses serious theoretical challenge to current modeling methodologies, and new mathematical frameworks/methods are needed to address this challenge. With this minisymposium, we invite mathematicians and theoretical biologists to discuss their state-of-art work on this area.

Organizer: Jessica M. Conway

Pennsylvania State University, USA

Organizer: Ruian Ke

North Carolina State University, USA

continued in next column

8:30-8:55 Emerging Disease Dynamics in a Model Coupling Within and Between-Host Systems

Zhilan Feng, Purdue University, USA

9:00-9:25 Examining Signatures of Within-Host Malaria Heterogeneity at an Epidemiological Level

Lauren Childs, Virginia Polytechnic Institute and State University, USA; Olivia Prosper, University of Kentucky, USA

9:30-9:55 Rhinovirus: From Biochemistry and Immunology to Families and Communities

Fred Adler, University of Utah, USA

10:00-10:25 The Role of Multi-Scale Selection in the Emergence of Drug Resistance

Troy Day and Johanna Hansen, Queen's University, Canada

Wednesday, May 24

MS116

Recent Results on Traveling Waves in Systems of PDEs - Part II of II

8:30 AM-10:30 AM

Room:Wasatch B

For Part 1 see MS103

This minisymposium will focus on recent results in the area of of traveling waves and related structures, obtained by either numerical or analytic techniques. Existence, stability, dynamic properties, and bifurcations of these special solutions will be addressed.

Organizer: Anna Ghazaryan

Miami University, USA

Organizer: Stephane Lafortune

College of Charleston, USA

Organizer: Vahagn Manukian

Miami University Hamilton, USA

8:30-8:55 Recent Advances in Rigorous Computation of the Evans Function

Blake Barker, Brigham Young University, USA; Kevin Zumbrun, Indiana University, USA

9:00-9:25 Complex Bifurcations in Benard-Marangoni Convection

Ivan Sudakov, University of Dayton, USA; Sergey Vakulenko, Russian Academy of Sciences, Russia

9:30-9:55 Center Manifolds for a Class of Degenerate Evolution Equations and Existence of Small-Amplitude Kinetic Shocks

Alin Pogan, Miami University, USA

10:00-10:25 The Gray-Scott Model: Bistable Regime

Vahagn Manukian, Miami University Hamilton, USA

Wednesday, May 24

MS117

Atmospheric Dynamics: Clouds, Convection, and Circulation

8:30 AM-10:30 AM

Room:Superior B

The dynamics in the Earth's atmosphere, and especially in clouds and the boundary layer, affect weather models and climate models. These models give predictions that are useful to our lives, individually and collectively, as well as on the short term and on the long term. The accuracy of these models can be improved with a better understanding of the dynamics involved. Moisture and heating are two areas of difficulty when modelling the atmosphere. In the context of convection and circulation, we'll examine these dynamics in the atmosphere and how they affect the models we use.

Organizer: David Collins

Vancouver Island University, Canada

8:30-8:55 Overview of the Boundary Layer, Cyclones, and the Dynamics Involved

David Collins, Vancouver Island University, Canada

9:00-9:25 A First Step Toward Quantifying the Climate's Information Production Over the Last 68,000 Years

Joshua Garland, Santa Fe Institute, USA; Tyler Jones and *Elizabeth Bradley*, University of Colorado Boulder, USA; Ryan G. James, University of California, Davis, USA; James White, University of Colorado Boulder, USA

9:30-9:55 The Dissipation Structure of Extratropical Cyclones

Jiangnan Li, Environment Canada, Canada

10:00-10:25 Dynamics of the Stably Stratified Atmospheric Boundary Layer

Amber Holdstworth and Adam Monahan, University of Victoria, Canada

Wednesday, May 24

MS118

Dynamics and Complexity in the Auditory Sensing System - Part II of II

8:30 AM-10:30 AM

Room:Superior A

For Part 1 see MS105

The auditory system displays remarkable mechanical sensitivity and frequency discrimination. These attributes have been shown to rely on an amplification process, which requires both biochemical and mechanical feedback loops, and leads to spatially localized oscillations inside the cochlea. In general, the origin of oscillatory localization can range from passive to dissipative mechanisms; however, specific mechanisms of cochlear amplification remain a puzzle. The goal of this minisymposium is to survey the development of theory of hearing and to scrutinize the connections between these models and experiments, at scales ranging from individual hair cells to the spatially extended cochlea.

Organizer: Arik Yochelis

Ben Gurion University, Israel

Organizer: Dolores Bozovic

University of California, Los Angeles, USA

8:30-8:55 Local and Spatially Extended Frequency Locking: Distinguishing Between Additive and Parametric Forcing

Arik Yochelis, Ben Gurion University, Israel; Yuval Edri, Ben-Gurion University of the Negev, Israel; Dolores Bozovic, University of California, Los Angeles, USA

9:00-9:25 From Passive to Active Mechanics in the Cochlea

Elizabeth S. Olson, Columbia University, USA

9:30-9:55 Effect of Electro-Mechanical Coupling on Stochastic Oscillations in a Model of Hair Cells

Alexander Neiman, University of Missouri, St. Louis, USA; Rami Amro, University of California, Los Angeles, USA

10:00-10:25 The Signal and the Noise: Microfluidics and Sensing in the Cochlea

Karl Grosh and Aritra Sasmal, University of Michigan, USA

Wednesday, May 24

MS119

Nonlinear Dynamics in Optics - Part II of II

8:30 AM-10:30 AM

Room:Wasatch A

For Part 1 see MS106

Nonlinear dynamical systems find their applications in many areas of optics. This minisymposium is devoted to the recent progress that has been made in the modeling of optical phenomena including topics such as Maxwell-Bloch Equations, Nonlinear modal interactions in micro-ring cavities, PT-symmetric lasers, Light-matter interaction dynamics, Wave instability and more.

Organizer: Alexey Sukhinin

University of Vermont, USA

Organizer: Dmitry Rachinskiy

University of Texas at Dallas, USA

8:30-8:55 Estimation of Timing Jitter in a Delayed Differential Model of Semiconductor Laser

Dmitry Rachinskiy, University of Texas at Dallas, USA

9:00-9:25 Time-delay Models of Multi-mode Laser Dynamics

Alexander Pimenov and Andrei G. Vladimirov, Weierstrass Institute, Germany

9:30-9:55 Instability of Steep Ocean Waves and Whitecapping

Sergey Dyachenko, Brown University, USA; Alan Newell, University of Arizona, USA

10:00-10:25 Generation of Broadband Chaotic Light and Its Applications in Detection and Communication

Longsheng Wang, Anbang Wang, Tong Zhao, Yuanyuan Guo, Daming Wang, and Yuncai Wang, Taiyuan University of Technology, China

Wednesday, May 24

MS120

Advanced Data-driven Techniques and Numerical Methods in Koopman Operator Theory - Part II of II

8:30 AM-10:30 AM

Room:Magpie A

For Part 1 see MS107

The Koopman operator governs the evolution of "observable-functions" of the state space, thereby offering an alternative framework to describe complex, nonlinear dynamical systems. It turns a nonlinear system into a linear (but infinite-dimensional) system that can be studied through spectral properties (e.g. eigenvalues, eigenfunctions, and so-called Koopman modes). Moreover, this framework has a direct connection to data-driven requirements for analysis and design of complex dynamics emerging in real-world applications. Thus, Koopman operator theory yields efficient data-driven techniques and numerical methods such as dynamic mode decomposition. These have a broad spectrum of applications, as diverse as fluid mechanics, power systems engineering, network inference, and control engineering. This minisymposium aims to report on new developments of this frontier field in dynamical systems and to discuss them with the audience of SIAM Conference on Dynamical Systems (DS). The topics developed in the session are data-driven techniques for system identification and time-series analysis (1,2), analysis of chaotic systems (3), numerical approximation of spectral densities (4), reduced-order modeling (5), nonlinear modal decompositions (6,7), and data-driven embeddings (8). The set of the topics is illustrated by the diversity of the eight speakers, which are invited from multiple parts of the world. This diversity is suitable for a highly international conference like DS.

Organizer: Yoshihiko Susuki

Osaka Prefecture University, Japan

Organizer: Alexandre Mauroy

University of Liege, Belgium

8:30-8:55 Extended Dynamic Mode Decomposition for Systems with Complex Dynamics

Clarence Rowley and Vivian Steyert, Princeton University, USA

9:00-9:25 Optimal Parameter Selection for Extended Dynamic Mode Decomposition

Wataru Kurebayashi, Aomori University, Japan; Sho Shirasaka and Hiroya Nakao, Tokyo Institute of Technology, Japan

9:30-9:55 Comparison of Dynamic Mode Decomposition, Koopman Mode Decomposition, and Vector Prony Analysis

Fredrik Raak, Kyoto University, Japan; Yoshihiko Susuki, Osaka Prefecture University, Japan; Igor Mezic, University of California, Santa Barbara, USA; Takashi Hikihara, Kyoto University, Japan

10:00-10:25 An Equal Space, An Equal Time: Data-Driven Embeddings of Complex Dynamics

Ioannis Kevrekidis, Princeton University, USA; *Felix Kemeth,* Technische Universität München, Germany

continued in next column

Wednesday, May 24

MS121

Nonlinear Mechanics and Locomotion

8:30 AM-10:30 AM

Room:White Pine

Locomotion through cyclic body deformation is a ubiquitous paradigm in nature, and designs inspired by nature are becoming increasingly popular in robotics as the advantages they promise in agility, adaptability, and efficiency are recognized. The performance of natural locomotion systems often hinges, however, on subtle nonlinear phenomena that must be understood to be exploited by engineered systems. Thorough illumination of such phenomena requires both analytical and computational modeling as well as complementary experimental work. This minisymposium convenes researchers engaged in this area with a practical focus on locomotion in fluids and a mathematical focus on tools from differential geometry, dynamical systems theory, and nonlinear control.

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

Organizer: Michael J. Fairchild
Princeton University, USA

8:30-8:55 3D Locomotion and Efficiency of a Yaw-Pitch Three-Link Robot in a Low Reynolds-Number Fluid
Jaskaran S. Grover, Tony Dear, Matthew Travers, and Howie Choset, Carnegie Mellon University, USA; Scott D. Kelly, University of North Carolina, Charlotte, USA

9:00-9:25 Efficient Locomotive Gaits for Swimming in Perfect Fluids
Michael J. Fairchild and Clarence Rowley, Princeton University, USA

9:30-9:55 Entrainment and Cooperative Locomotion in Nonholonomic Systems and Swimming Systems
Scott D. Kelly, University of North Carolina, Charlotte, USA

10:00-10:25 The Geometry of Self-Propulsion in (and on) Frictional Fluids
Daniel Goldman, Georgia Institute of Technology, USA

Wednesday, May 24

Coffee Break

10:30 AM-11:00 AM

Room:Golden Cliff

IP5

Dynamics, Mixing, and Coherence

11:00 AM-11:45 AM

Room:Ballroom

Chair: Martin Wechselberger, University of Sydney, Australia

Coherent regions in geophysical flows play fundamental roles by organising fluid flow and obstructing transport. For example, in the ocean, coherence impacts dynamics from global scales down to scales of at least tens of kilometres, and strongly influences the transportation of heat, salt, nutrients, phytoplankton, pollution, and garbage. I will describe some recent mathematical constructions, ranging across dynamical systems, probability, and geometry, which enable the accurate identification and tracking of such structures, and the quantification of associated mixing and transport properties. I will present case studies from a variety of geophysical settings.

Gary Froyland
University of New South Wales, Australia

Lunch Break

11:45 AM-1:15 PM

Attendees on their own

Wednesday, May 24

MS122

Patterns of Dynamics in Complex Networks

1:15 PM-3:15 PM

Room:Ballroom 1

Patterns of dynamics of coupled oscillators in a complex network are often affected by the structure of the network itself. Understanding the relationship between a network and the collective dynamics of its oscillators remains incomplete despite the ubiquity of natural and man-made networks with dynamical nodes. Experimental work involving opto-electronic and mechanical oscillators as well as computational studies using symmetries and group theory along with linear programming are shown to be effective in exposing the role of network structure in determining the dynamical patterns observed.

Organizer: Francesco Sorrentino
University of New Mexico, USA

Organizer: Louis M. Pecora
Naval Research Laboratory, USA

1:15-1:40 Chimeras, Cluster States, and Symmetries: Experiments on the Smallest Chimera
Joseph Hart, University of Maryland, USA

1:45-2:10 Synchronization in Experiments with Coupled Mechanical Oscillators
Karen Blaha, University of New Mexico, USA

2:15-2:40 Algorithms and Experiments for the Approximate Balanced Coloring Problem
David Philips, US Naval Academy, USA

2:45-3:10 Approximate Cluster Synchronization in Networks with Symmetries
Francesco Sorrentino, University of New Mexico, USA

Wednesday, May 24

MS123

Conceptual Climate Models: Approaches and Techniques - Part I of II

1:15 PM-2:45 PM

Room:Ballroom 2

For Part 2 see MS129

Conceptual models have proven very useful for investigating fundamental properties of a climate system because they are simple enough to allow for rigorous mathematical analysis. When deciding how to describe a given climate system, there are several approaches available. This minisymposium will provide a forum to highlight and discuss the use of fast-slow, partial differential equation, delay differential equation and non-smooth climate models, each with their own methodological advantages and challenges.

Organizer: Andrew Keane

University of Auckland, New Zealand

1:15-1:40 Conceptual Climate Models with Global Feedback Mechanisms

Bernd Krauskopf, University of Auckland, New Zealand

1:45-2:10 Interpreting Huybers' Glacial Cycles Model As a Nonsmooth Dynamical System

Somyi Baek, University of Minnesota, USA

2:15-2:40 Understanding the Variability of the Indian Monsoons - Combining Data with Model

Raj Saha, University of North Carolina, USA

Wednesday, May 24

MS124

Data-driven Modeling and Prediction of Dynamical Systems - Part II of II

1:15 PM-3:15 PM

Room:Ballroom 3

For Part 1 see MS111

An emerging problem in computational science is to build effective models of dynamical processes using various types of data, and to use such models to make statistical predictions of complex dynamics. This is especially useful when a first-principles model is either unavailable or too complex to be practical. Recent progress in this area has made use of diverse ideas from dynamical systems, nonequilibrium statistical mechanics, and stochastic processes. The purpose of this minisymposium is to bring together researchers developing different data-driven modeling approaches, as well as those working on applications to computational science, data assimilation, and uncertainty quantification.

Organizer: Kevin K. Lin

University of Arizona, USA

Organizer: John Harlim

Pennsylvania State University, USA

1:15-1:40 Data-Driven Correction of Model Error for Forecasting

Tyrus Berry, George Mason University, USA; John Harlim, Pennsylvania State University, USA

1:45-2:10 Accounting for Model Errors from Unresolved Scales by Stochastic Parametrization in Ensemble Kalman Filters

Fei Lu, Lawrence Berkeley National Laboratory, USA; Alexandre Chorin, University of California, Berkeley, USA; Xuemin Tu, University of Kansas, USA

2:15-2:40 Uncertainty Quantification for Generalized Langevin Dynamics

Eric J. Hall, University of Massachusetts, USA; Markos A. Katsoulakis, University of Massachusetts, Amherst, USA; Luc Rey-Bellet, University of Massachusetts, USA

2:45-3:10 Estimating Parameters with Linear Response Statistics

John Harlim, Xiantao Li, and *He Zhang*, Pennsylvania State University, USA

Wednesday, May 24

MS125

Advances in Stochastic Dynamics and Applications - Part II of II

1:15 PM-3:15 PM

Room:Primrose A

For Part 1 see MS112

Dynamical systems in biosciences and geosciences are often under the influences of stochastic fluctuations. Examples from modeling gene regulation as well as from the cryosphere physics have shown that various processes or mechanisms are inherently driven by stochastic events. For better understanding of these randomly influenced systems the quantitative biology and climatology have been guided by new modeling-based stochastic dynamical systems (SDS). The stochastic fluctuations have been considered under assumptions of Gaussian (Brownian) and non-Gaussian (Levy) distributions. Given a SDS, stochastic stability, mechanism of transition to equilibrium, non-equilibrium structures such as meta-stable states are perhaps the most important features to understand since its play an important role in the structural evolution of the biological and geological systems. To quantify dynamical behavior of SDS are often considered deterministic quantities such as moments for solution paths, probability density functions, mean exit time, escape probability and random invariant manifolds. These techniques are being used in analyzing biophysical and geophysical mechanisms. This minisymposium brings together researchers with diverse but related background suitable to study stochastic dynamics. It is an effort to give the scientific community a flavor of the most important stochastic approaches relevant to systems in biology and meteorology.

Organizer: Yayun Zheng

Huazhong University of Science & Technology, China

continued on next page

Wednesday, May 24

MS125

Advances in Stochastic Dynamics and Applications - Part II of II

1:15 PM-3:15 PM

continued

1:15-1:40 Stochastic Dynamics that are Central to Biological Mechanisms: Sleep-wake Transitions

Janet Best, The Ohio State University, USA

1:45-2:10 Yeast Cultures Have Large Coupling Strengths: Random Perturbations on Cell-cell Coupling Dynamics

Xue Gong, Augustana College, USA; Gregory Moses, Ohio University, USA; Alexander Neiman, University of Missouri, St. Louis, USA; Todd Young, Ohio University, USA

2:15-2:40 Hope Bifurcation in Random Dynamical Systems

Jeroen Lamb, Imperial College London, United Kingdom

2:45-3:10 Transitions in a Genetic Transcriptional Regulatory System Under Lévy Motion

Yayun Zheng, Huazhong University of Science & Technology, China

Wednesday, May 24

MS126

Emergence and Interactions of Spatially Localized Patterns - Part I of II

1:15 PM-3:15 PM

Room:Primrose B

For Part 2 see MS132

Spatially localized structures are common in a variety of pattern forming systems,appearing in chemical reactions, fluid mechanics, nonlinear optics, gas discharge, and plant ecology. Despite the diversity, there are common mathematical structures and driving mechanisms leading to rich dynamics,such as snaking bifurcation, self-replication, self-excitation, and collision dynamics. In this minisymposium we collect researchers working on various types of model equations for the above phenomena and try to extract key features of emergent dynamics common to those model equations from a dynamical system viewpoint. In particilar we focus on the dynamics of localized patterns in heterogeneous media and strong interactions like collisions.

Organizer: Lendert Lendert Gelens

Katholieke University Leuven, Netherlands

Organizer: Yasumasa Nishiura

Tohoku University, Japan

1:15-1:40 Dynamics of Localized Structures in Dissipative Systems

Yasumasa Nishiura, Tohoku University, Japan

1:45-2:10 The Dynamics of Interacting Pulses in an Extended Klausmeier Model

Arjen Doelman and Robbin Bastiaansen, Leiden University, Netherlands

2:15-2:40 Dynamics of Traveling Spots with Oscillatory Tails in Heterogeneous Media

Takeshi Watanabe, University of Tokyo, Japan; Yasumasa Nishiura, Tohoku University, Japan

2:45-3:10 Interactions of Spatially Localized Structures in Bioconvection of Photosensitive Microorganism

Makoto Iima and Takayuki Yamaguchi, Hiroshima University, Japan

Wednesday, May 24

MS127

Control of Dynamics in Brain Networks

1:15 PM-3:15 PM

Room:Maybird

The control of brain dynamics provides great promise for the enhancement of cognitive function in humans, and by extension betterment in their quality of life. Yet, successfully controlling dynamics in neural systems is particularly challenging, not least due to the immense complexity of the brain and the large set of interactions that can affect any single change. While we have gained some understanding of the control of single neurons, the control of large-scale neural systems – networks of interacting components or so-called connectomes – remains poorly understood. This lack has prompted the recent development of new control tools for brain networks, mostly adapted from control and systems theory. These contributions provide new models that draw from a wide array of approaches, from applied mathematics to opportunities for practical intervention. This minisymposium highlights emerging strategies of control in brain networks, while suggesting potential mechanisms that underlie such processes. These include control of more general cognitive processes with implications for brain development and decision-making, as well as within disparate fields of medical treatment such as anesthesia administration and seizure suppression. By presenting a variety of theoretical, computational, and experimental efforts, we hope to facilitate dialogue between mathematicians and practitioners in this exciting and rapidly developing field.

Organizer: Evelyn Tang

University of Pennsylvania, USA

Organizer: Danielle S. Bassett

University of Pennsylvania, USA

continued on next page

Wednesday, May 24

MS127

Control of Dynamics in Brain Networks

1:15 PM-3:15 PM

continued

1:15-1:40 Moving to the Network Level in Brain Activity Control: Implications for Cognition and Development
Evelyn Tang, University of Pennsylvania, USA

1:45-2:10 Control, Optimization and the Dynamics of Function in Neuronal Networks
ShiNung Ching, Washington University in St. Louis, USA

2:15-2:40 Fragility in the Human Decision Making System: When Irrationality Hijacks Logic
Sridevi V. Sarma and Pierre Sacre, Johns Hopkins University, USA; John Gale, Emory University, USA; Jorge Martinez-Gonzalez, Cleveland Clinic, USA

2:45-3:10 Coupling Single Neuronal Activity to Complex Brain Functions: Large-Scale, High-Resolution Approaches to Dissect and to Modify Neuronal Network Activities
Antal Berenyi, University of Szeged, Hungary

Wednesday, May 24

CP8

1:15 PM-3:15 PM

Room:Magpie B

Chair: Poul G. Hjorth, Technical University of Denmark, Denmark

1:15-1:30 Dynamics of Arrays of Coupled Cilia and Flagella-like Structures Driven by Axonemal Beating
Davide Spinello, University of Ottawa, Canada

1:35-1:50 Mapping of Large-Scale Biological Dynamical Networks
Lin Wan, Chinese Academy of Sciences, China

1:55-2:10 Fish Schooling
Ton V. Ta and Linh Nguyen, Kyushu University, Japan; Atsushi Yagi, Osaka University, Japan

2:15-2:30 How NF-KB Oscillations Drive Stochastic Gene Expression
Samuel Zambrano, San Raffaele University, Italy; Nacho Molina, Institut de Génétique et Biologie Moléculaire Cellulaire, France; Davide Mazza and Alessia Loffreda, Experimental Imaging Center Ospedale San Raffaele, Italy; Marco Bianchi and Alessandra Agresti, San Raffaele University, Italy

2:35-2:50 Stabilized Coexistence Among Mutual Cheaters in Cyclic Public Goods Games with Optimized Taxation
Christopher H. Griffin and Andrew Belmonte, Pennsylvania State University, USA

2:55-3:10 Pedestrian Dynamics from Social Force Models
Poul G. Hjorth, Technical University of Denmark, Denmark

Wednesday, May 24

CP9

1:15 PM-3:15 PM

Room:Wasatch B

Chair: Kourosh Tavakoli, Oklahoma City University, USA

1:15-1:30 Unstable Manifolds of Relative Equilibria and Relative Periodic Orbits
Nazmi Burak Budanur, Georgia Institute of Technology, USA

1:35-1:50 Exploring Relations Between Smooth and Piecewise Smooth Models
Alessandro Colombo, Politecnico di Milano, Italy

1:55-2:10 Dynamics of Some Nonanalytic Singular Perturbations of z^2+c
Bruce B. Peckham, University of Minnesota, Duluth, USA

2:15-2:30 Dynamics of Iterated Holomorphic Function Systems
Kourosh Tavakoli, Oklahoma City University, USA

2:35-2:50 Generalizations of Conley Index and Relevant Applications
Jintao Wang, Huazhong University of Science & Technology, China

2:55-3:10 Internally Delayed Oscillator in Coupling
Lauren Lazarus, Harvey Mudd College, USA

Wednesday, May 24

CP10

1:15 PM-2:55 PM

Room:Superior B

Chair: Paul Carter, Brown University, USA

1:15-1:30 Solution Surfaces of PDE's As Families of Orbit Segments

Pablo Aguirre, Universidad Técnica Federico Santa María, Chile

1:35-1:50 Snaking and Localized Patterns with Twisted Invariant Manifolds

Paul Carter and Tarik Aougab, Brown University, USA; Margaret Beck, Boston University, USA; Surabhi Desai, University of St. Andrews, United Kingdom; Bjorn Sandstede, Brown University, USA; Melissa Stadt, University of Washington, USA; Aric Wheeler, University of North Carolina, Chapel Hill, USA

1:55-2:10 Fractional Integrated Semi Groups and Non Local Cauchy Problem for Abstract Nonlinear Fractional Differential Equations

Mahmoud M. El-Borai, Alexandria University, Egypt

2:15-2:30 Mild Solutions for Multi-Term Time-Fractional Impulsive Differential Equations with Non Local Initial Conditions

Vikram Singh and Dwijendra N Pandey, Indian Institute of Technology Roorkee, India

2:35-2:50 Revisiting Delay-Embedding by Using Hilbert-Schmidt Integral Operator Theory for Dynamical Reconstruction

Naoto Nakano, Hokkaido University, Japan

Wednesday, May 24

CP11

1:15 PM-3:15 PM

Room:Superior A

Chair: James D. Meiss, University of Colorado Boulder, USA

1:15-1:30 Bifurcations of Invariant Tori in 3-Dimensional Piecewise Smooth Maps

Soumitro Banerjee and Mahashweta Patra, Indian Institute of Science Education and Research, India

1:35-1:50 Multiple Winner-Take-All Solutions in the Star-Like System of Phase Oscillators with Parameter Adaptation

Roman M. Borisyuk, Plymouth University, United Kingdom; Yakov Kazanovich, Russian Academy of Sciences, Russia; Oleksandr Burylko, Ukranian Academy of Science, Kiev, Ukraine

1:55-2:10 Explicit Symmetry Breaking and Hopf Bifurcations

Timothy K. Callahan, Embry-Riddle Aeronautical University, USA

2:15-2:30 Detecting Phase Transitions in Collective Behavior Using Manifold's Curvature

Kelum D. Gajamannage and Erik Bollt, Clarkson University, USA

2:35-2:50 Elliptic Bubbles in Moser's Quadratic Maps

James D. Meiss, University of Colorado Boulder, USA; Arnd Baecker, Institut für Theoretische Physik, Germany

2:55-3:10 On Stability of Coupled Systems with Delay and Hysteresis

Prasad G. Chhapkhane, Devchand College, India

Wednesday, May 24

CP12

1:15 PM-3:15 PM

Room:Wasatch A

Chair: Christoffer R. Heckman, University of Colorado Boulder, USA

1:15-1:30 A Model of Intergenerational Wealth Dynamics and Intergenerational Wealth Traps

Joel D. Nishimura, Arizona State University, USA

1:35-1:50 Users Dynamics on Internet Platforms

Victoria Rayskin, Tufts University, USA

1:55-2:10 The Emergence of Power-Law Scalings in Large-Scale Systems of Weakly Correlated Units

Jonathan D. Touboul, Collège de France, France; Alain Destexhe, CNRS, France

2:15-2:30 Using Modeled Dynamics for the Control of Autonomous Vehicles

Christoffer R. Heckman, University of Colorado Boulder, USA

2:35-2:50 Analysis of Entropy Generation Due to Time Periodic Heating in a MHD Porous Enclosure

Sumit Malik and Ameeya Nayak, Indian Institute of Technology Roorkee, India

2:55-3:10 Life-Detection and Through-Wall Imaging Using Ultra-Wideband Chaos Radar

Hang Xu, Li Liu, Jianguo Zhang, Jingxia Li, Bingjie Wang, Anbang Wang, and Yuncai Wang, Taiyuan University of Technology, China

Wednesday, May 24

CP13

1:15 PM-2:55 PM

Room:Magpie A

Chair: Abd Almomani, Clarkson University, USA

1:15-1:30 Deterministic Method to Identify Sparse Matrix of Parameters Based on Information Theory
Abd Alrahman R. Almomani, Clarkson University, USA

1:35-1:50 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

1:55-2:10 Perron-Frobenius Meet Monge-Kantorovich: A Set-Oriented Graph-Based Approach to Optimal Transport
Piyush Grover, Mitsubishi Electric Research Laboratories, USA; Karthik Elamvazhuthi, Arizona State University, USA

2:15-2:30 Forecasting Chaotic Business Cycles Perturbed by Noise
James M. Haley, Point Park University, USA

2:35-2:50 Entropy of Recurrence Plot Configurations
Thiago L. Prado, Universidade Federal dos Vales do Jequitinhonha e Mucuri, Brazil; Gilberto Corso, Universidade Federal do Rio Grande do Norte, Brazil; Gustavo Lima, Federal University of Rio Grande do Norte, Brazil; Sergio Lopes, Universidade Federal do Parana, Brazil

Wednesday, May 24

CP14

1:15 PM-2:55 PM

Room:White Pine

Chair: David Swigon, University of Pittsburgh, USA

1:15-1:30 Coupled System of Electrical Oscillators and Their Solutions in Perspective of Fractional Derivatives
Naseer Ahmad Asif and Muhammad Imran Jamil, University of Management and Technology, Pakistan

1:35-1:50 Understanding Mixing Processes by Transfer Operator
Yiwei Zhang, Huazhong University of Science & Technology, China

1:55-2:10 Inverse Problem for Dynamical Systems with Uncertain Data
David Swigon, University of Pittsburgh, USA; Shelby Stanhope, Temple University, USA; Jonathan E. Rubin, University of Pittsburgh, USA

2:15-2:30 Existence Results for Two-Term Time Fractional Differential Equations with Nonlocal Conditions
Renu Chaudhary and Dwijendra N Pandey, Indian Institute of Technology Roorkee, India

2:35-2:50 Robust Regulation of Hepatic Pericentral Amination by Glutamate Dehydrogenase Kinetics
Mubasher Rather, Soumen Bera, and Amit Chakraborty, University of Rajasthan, India; Claudia Acquisti, West Virginia University, USA; Bai-Lian Li, University of California, Riverside, USA

Coffee Break

3:15 PM-3:45 PM

Room:Golden Cliff

Wednesday, May 24

MS128

Recent Developments in Objective Coherent Structure Detection - Part I of II

3:45 PM-5:45 PM

Room:Ballroom 1

For Part 2 see MS141

Coherent structures play a significant role in the transport and mixing of passive and active scalars in fluids. Such structures arise at spatial scales ranging from the geophysical to the nanofluidic. Their self-consistent detection requires objective mathematical approaches, i.e., independent of an assumed observer. This two-part minisymposium brings together theoreticians, computational experts and experimentalists to survey the current state of the art and challenges in objective coherent structure analysis and its applications. Part I reviews recent developments in coherent structure theory and numerical detection methods, while Part II focuses on applied and experimental aspects in real-world flow problems.

Organizer: Daniel Karrasch
Technische Universität München, Germany

Organizer: George Haller
ETH Zürich, Switzerland

3:45-4:10 Mathematical Relations Between Geometric and Probabilistic Coherent Structure Detection Methods
Daniel Karrasch and Johannes Keller, Technische Universität München, Germany

4:15-4:40 Objective Eulerian Coherent Structures
Mattia Serra and George Haller, ETH Zürich, Switzerland

4:45-5:10 A Comparison of Lagrangian Methods for Coherent Structure Detection
Alireza Hadjighasem and Mohammad Farazmand, Massachusetts Institute of Technology, USA; Daniel Blazevski, Insight Data Science, USA; Gary Froyland, University of New South Wales, Australia; George Haller, ETH Zürich, Switzerland

5:15-5:40 The Motion of Objects Floating on the Ocean Surface
Francisco J. Beron-Vera and M. Josefina Olascoaga, University of Miami, USA; Rick Lumpkin, National Oceanic and Atmospheric Administration - ESRL, USA

Wednesday, May 24

MS129

Conceptual Climate Models: Approaches and Techniques - Part II of II

3:45 PM-5:45 PM

Room:Ballroom 2

For Part 1 see MS123

Conceptual models have proven very useful for investigating fundamental properties of a climate system because they are simple enough to allow for rigorous mathematical analysis. When deciding how to describe a given climate system, there are several approaches available. This minisymposium will provide a forum to highlight and discuss the use of fast-slow, partial differential equation, delay differential equation and non-smooth climate models, each with their own methodological advantages and challenges.

Organizer: Andrew Keane

University of Auckland, New Zealand

3:45-4:10 A Dynamical Systems Approach to the Pleistocene Climate - Part I of II

Hans Engler, Georgetown University, USA*; Hans G. Kaper,* Argonne National Laboratory and Georgetown University, USA; Tasso J. Kaper and Theodore Vo, Boston University, USA

4:15-4:40 A Dynamical Systems Approach to the Pleistocene Climate - Part II of II

Hans Engler, Georgetown University, USA; Hans G. Kaper, Argonne National Laboratory and Georgetown University, USA; Tasso J. Kaper and Theodore Vo, Boston University, USA

4:45-5:10 Interconnected Climate Variability in the Pacific and Indian Oceans

Malte Stuecker, University of Hawaii, Manoa, USA

5:15-5:40 Palaeoclimate Dynamics Modelled with Delay Differential Equations

Courtney Quinn, University of Exeter, United Kingdom

Wednesday, May 24

MS130

Simple Systems with Complex Dynamics - Part I of II

3:45 PM-5:45 PM

Room:Ballroom 3

For Part 2 see MS143

Lab experiments can often be very costly as they may require expensive equipment. However, research in dynamical systems can still be done using simple table top experiments at low cost. Many of these systems may seem extremely simple and mundane in set up, yet they can be very rich in their dynamics. In this minisymposium, we present four table top experiments involving mechanical, chemical and electrical oscillators and show how they can produce complex phenomena such as synchronization, period doubling bifurcation and chaos. We also demonstrate how these systems can be studied mathematically and numerically.

Organizer: Andrea J. Welsh

Georgia Institute of Technology, USA

Organizer: Mary Elizabeth Lee

Georgia Institute of Technology, USA

3:45-4:10 Chaotic Ollations of Smple Mchanical Sstems

Lucas Illing, Reed College, USA

4:15-4:40 Coins Falling in Water

Lionel Vincent, University of Southern California, USA; Try Lam, NASA Jet Propulsion Laboratory and University of Southern California, USA; *Eva Kanso*, University of Southern California, USA

4:45-5:10 Pattern Formation of Swarms of Artemia Franciscana

Andrea J. Welsh, Krishma Singal, and Flavio H. Fenton, Georgia Institute of Technology, USA

5:15-5:40 Self-Organizing Dynamics in Active Elastic Systems

Cristian Huepe, CHuepe Labs Inc., USA; Ali Emre Turgut, Middle East Technical University, Turkey; Eliseo Ferrante, KU Leuven, Belgium

Wednesday, May 24

MS131

Recent Advances in Time-delayed Models of Gene Regulatory Networks

3:45 PM-5:45 PM

Room:Primrose A

Many biological processes are known to be significantly affected by various time delays, including transcription and translation delays during production of proteins from DNA, propagation delays in neural networks, latency and immunity in infectious diseases etc. In the context of gene regulatory networks, recent technological advances have provided substantial new understanding of underlying biological processes, as well as more precise measurements of various important parameters. At the same time, the development of mathematical models that can effectively capture the complex dynamics often exhibited by such systems remains a major challenge. Some specific modeling difficulties include complicated interactions between noise and time delays, the role of various delay distributions, as well as identifying most relevant parameters that control system dynamics. This minisymposium will showcase latest results on analysis and simulations of various gene regulatory networks that are relevant for different application areas, ranging from biological clocks to flowering of plants.

Organizer: Konstantin Blyuss

University of Sussex, United Kingdom

Organizer: Thomas W. Carr

Southern Methodist University, USA

3:45-4:10 Delays and Nonlinearities in Biological Clocks

Thomas W. Carr, Southern Methodist University, USA

continued on next page

Wednesday, May 24

MS131

Recent Advances in Time-delayed Models of Gene Regulatory Networks

3:45 PM-5:45 PM

continued

4:15-4:40 Characterization of Transcriptional Delays under Time-Varying Temperatures

Marcella M. Gomez, Rice University, USA; Richard Murray, California Institute of Technology, USA; Matthew Bennett, Rice University, USA

4:45-5:10 Which Delays Matter in Gene Expression?

Marc R. Roussel, University of Lethbridge, Canada

5:15-5:40 Deterministic and Stochastic Stability of Arabidopsis Flowering Model

Maia Angelova, Emrah Haspolat, and Benoit Huard, Northumbria University, United Kingdom

Wednesday, May 24

MS132

Emergence and Interactions of Spatially Localized Patterns - Part II of II

3:45 PM-5:45 PM

Room:Primrose B

For Part 1 see MS126

Spatially localized structures are common in a variety of pattern forming systems,appearing in chemical reactions, fluid mechanics, nonlinear optics, gas discharge, and plant ecology. Despite the diversity, there are common mathematical structures and driving mechanisms leading to rich dynamics,such as snaking bifurcation, self-replication, self-excitation, and collision dynamics. In this minisymposium we collect researchers working on various types of model equations for the above phenomena and try to extract key features of emergent dynamics common to those model equations from a dynamical system viewpoint. In particilar we focus on the dynamics of localized patterns in heterogeneous media and strong interactions like collisions.

Organizer: Lendert Gelens
KU Leuven, Belgium

Organizer: Yasumasa Nishiura
Tohoku University, Japan

3:45-4:10 Localized Structures in Nonlinear Optical Resonators

Lendert Gelens, KU Leuven, Belgium; Pedro Parra-Rivas, Vrije Universiteit Brussel, Belgium; Damia Gomila, Instituto de Fisica Interdisciplinary Sistemas Complejos, Spain; François Leo, Université Libre de Bruxelles, Belgium; Stéphane Coen, University of Auckland, New Zealand; Edgar Knobloch, University of California, Berkeley, USA - Nonlinearity, Institute of Physics

4:15-4:40 Forced Snaking

Benjamin C. Ponedel and Edgar Knobloch, University of California, Berkeley, USA

continued in next column

4:45-5:10 Stabilization of Flat Localized Structures and their Interaction through Strong Nonlocal Coupling

Cristian Fernandez-Oto, Simon Weisser, and Mustapha Tlidi, Université Libre de Bruxelles, Belgium; Marcel Clerc, Universidad de Chile, Chile; Daniel Escaff, Universidad de los Andes, Colombia

5:15-5:40 Spatially Localized Patterns in Networks of Spiking Neurons

Helmut Schmidt, Centre de Recerca Matemàtica, Spain; Daniele Avitabile, University of Nottingham, United Kingdom; Ernest Montbrio, Universitat Pompeu Fabra, Spain; Alex Roxin, Centre de Recerca Matemàtica, Spain

Wednesday, May 24

MS133

Large Scale Dynamics in Coupled Systems on Networks - Part I of II

3:45 PM-5:45 PM

Room:Maybird

For Part 2 see MS146

Many natural and man-made networks in physical and life sciences feature extraordinary richness and complexity of interconnections. Understanding collective dynamics of such networks poses new challenges for nonlinear science and calls for new approaches incorporating combinatorial and probabilistic methods into dynamical analysis of complex systems. The talks of this minisymposium address large time behavior, pattern formation, and bifurcations in coupled networks with an emphasis on the link between the network structure and its dynamics.

Organizer: Georgi S. Medvedev

Drexel University, USA

Organizer: Hayato Chiba

Kyushu University, Japan

3:45-4:10 The Mean Field Limit of the Kuramoto Model on Convergent Graph Sequences

Georgi S. Medvedev, Drexel University, USA

4:15-4:40 A Bifurcation of the Kuramoto Model on Networks

Hayato Chiba, Kyushu University, Japan

4:45-5:10 Bifurcations Mediating Appearance of Chimera States

Oleh Omel'chenko, Weierstrass Institute for Applied Analysis and Stochastics, Germany

5:15-5:40 Bumps in Small-World Networks

Carlo R. Laing, Massey University, New Zealand

Wednesday, May 24

MS134

Reductions of Coupled Oscillator Networks: A New Tool for Neuroscience

3:45 PM-5:45 PM

Room:Magpie B

Transitions from high amplitude to low amplitude signals, as observed in electrophysiological brain recordings, are thought to be caused by changes in the synchrony of the underlying neuronal population firing patterns. There are now a plethora of models to describe neural dynamics at a range of different scales, yet very few which can describe synchronisation phenomena in a parsimonious way scale. Recent advances in the field of coupled oscillator theory has allowed for the reduction of large networks of oscillators. With this new found analytical tractability comes the ability to understand how synchrony can dynamically couple to network states. This minisymposium will explore the reduction and analysis of coupled oscillator models, in relation to neuroscience. Particular emphasis will be placed on synchrony and the generation of brain rhythms.

Organizer: Aine Byrne

University of Nottingham, United Kingdom

3:45-4:10 Introduction, Exact Results for Globally-Coupled Theta Neurons, and Extensions

Ernest Barreto, George Mason University, USA

4:15-4:40 Exact Low-Dimensional Mean-Field Dynamics of Neuronal Networks

Bastian Pietras, Vrije Universiteit Amsterdam, The Netherlands

4:45-5:10 Weakly Coupled Oscillators in a Slowly Varying World

Youngmin Park and Bard Ermentrout, University of Pittsburgh, USA

5:15-5:40 Next Generation Neural Field Modelling

Aine Byrne, Stephen Coombes, and Daniele Avitabile, University of Nottingham, United Kingdom

Wednesday, May 24

MS135

Causation Inference and Information Flow in Dynamical Systems: Theory and Applications - Part I of II

3:45 PM-5:45 PM

Room:Wasatch B

For Part 2 see MS148

A basic question in science is to infer amongst causal interactions. In terms of dynamical systems, one may ask amongst coupled dynamic variables, which may influence each other, and furthermore, directly so. Information theoretic descriptions of chaotic dynamical systems have underpinnings in symbolic dynamics, whereas the Shannon information underpins general concepts of entropy and data. Analogous to Granger causality for linear systems, transfer entropy has become a highly popular way to consider questions of pairwise information flow between nonlinear dynamical systems. In a basic sense the measurement describes how observations of various factors of an underlying system effect predictability of other factor. However, transfer entropy can not properly represent secondary versus primary influences when used in large scaled coupled systems leading to causation entropy as a specifically conditioned transfer entropy. In this session, applications of information flow in social and also animal interaction systems will be discussed. However, there are important limitations and caveats that must be understood so as to not over interpret what can understood in using transfer entropy like quantities, such as resolution and Markov order and also questions of when pairwise interactions can completely capture all influences, versus inherently multi- element interactions.

Organizer: Erik Bollt

Clarkson University, USA

Organizer: Shawn D. Pethel

US Army RDECOM, USA

continued on next page

Wednesday, May 24

MS135

Causation Inference and Information Flow in Dynamical Systems: Theory and Applications - Part I of II

3:45 PM-5:45 PM

continued

3:45-4:10 Extracting Information Flow Between Animals in the Wild

Nicole Abaid and Subhradeep Roy, Virginia Tech, USA

4:15-4:40 Information and Prediction Limits in Online Social Activity

James Bagrow, University of Vermont, USA; Lewis Mitchell, University of Adelaide, South Australia

4:45-5:10 Inferring Influence and Leadership in Mobile Animal Groups

Andrew Berdahl and Joshua Garland, Santa Fe Institute, USA; Jie Sun and Erik Bollt, Clarkson University, USA

5:15-5:40 Network Flux based on Directed Links in Spatially Embedded Climate Networks

Ugur Ozturk, Potsdam Institute for Climate Impact Research and University of Potsdam, Germany

Wednesday, May 24

MS136

Multiscale Modelling in Health and Disease

3:45 PM-5:45 PM

Room:Superior B

The functioning of biological systems is controlled by regulations at multiple scales (including gene regulation, cell-cycle control, cell morphology) at single cell level, with emerging properties in populations of cells. Mathematical models developed in Systems Biology can either consider such features independently, or incorporate them across several scales. The benefits of multiscale models in Systems Biology are broad, as they allow considering the interplay between different processes, while being modular, and predicting the resulting cellular phenotype. The unifying idea of this minisymposium is to get insights into applications of multiscale modelling for the formalisation of biological systems involved in health and disease, with a focus on understanding the transition from healthy to diseased states within the human body. Whether we are looking at how a single mutant epithelial cell in our intestines leads to an entire system of mutant crypts, or predicting heterogeneous tumour growth dynamics, multiscale tools are vital in understanding and proposing ways to improve our understanding and treatment of these diseased systems. To this end, this minisymposium will also provide links to experimental biology, describing how the inclusion of multiscale modelling can allow for informing back and forth between disciplines, improving both the models themselves as well as the experimental techniques.

continued in next column

Organizer: Daniel Ward
University of Bristol, United Kingdom

Organizer: Martin Homer
University of Bristol, United Kingdom

Organizer: Lucia Marucci
Telethon Institute of Genetics and Medicine, Italy

3:45-4:10 The Dynamics of Colonic Crypt Dysplasia

Daniel Ward, University of Bristol, United Kingdom; Lucia Marucci, Telethon Institute of Genetics and Medicine, Italy; Martin Homer, University of Bristol, United Kingdom

4:15-4:40 Multiscale Agent-Based Models Predict Emergent Dynamics of Heterogeneous Tumor Growth

Jessica Yu and *Neda Bagheri*, Northwestern University, USA

4:45-5:10 Optimal Chemotherapy Scheduling Based on a Pair of Collaterally Sensitive Drugs

Nara Yoon, Case Western Reserve University, USA; Robert Vander Velde, University of South Florida, USA; Andriy Marusyk, H. Lee Moffitt Cancer Center & Research Institute, USA; Jacob G. Scott, Cleveland Clinic Lerner Research Institute, USA

5:15-5:40 Cell Based Modelling of Tissue Size Control in the Drosophila Embryonic Epidermis

Jochen Kursawe, University of Oxford, United Kingdom

Wednesday, May 24

MS137

Existence, Stability, and Dynamics of Patterns on Multi-dimensional Domains - Part I of II

3:45 PM-5:45 PM

Room:Superior A

For Part 2 see MS150

The study of patterns which are inherently multi-dimensional has diverse applications in areas such as ecology, fluid dynamics, polymer physics, chemical deposition, and optics. We wish to bring together researchers working in different settings and who use different technical approaches to surmount the numerous difficulties which arise when studying such patterns. We wish to highlight advances which tackle these difficulties using classical and infinite-dimensional dynamical systems techniques (for instance, exponential dichotomies, the Maslov index, and the Evans function, and their multi—spatial-dimension extensions), as well as approaches which bypass them through the use of functional analysis, modulational/ asymptotic analysis, and variational tools. While the dynamical systems viewpoint in general provides a relatively thorough understanding of the phenomena, these latter techniques offer novel alternatives and allow for the study of new areas. We also hope that by bringing together theoretical, numerical, and modeling perspectives, new connections can be made, possibly fostering future collaborations.

Organizer: Ryan Goh
Boston University, USA

Organizer: Qiliang Wu
Michigan State University, USA

continued in next column

3:45-4:10 Oblique Stripes in a Triggered Swift-Hohenberg Equation

Ryan Goh, Boston University, USA; Arnd Scheel, University of Minnesota, USA

4:15-4:40 Phase Separation from Directional Quenching and Unbalanced Patterns in Cahn-Hilliard and Allen-Cahn Equations

Rafael Monteiro da Silva, University of Minnesota, USA

4:45-5:10 A Dynamical Approach to Elliptic Equations on Bounded Domains

Alim Sukhtayev, Indiana University, USA

5:15-5:40 Waves and Obstacles in Square Lattices

Hermen Jan Hupkes, University of Leiden, The Netherlands; Erik Van Vleck, University of Kansas, USA; Aaron Hoffman, Franklin W. Olin College of Engineering, USA; Leonardo Morelli, University of Leiden, The Netherlands

Wednesday, May 24

MS138

Coarse Graining and Dimensionality Reduction for Stochastic Dynamical Systems - Part I of II

3:45 PM-5:45 PM

Room:Wasatch A

For Part 2 see MS151

In numerous application areas, e.g. molecular dynamics or geophysical fluid dynamics, one encounters stochastic systems whose complexity renders an efficient numerical analysis virtually impossible. It is then the goal of coarse graining methods to replace the full description of the system by a reduced representation that retains the properties of interest. This minisymposium features novel approaches for the systematic derivation of coarse grained models, their numerical realization with a focus on data-driven methods, and their validation based on both mathematical insight as well as real-life experiments. We have tried to keep a balance between younger and more established speakers, thus the minisymposium would be an excellent vehicle for bringing both new faces and new ideas to SIAM DS.

Organizer: Stefan Klus
Freie Universität Berlin, Germany

Organizer: Andreas Bittracher
Freie Universitaet Berlin, Germany

Organizer: Carsten Hartmann
Brandenburgische Technische Universität Cottbus, Germany

3:45-4:10 Complex Dynamics in Multiscale Systems

Serafim Kalliadasis, Imperial College London, United Kingdom

4:15-4:40 Diffusion Forecast: A Nonparametric Probabilistic Modeling of Dynamical Systems

John Harlim, Pennsylvania State University, USA

4:45-5:10 Information-Theoretic Methods for Coarse-Graining Stochastic Dynamics

Petr Plechac, University of Delaware, USA

5:15-5:40 Coarse Graining under Prevalent Embeddings

Andreas Bittracher, Freie Universitaet Berlin, Germany

Wednesday, May 24

MS139

Recent Advances in Chaos-based and Noise-based Random Number Generation

3:45 PM-5:45 PM

Room:Magpie A

This minisymposium aims at presenting the cutting-edge technologies of chaos-based and noise-based random number generation (RNG) as well as emerging fundamental issues on the evaluation of physical entropy source of RNG. The research field on RNG with chaotic or noisy lasers has been developed very rapidly since the first demonstration was reported in 2008. We discuss three aspects of recent development of RNG in this minisymposium: speed, miniaturization, and entropy-source evaluation. The speed of RNG has been improved drastically from Gigabit to Terabit per second for a decade. The miniaturization of RNG with photonic integrated circuits has been progressing, and real-time implementation of post-processing has been reported to distill random numbers. Compared with these two directions of RNG, the evaluation techniques of the quality of generated random numbers are still lacking, since the random numbers are generated from both physical entropy source and complicated digital post-processing. Apart from the digital post-processing, the evaluation of the quality of physical entropy source (e.g., Kolmogorov-Sinai entropy estimated from Lyapunov spectrum) is one of the most important issues, which will be discussed in this minisymposium. We believe this minisymposium is timely and of much significance. We hope that the proposed minisymposium will lead to new collaborations and new directions of this research field.

Organizer: Atsushi Uchida

Saitama University, Japan

continued in next column

3:45-4:10 Progress in Random Number Generation with Chaotic Lasers

Atsushi Uchida, Kazusa Ugajin, Yuta Terashima, and Keigo Yoshiya, Saitama University, Japan

4:15-4:40 Real-Time Fast Physical Random Number Generators

Yuncai Wang, Pu Li, Anbang Wang, Jianguo Zhang, Xianglian Liu, Yanqiang Guo, and Luxiao Sang, Taiyuan University of Technology, China

4:45-5:10 Quantum Random Number Generator: Speed and Security

Jun Zhang, University of Science and Technology of China, China

5:15-5:40 Shannon Entropy Estimation Based on Chaotic Attractor Reconstruction for a Semiconductor Laser

Xiao-Zhou Li, Jun-Ping Zhuang, Song-Sui Li, and *Sze-Chun Chan*, City University of Hong Kong, Hong Kong

Wednesday, May 24

MS140

New Developments in Attractor Reconstruction

3:45 PM-5:45 PM

Room:White Pine

Attractor reconstruction originated with a topological theorem of Takens which shows how to reconstruct the state space of a dynamical system from a generic observable. The Takens theorem guarantees a topological reconstruction, up to diffeomorphism, in the limit of infinite data. However, this theoretical guarantee belies significant practical limitations, such as data requirements, presence of noise, tuning of nuisance parameters, and strongly biased geometry. Recently, the proliferation of big data gathered from complex dynamical systems has led to renewed interest. In particular, the geometric, statistical, and stability/robustness aspects of the reconstruction process are being reconsidered. In this minisymposium, we explore methods of modifying and improving attractor reconstruction, and extensions of the methodology for dynamical data analysis.

Organizer: Tyrus Berry

George Mason University, USA

Organizer: Franz Hamilton

North Carolina State University, USA

3:45-4:10 Nonparametric Reconstruction from Noisy Time Series: The Kalman-Takens Method

Franz Hamilton, North Carolina State University, USA

4:15-4:40 Topological Symmetries: Quasiperiodicity and Its Application to Filtering and Classification Problems

Michael Robinson, American University, USA

4:45-5:10 Stabilizing Embedology: When Do Delay-Coordinate Maps Preserve Geometry?

Armin Eftekhari, Alan Turing Institute, United Kingdom; Han Lun Yap, Georgia Institute of Technology, USA; *Michael B. Wakin,* Colorado School of Mines, USA; Chris Rozell, Georgia Institute of Technology, USA

5:15-5:40 Delay Embeddings and the Spectra of Koopman Operators

Suddhasattwa Das, New York University, USA; Dimitrios Giannakis, Courant Institute of Mathematical Sciences, New York University, USA

Wednesday, May 24

Dinner Break

5:45 PM-8:30 PM

Attendees on their own

DSWeb Editorial Board Meeting

6:00 PM-8:00 PM

Room:Aerie Restaurant (Mountain Private Dining Room)

Wednesday, May 24

PP2

Poster Session and Dessert Reception

8:30 PM-10:30 PM

Room:Ballroom

Social Experience Reconfigures Decision-Making Circuits in Zebrafish

Sungwoo Ahn, Thomas Miller, and Katie Clements, East Carolina University, USA; Choongseok Park, University of Pittsburgh, USA; Eoon Hye Ji, University of California, Los Angeles, USA; Fadi Issa, East Carolina University, USA

Network Bursting in Melibe Swim CPG

Deniz Alacam and Andrey Shilnikov, Georgia State University, USA

Theory and Computation of Nonlinear Deformation Spectra of Flows

Siavash Ameli, University of California, Berkeley, USA

Symbolic Dynamics Applied to a Numerical Simulation of a Perturbed Hill's Spherical Vortex

Joshua Arenson, University of California, Merced, USA; Spencer A. Smith, Mount Holyoke College, USA; Kevin A. Mitchell, University of California, Merced, USA

Channel Capacity of Cardiac Action Potential Transmission and Spiral Wave Initiation

Ameneh Asgari-Targhi, University of Glasgow, Scotland, UK; Hiroshi Ashikaga, Johns Hopkins University, USA

Computing the Optimal Path for Stochastic Populations Coupled Through Migration

Alexa Aucoin, Lora Billings, and Eric Forgoston, Montclair State University, USA

Conservation Laws in Nonlocal Equations

Berry Bakker, VU University, Amsterdam, Netherlands

Three-Dimensional Chattering of Rigid Bodies

Tamás Baranyai and Peter L. Varkonyi, Budapest University of Technology and Economics, Hungary

Closed-Form Solutions and New Algorithm for Two-Dimensional Frictional Problems

Jim Barber, University of Michigan, USA

continued in next column

Glycinergic Neurons in the Pre-Bötzinger Complex Are Crucial for Eupnea: An Optogenetic Study

William H. Barnett and Yaroslav Molkov, Georgia State University, USA; Ana Abdala and Beihui Liu, University of Bristol, United Kingdom; Davi Moraes, University of Sao Paulo, Brazil; Sergey Kasparov and Lucas Koolen, University of Bristol, United Kingdom; Jeffrey Smith, National Institutes of Health, USA; Julian Paton, University of Bristol, United Kingdom

Particle Diffusion and Competitive Receptor Binding

Alla Borisyuk, University of Utah, USA; Gregory A. Handy and Sean Lawley, University of Utah, USA

Improving Network Inference of Oscillatory Systems: The Impact of False Positive and False Negative Conclusions About the Presence Or Absence of Links

Gloria Cecchini, Bjoern Schelter, Marco Thiel, and Linda Sommerlade, University of Aberdeen, United Kingdom

Partial Synchronization in Pulse-Coupled Oscillator Networks

Bolun Chen, Jan Engelbrecht, and Renato Mirollo, Boston College, USA

Axonal Transport in Cells: Modeling of Motor-Cargo Dynamics

Abhishek Choudhary, Rensselaer Polytechnic Institute, USA

Noise-Induced Stabilization of Collective Behavior in Oscillatory Ensembles

Pau Clusella Cobero and Antonio Politi, University of Aberdeen, United Kingdom

Numerical Solutions of Three Dimensional Telegraphic Equations Using Differential Quadrature Method

Sumita Dahiya and Ramesh Mittal, Indian Institute of Technology Roorkee, India

Observation Impact in Data Assimilation for Flood Inundation Forecasting

Sarah Dance and Elizabeth Cooper, University of Reading, United Kingdom; Javier Garcia-Pintado, University of Bremen, Germany; Nancy K. Nichols and Polly Smith, University of Reading, United Kingdom

continued on next page

Synaptic Plasticity in Excitatory and Inhibitory Hippocampal Neuron Circuit Dynamics

Claire Seibold, *Dominika Dec*, and Emily F. Stone, University of Montana, USA

Determining the Mean Field Dynamics in Complex Networks Via the Kramers-Moyal Expansion

Nicolás Deschle and Björn Schelter, University of Aberdeen, United Kingdom; Andreas Daffertshofer, Vrije Universiteit Amsterdam, The Netherlands

Spectral Properties of Spiral Waves in the Barkley Model

Stephanie Dodson and Bjorn Sandstede, Brown University, USA

Developing a Hybrid Model for Chemotactically Driven Neuritogenesis

Jeremy P. D'Silva and Marisa Eisenberg, University of Michigan, USA

Large Time Behavior of a Conserved Phase-Field System

Cyril D. Enyi, King Fahd University of Petroleum and Minerals, Saudi Arabia

Exploring the Risk of Desynchronization in Complex Networks

Jeremie A. Fish and Jie Sun, Clarkson University, USA

Measurement Sequences and Chernoff Information

Andrew M. Fraser, Los Alamos National Laboratory, USA

Parameter Estimation for Dynamical Systems Using Bifurcation Analysis

Jace E. Gilbert and Paul J. Hurtado, University of Nevada, Reno, USA

Saddle Slow Manifolds and Canard Orbits in the Hodgkin-Huxley Model

Cris Hasan, Hinke M. Osinga, and Bernd Krauskopf, University of Auckland, New Zealand

Clustered Ventilation Defects in Asthmatics

Austin J. Ibarra, University of Auckland, New Zealand

Mathematical Tales of Fairy Circles

Olfa Jaibi, University of Leiden, The Netherlands; Martina Chirilus-Bruckner and Arjen Doelman, Leiden University, Netherlands; Ehud Meron, Ben-Gurion University, Israel

continued in next column

High-Order Finite-Difference Time-Domain Simulation of Electromagnetic Waves at Complex Interfaces Between Dispersive Media

Michael Jenkinson, Rensselaer Polytechnic Institute, USA

Torus Bifurcation in Purkinje Cell

Huiwen Ju and Andrey Shilnikov, Georgia State University, USA; Alexander Neiman, University of Missouri, St. Louis, USA

A Hamiltonian Formulation for the Estimation of Partially Observed Chaotic Systems

Nirag Kadakia, Daniel Rey, Jingxin Ye, and Henry D. Abarbanel, University of California, San Diego, USA

Consensus in One and Two Population Models of Opinion Dynamics

Ratna Khatri, George Mason University, USA

Topological Principles of Control in Dynamical Networks

Jason Kim, University of Pennsylvania, USA; Fabio Pasqualetti, University of California, Riverside, USA; Danielle S. Bassett, University of Pennsylvania, USA

The Acceleration and Deceleration of Mixing Rates by Discontinuities in Chaotic Flows

Hannah E. Kreczak, Rob Sturman, and Mark Wilson, University of Leeds, United Kingdom

Reaction Front Barriers in Unsteady Fluid Flows

Rory A. Locke and Kevin A. Mitchell, University of California, Merced, USA

Inference and Comparison of Dynamical Systems As Models for Glacial Climate Variability

Johannes Lohmann and Peter Ditlevsen, University of Copenhagen, Denmark

A Variant of the Aubry-André Model for Granular Materials

Alejandro J. Martinez, University of Oxford, United Kingdom; Mason A. Porter, University of California, Los Angeles, USA; Panayotis Kevrekidis, University of Massachusetts, USA

A Heterodimensional Cycle in the Flow of a 4D Differential Equation

Gemma Mason, University of Auckland, New Zealand; Andy Hammerlindl, Monash University, Australia; Bernd Krauskopf and Hinke M. Osinga, University of Auckland, New Zealand

continued in next column

Designing a Finite-Time Mixer: Optimizing Stirring for Two-Dimensional Maps

Rebecca A. Mitchell and James D. Meiss, University of Colorado Boulder, USA

Global Invariant Manifolds and Slow Manifolds Near a Singular Hopf Bifurcation

Jose Mujica, Bernd Krauskopf, and Hinke M. Osinga, University of Auckland, New Zealand

Global Regularity in a Surface Growth Model Using a-Posteriori Methods

Christian Nolde, Universität Augsburg, Germany; Dirk Blömker, Universitaet Augsburg, Germany

Improving Synchronization Via Adaptive Rewiring in Networks of Kuramoto Oscillators

Lia Papadopoulos, Jason Kim, and Danielle S. Bassett, University of Pennsylvania, USA

A Discontinuous Map for a Human Sleep-Wake Network Model Predicts Recovery from Sleep Deprivation

Sofia H. Piltz, University of Michigan, USA; Cecilia Diniz Behn, Colorado School of Mines, USA; Victoria Booth, University of Michigan, USA

Oscillatory States in Working Memory Model Facilitate Activation and Network Capacity

Jason E. Pina, University of Pittsburgh, USA

Unraveling the Chaos-Land and Its Organization in the Rabinovich System

Krishna Pusuluri, Georgia State University, USA; Arkady Pikovsky, University of Potsdam, Germany; Andrey Shilnikov, Georgia State University, USA

Kernel-Based Lasso for the Inference of Complex Spatial Networks

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

A Model of Localized States in Visual Cortex

James Rankin, New York University, USA; Frédéric Chavane, Institut de Neurosciences de la Timone, CNRS & Aix-Marseille Université, Marseille, France

Synchronized Bursting from Combined Inhibitory and Electrical Coupling in a Neuronal Model

Reimbay Reimbayev, Kevin Daley, and Igor Belykh, Georgia State University, USA

continued on next page

Wednesday, May 24

PP2

Poster Session and Dessert Reception

8:30 PM-10:30 PM

continued

Computing Electron Transport Rates Via Classical Periodic Orbits

Sulimon Sattari, University of California, Merced, USA

Droplet Motion for the Stochastic Cahn-Hilliard Equation

Alexander Schindler, Universität Augsburg, Germany; Dirk Blömker, Universitaet Augsburg, Germany

Model of Dendronotus Iris Swim Cpg Circuit

Andrey Shilnikov, Deniz Alacam, and *Jack Scully*, Georgia State University, USA

Validated Computations for Heteroclinic Orbits Between Hyperbolic Equilibria for ODEs

Ray Sheombarsing, VU University, Amsterdam, Netherlands

The Effect of Latent Confounding Processes on the Estimation of the Strength of Casual Influences in Chain-Type Networks

Helen Shiells, Marco Thiel, Claude Wischik, and Björn Schelter, University of Aberdeen, United Kingdom

Coherent Structures in Axially Symmetric Landau-Lifshitz-Gilbert-Slonczewski Equation

Lars Siemer and Jens Rademacher, University of Bremen, Germany; Christof Melcher, RTWH Aachen, Germany

System Parameter Variations from Attractor Deformation

Andrew R. Sloboda and Trung Tran, Bucknell University, USA

Bounds for Generalised Lyapunov Exponents for Random Products of Shears

Rob Sturman, University of Leeds, United Kingdom; Jean-Luc Thiffeault, University of Wisconsin, Madison, USA

continued in next column

Mean Field Reduction for Expanding Maps Coupled on Heterogeneous Networks

Matteo Tanzi, Imperial College London, United Kingdom

Bifurcation of Coherent Structures in Nonlocally Coupled System

Tianyu Tao, University of Minnesota, USA; Arnd Scheel, University of Minnesota, Minneapolis, USA

A New Partitioned Method for Viscous Fsi

David Wells, Rensselaer Polytechnic Institute, USA

Connecting Vegetation Models with Data: the Role of Topography, on Multiple Scales, for Water Harvesting in Channeled Vegetation Patterns

Lucien D. Werner, Northwestern University, USA; Punit Gandhi, Ohio State University, USA; Karna V. Gowda, Northwestern University, USA; Sarah Iams, Harvard University, USA; Mary Silber, University of Chicago, USA

Goal-Oriented Network Design for Pairwise Comparison Ranking

Shandeepa D. Wickramasinghe, Christino Tamon, and Jie Sun, Clarkson University, USA

Spectra and Turing Instabilities for Reaction Diffusion Systems with Anomalous Diffusion

Jichen Yang and Jens Rademacher, University of Bremen, Germany

Political Elections and Third Parties: A Mathematical Model and Empirical Evidence

Vicky Chuqiao Yang and Daniel M. Abrams, Northwestern University, USA; Georgia Kernell, University of California, Los Angeles, USA; Adilson E. Motter, Northwestern University, USA

Dynamics of a Class I Calcium Model

Xueshan Yang, University of Auckland, New Zealand; Vivien Kirk, University of Auckland, New Zealand; James Sneyd, University of Auckland, New Zealand

Stability Properties of Flying Snakes During Transient Glides

Isaac Yeaton, Gary K. Nave, John Socha, and Shane D. Ross, Virginia Tech, USA

continued in next column

Pattern Formation in Marsh Ecosystems Modeled Through the Interaction of Marsh Vegetation, Mussels and Sediment

Sofya Zaytseva, The College of William & Mary, USA; Leah Shaw and Junping Shi, College of William & Mary, USA; Rom Lipcius, Virginia Institute of Marine Science, USA

A Parameter Estimation Method Using Linear Response Statistics

He Zhang, John Harlim, and Xiantao Li, Pennsylvania State University, USA

Geometry of Transition Dynamics for a Buckled Beam

Jun Zhong, Virginia Tech, USA; L. N. Virgin, Duke University, USA; Shane D. Ross, Virginia Tech, USA

Thursday, May 25

Registration

8:00 AM-4:00 PM

Room:Ballroom Foyer

Thursday, May 25

MS141

Recent Developments in Objective Coherent Structure Detection - Part II of II

8:30 AM-10:00 AM

Room:Ballroom 1

For Part 1 see MS128

Coherent structures play a significant role in the transport and mixing of passive and active scalars in fluids. Such structures arise at spatial scales ranging from the geophysical to the nanofluidic. Their self-consistent detection requires objective mathematical approaches, i.e., independent of an assumed observer. This two-part minisymposium brings together theoreticians, computational experts and experimentalists to survey the current state of the art and challenges in objective coherent structure analysis and its applications. Part I reviews recent developments in coherent structure theory and numerical detection methods, while Part II focuses on applied and experimental aspects in real-world flow problems.

Organizer: Daniel Karrasch
Technische Universität München, Germany

Organizer: George Haller
ETH Zürich, Switzerland

8:30-8:55 Application of Dynamical Systems Approach to Lagrangian Separation in Laminar and Turbulent Flows

Seán Crouzat and Jérôme Vétel, Polytechnique Montreal, Canada

9:00-9:25 Objective Detection of Kinematic and Magnetic Vortices in Astrophysical Plasmas

Erico L. Rempel, ITA - Technological Institute of Aeronautics, Brazil; A*braham C. Chian*, University of Adelaide, Australia; Francisco J. Beron-Vera, University of Miami, USA; Sandor Szanyi and George Haller, ETH Zürich, Switzerland; Tiago F. P. Gomes, National Institute for Space Research, Brazil; Suzana S. A. Silva, ITA - Technological Institute of Aeronautics, Brazil

9:30-9:55 Ephemeral Transport Boundaries in Geophysical Fluid Flows

Denny Kirwan, Henry Chang, and Helga S. Huntley, University of Delaware, USA

Thursday, May 25

MS142

Symmetry, Asymmetry, and Network Synchronization

8:30 AM-10:30 AM

Room:Ballroom 2

The recent discovery of new patterns of network synchronization has shed new light on the role of symmetry resulting from the interplay between the dynamical units, the interactions, the initial conditions, and possible coupling with external factors. In particular, symmetry, asymmetry, symmetry breaking, and the converse of symmetry breaking have been shown to underlie various forms of synchronization dynamics in networks. This minisymposium brings together contributions at the forefront of these developments, including the topics of asymmetry-induced synchronization, partial synchrony, east-west jet-lag asymmetry, and chimera-like states.

Organizer: Adilson E. Motter
Northwestern University, USA

Organizer: Takashi Nishikawa
Northwestern University, USA

8:30-8:55 Symmetric States Requiring System Asymmetry

Takashi Nishikawa and Adilson E. Motter, Northwestern University, USA

9:00-9:25 Two Types of Quasiperiodic Partial Synchrony: What Happens When Symmetric States Become Unstable

Michael Rosenblum, University of Potsdam, Germany

9:30-9:55 Resynchronization of Circadian Oscillators and the East-West Asymmetry of Jet-Lag

Zhixin Lu, University of Maryland, USA; Kevin Klein-Cardena, DePaul University, USA; Steven Lee, City University of New York, Brooklyn, USA; Thomas Antonsen Jr., *Michelle Girvan,* and Edward Ott, University of Maryland, USA

10:00-10:25 Chimera and Chimera-Like States in Populations of Nonlocally Coupled Homogeneous and Heterogeneous Chemical Oscillators

Kenneth Showalter, West Virginia University, USA

Thursday, May 25

MS143

Simple Systems with Complex Dynamics - Part II of II

8:30 AM-10:30 AM

Room:Ballroom 3

For Part 1 see MS130

Lab experiments can often be very costly as they may require expensive equipment. However, research in dynamical systems can still be done using simple table top experiments at low cost. Many of these systems may seem extremely simple and mundane in set up, yet they can be very rich in their dynamics. In this minisymposium, we present four table top experiments involving mechanical, chemical and electrical oscillators and show how they can produce complex phenomena such as synchronization, period doubling bifurcation and chaos. We also demonstrate how these systems can be studied mathematically and numerically.

Organizer: Andrea J. Welsh

Georgia Institute of Technology, USA

Organizer: Mary Elizabeth Lee

Georgia Institute of Technology, USA

8:30-8:55 Coherent Structures in the Motion of Reaction Fronts and Swimming Organisms in Laminar Flows

Thomas H. Solomon, Minh Doan, Katie Lilienthal, JJ Simons, Payton Johnsom, and Joan Gannon, Bucknell University, USA

9:00-9:25 Jamming in Granular Systems of Regular Polygons

Cacey Stevens Bester and Yiqiu Zhao, Duke University, USA; Jonathan Bares, University of Montpellier, France; Robert Behringer, Duke University, USA

9:30-9:55 Noise, Chaos and Random Numbers

Kevin Fei, Harvard University, USA; Joseph Hart, University of Maryland, USA; Thomas E. Murphy and *Rajarshi Roy,* University of Maryland, College Park, USA

10:00-10:25 Dynamical Transitions Between a Limit Cycle and a Fix Point in a Saline Oscillator

Flavio H. Fenton, Georgia Institute of Technology, USA; Hortencia Gonzales and Humberto Arce, Universidad Nacional Autónoma de México, Mexico

Thursday, May 25

MS144

Quantitative Models of Neural Dynamics - Challenges and Limitations

8:30 AM-10:30 AM

Room:Primrose A

This minisymposium is concerned with development and analysis of quantitative models of neural dynamics. Neural dynamics can be modeled on different levels, from membrane potential dynamics in detailed single-cell models, to discrete networks of individual neurons, to spatially extended neural field models giving a coarse-grained description of activity in neural tissue. In many cases, simulations of these models quantitatively reproduce experimental data and allow for formulation of experimentally falsifiable predictions. On the other hand, complexity of the quantitative models can limit the applicability of theoretical and numerical tools for analysing dynamical systems. The talks will showcase different modelling approaches, parameter identification methods and data assimilation techniques that can be used to reproduce experimentally observed phenomena and make predictions. More generally, the minisymposium will illustrate how modern dynamical systems theory fits in the framework of quantitative modelling of neural systems.

Organizer: Piotr Slowinski

University of Exeter, United Kingdom

Organizer: James Rankin

New York University, USA

8:30-8:55 Large-Scale Connectome-Based Brain Networks Models of Seizure Spread

Viktor Jirsa, Aix-Marseille Université, France

continued in next column

9:00-9:25 Finite Size Effects and Rare Events in Balanced Cortical Networks

Jeffrey Dunworth and Bard Ermentrout, University of Pittsburgh, USA; Michael Graupner, Université Paris Descartes, France; Alex Reyes, New York University, USA; Brent Doiron, University of Pittsburgh, USA

9:30-9:55 A Path-Integral Approach to Data Assimilation for Mapping Small Neuronal Networks

Eve Armstrong, University of California, San Diego, USA

10:00-10:25 Clustered Desynchronization of Neural Oscillators

Jeff Moehlis and Timothy Matchen, University of California, Santa Barbara, USA

Thursday, May 25

MS145

Pattern Formation in Reaction-diffusion Systems with Heterogenous Parameters

8:30 AM-10:30 AM

Room:Primrose B

There is a large body of work on pattern formation in RD systems, spanning several decades. It is natural to ask what happens when parameters are either spatially or time-dependent. Most of the problems in nature have some variance or impurities in parameters over the domain, and this can have a significant effect on pattern formation. For example, the classical problem of zone of fishing exclusion near the coast corresponds to taking a piecewise-constant harvest rate. Other applications include vegetation patterns with variable precipitation rates, pattern development on growing domains, cell differentation, and patterns on surfaces, which depend on thickness and curvature of the surface. Recent advances have shown that incorporating heterogenuity can lead to a completely new phenomena as well as new and interesting mathematics. This minisymposium will showcase recent developments in this direction, connecting diverse groups that study these phenomena from various points of view (spectral methods, geometric singular perturbation, asymptotic theory, mean-field analysis...). The goal is to identify future challenges and new directions. Some potential subtopics include: Spatial impurities and their effect on pattern formation; Spike concentrations with precursor gradients or variable feed-rate; Effect of slowly-varying parameters on pattern formation; Applications to ecology and biology.

Organizer: Theodore Kolokolnikov

Dalhousie University, Canada

continued in next column

Organizer: Arjen Doelman

Leiden University, Netherlands

8:30-8:55 Amoeboid Locomotion in Heterogenous Media

Kei-Ichi Ueda, University of Toyama, Japan; Itsuki Kunita, Kumamoto University, Japan; Shigeru Kuroda, Dai Akita, and Toshiyuki Nakagaki, Hokkaido University, Japan

9:00-9:25 The Stability and Slow Dynamics of Localized Spot Patterns for the 3-D Schnakenberg Reaction-Diffusion Model

Justin C. Tzou, University of British Columbia, Canada

9:30-9:55 Wavenumber Selection Via Spatial Parameter Step

Jasper Weinburd, University of Minnesota, Twin Cities, USA; Arnd Scheel, University of Minnesota, Minneapolis, USA

10:00-10:25 Title Not Available At Time Of Publication

Shuangquan Xie, Dalhousie University, Canada

Thursday, May 25

MS146

Large Scale Dynamics in Coupled Systems on Networks - Part II of II

8:30 AM-10:30 AM

Room:Maybird

For Part 1 see MS133

Many natural and man-made networks in physical and life sciences feature extraordinary richness and complexity of interconnections. Understanding collective dynamics of such networks poses new challenges for nonlinear science and calls for new approaches incorporating combinatorial and probabilistic methods into dynamical analysis of complex systems. The talks of this minisymposium address large time behavior, pattern formation, and bifurcations in coupled networks with an emphasis on the link between the network structure and its dynamics.

Organizer: Georgi S. Medvedev

Drexel University, USA

Organizer: Hayato Chiba

Kyushu University, Japan

8:30-8:55 Molecular Mechanisms Underlying the Kuramoto Model of Coupled Oscillators

Jae Kyoung Kim, Korea Advanced Institute of Science and Technology, Korea; Zachary P. Kilpatrick, University of Colorado Boulder, USA; Matthew Bennett, Rice University, USA; Kresimir Josic, University of Houston, USA

9:00-9:25 Turing Patterns in Reaction-diffusion Systems on Random Networks

Hiroya Nakao, Tokyo Institute of Technology, Japan

9:30-9:55 Approximating Consensus with Graph Limits

Barton Lee, University of New South Wales, Australia

10:00-10:25 Dynamics of Large Networks of FitzHugh-Nagumo Neuronal Models with Heterogeneous Inputs

Elizabeth Davison, Biswadip Dey, Zahra Aminzare, and Naomi E. Leonard, Princeton University, USA

Thursday, May 25

MS147

Dynamics in Microbiology

8:30 AM-10:30 AM

Room:Magpie B

The field of microbiology is rapidly growing and evolving in response to introduction of powerful, novel technologies of various sorts (e.g., the 'omics revolution) and the consequent data that they are generating. In response, it is increasingly clear that there is an important role for mathematics at many levels, but notably including through analysis of dynamics at scales from the cellular to the community. This minisymposium is intended to present a sample of such studies.

Organizer: Isaac Klapper

Temple University, USA

8:30-8:55 Dynamics of Cell Signaling Within a Biofilm

Jack D. Dockery, Montana State University, USA

9:00-9:25 Metabolic Processes As Dynamical Systems. A Hotbed of Nonlinear Phenomena?

Doraiswami Ramkrishna, Purdue University, USA

9:30-9:55 Exclusion and Clock Behavior in An Oscillating Chemostat

Isaac Klapper, Temple University, USA

10:00-10:25 Separating Putative Pathogens from Background Contamination with Principal Orthogonal Decomposition: Evidence for Leptospira in the Ugandan Neonatal Septisome

Steven J. Schiff, Pennsylvania State University, USA

Thursday, May 25

MS148

Causation Inference and Information Flow in Dynamical Systems: Theory and Applications - Part II of II

8:30 AM-10:30 AM

Room:Wasatch B

For Part 1 see MS135

A basic question in science is to infer amongst causal interactions. In terms of dynamical systems, one may ask amongst coupled dynamic variables, which may influence each other, and furthermore, directly so. Information theoretic descriptions of chaotic dynamical systems have underpinnings in symbolic dynamics, whereas the Shannon information underpins general concepts of entropy and data. Analogous to Granger causality for linear systems, transfer entropy has become a highly popular way to consider questions of pairwise information flow between nonlinear dynamical systems. In a basic sense the measurement describes how observations of various factors of an underlying system effect predictability of other factor. However, transfer entropy can not properly represent secondary versus primary influences when used in large scaled coupled systems leading to causation entropy as a specifically conditioned transfer entropy. In this session, applications of information flow in social and also animal interaction systems will be discussed. However, there are important limitations and caveats that must be understood so as to not over interpret what can understood in using transfer entropy like quantities, such as resolution and Markov order and also questions of when pairwise interactions can completely capture all influences, versus inherently multi- element interactions.

Organizer: Erik Bollt

Clarkson University, USA

Organizer: Shawn D. Pethel

US Army RDECOM, USA

8:30-8:55 Causation Entropy and Pure Inference of Boolean Factors

Jie Sun and Erik Bollt, Clarkson University, USA

9:00-9:25 Significance Testing of Information Theoretic Quantities

Shawn D. Pethel, US Army RDECOM, USA; Daniel Hahs, Torch Technologies, USA

9:30-9:55 Multivariate Dependence Beyond Shannon Information

Ryan G. James, University of California, Davis, USA

10:00-10:25 Prediction vs Generation in Simple Markov Chains

John R. Mahoney, University of California, Davis, USA; Josh Ruebeck, Carleton College, USA; Ryan G. James, University of California, Davis, USA

continued in next column

Thursday, May 25

MS149

Delay and Stability of Complex Network Dynamics

8:30 AM-10:30 AM

Room:Superior B

Time delay plays an important role in many coupled dynamical processes including electrical circuits, lasers, animal interactions, and other types of complex excitable systems, spanning interdisciplinary fields such as biology, neuroscience, engineering, chemistry, etc. Understanding the effects of time delay on the dynamic patterns, and on the control and stability of complex networks has become an exciting topic that has attracted attention from many researchers in the nonlinear dynamics community. In this minisymposium, we will bring together four experts in the field of time delay and nonlinear network dynamics to discuss their recent contributions to this active area of research. These presentations will cover a diverse set of problems, including the mathematical analysis of the effects of coupling delay on oscillation and amplitude death islands, intricate interplay between communication delay and time-dependent network structure, delay and control of biological networks, and emerging patterns of delay-excitable systems.

Organizer: Stanley R. Huddy
Clarkson University, USA

Organizer: Joseph Skufca
Clarkson University, USA

continued in next column

8:30-8:55 Master Stability Islands for Amplitude Death in Networks of Delay-Coupled Oscillators
Stanley R. Huddy and Jie Sun, Clarkson University, USA

9:00-9:25 Dynamic Networks and Delay: Communication Delay on Time Varying Networks
Joseph Skufca, Clarkson University, USA

9:30-9:55 Controlling Nonlinear Biological Systems Based on Network Structures
Atsushi Mochizuki, RIKEN, Japan

10:00-10:25 Patterns in Circular Networks of Excitable Systems with Time Delay
Serhiy Yanchuk, Technical University Berlin, Germany; Leonhard Lücken, German Aerospace Center (DLR), Germany; David P. Rosin and Vasco Worlitzer, Technische Universitaet Berlin, Germany

Thursday, May 25

MS150

Existence, Stability, and Dynamics of Patterns on Multi-dimensional Domains - Part II of II

8:30 AM-10:30 AM

Room:Superior A

For Part 1 see MS137

The study of patterns which are inherently multi-dimensional has diverse applications in areas such as ecology, fluid dynamics, polymer physics, chemical deposition, and optics. We wish to bring together researchers working in different settings and who use different technical approaches to surmount the numerous difficulties which arise when studying such patterns. We wish to highlight advances which tackle these difficulties using classical and infinite-dimensional dynamical systems techniques (for instance, exponential dichotomies, the Maslov index, and the Evans function, and their multi—spatial-dimension extensions), as well as approaches which bypass them through the use of functional analysis, modulational/asymptotic analysis, and variational tools. While the dynamical systems viewpoint in general provides a relatively thorough understanding of the phenomena, these latter techniques offer novel alternatives and allow for the study of new areas. We also hope that by bringing together theoretical, numerical, and modeling perspectives, new connections can be made, possibly fostering future collaborations.

Organizer: Ryan Goh
Boston University, USA

Organizer: Qiliang Wu
Michigan State University, USA

continued on next page

Thursday, May 25

MS150

Existence, Stability, and Dynamics of Patterns on Multi-dimensional Domains - Part II of II

8:30 AM-10:30 AM

continued

8:30-8:55 Interfacial Dynamics in Biological Systems
Scott McCalla, Montana State University, USA; James von Brecht, California State University, Long Beach, USA

9:00-9:25 The Soft Mode Plays A Role In Defect Persistence In Pattern-Forming Systems
Patrick Shipman, Colorado State University, USA

9:30-9:55 Stripe Formation on Zebrafish Fins
Alexandria Volkening and Bjorn Sandstede, Brown University, USA

10:00-10:25 Spots and Stripes: Vegetation Patterns in Drylands
Eric Siero, Leiden University, Netherlands

Thursday, May 25

MS151

Coarse Graining and Dimensionality Reduction for Stochastic Dynamical Systems - Part II of II

8:30 AM-10:30 AM

Room:Wasatch A

For Part 1 see MS138

In numerous application areas, e.g. molecular dynamics or geophysical fluid dynamics, one encounters stochastic systems whose complexity renders an efficient numerical analysis virtually impossible. It is then the goal of coarse graining methods to replace the full description of the system by a reduced representation that retains the properties of interest. This minisymposium features novel approaches for the systematic derivation of coarse grained models, their numerical realization with a focus on data-driven methods, and their validation based on both mathematical insight as well as real-life experiments. We have tried to keep a balance between younger and more established speakers, thus the minisymposium would be an excellent vehicle for bringing both new faces and new ideas to SIAM DS.

Organizer: Stefan Klus
Freie Universität Berlin, Germany

Organizer: Andreas Bittracher
Freie Universitaet Berlin, Germany

Organizer: Carsten Hartmann
Brandenburgische Technische Universität Cottbus, Germany

8:30-8:55 The Cgdna Coarse Grain Model of the Sequence-Dependent Statistical Mechanics of DNA
John H. Maddocks, École Polytechnique Fédérale de Lausanne, Switzerland

9:00-9:25 The Coarse Graining of Neural Field Models
Yao Li, University of Massachusetts, Amherst, USA

9:30-9:55 Effective Variables and Interaction Potentials for Coarse Graining of Macromolecular Systems
Cecilia Clementi, Rice University, USA

10:00-10:25 Transfer Operator Approximation Using Low-Rank Tensor Decompositions
Stefan Klus, Freie Universität Berlin, Germany

Thursday, May 25

MS152

Data Driven Biomedical Dynamics, Modeling and Data Assimilation

8:30 AM-10:30 AM

Room:Magpie A

We will discuss novel computational methods and newly available biomedical data to develop biological models, reconstruct and forecast biological systems, and observe new biological dynamics in different contexts. Our minisymposium has three goals driven by uniting dynamical systems with data, to push forward mechanistic, high-fidelity biological modeling, understand the data collection properties that can help make model development and forecasting more accurate, and to detail the mathematical machinery that can help achieve a deeper understanding of biology and physiology. We bring together diverse people whose foci range from data assimilation, to time series analysis, to dynamical systems, to large-scale data. The opics we address include: glucose-insulin model mechanism development and refinement using data assimilation and sparse, self-collected physiologic data; a new framework for online data assimilation-based state forecasting using competing offline Bayesian and Optimization parameter estimation methods in the context of glucose physiology; methods for understanding health and treatment dynamics applied to new, world-spanning big health data sets; and a new statistical framework to go from single or multi-unit recordings to data assimilation in mean-field models. The talks focus integrating a diverse set of tools such as Bayesian inverse methods, optimization, data assimilation, spectral analysis and mechanistic biological modeling.

Organizer: David J. Albers
Columbia University, USA

continued on next page

Thursday, May 25

MS152

Data Driven Biomedical Dynamics, Modeling and Data Assimilation

8:30 AM-10:30 AM

continued

8:30-8:55 Physiologic Model Development Using Data Assimilation and Self-Monitoring Data
David J. Albers, Columbia University, USA

9:00-9:25 Competitive Offline Parameter Estimation for Online Data Assimilation in Glucose Dynamics
Matthew Levine and David J. Albers, Columbia University, USA; Andrew Stuart, California Institute of Technology, USA; George Hripcsak, Columbia University, USA

9:30-9:55 Dynamics and Big Biomedical Data Sets
George Hripcsak, Columbia University, USA

10:00-10:25 Statistical Framework for Data Assimilation from Single & Multi-Unit Recording to Mean Field Network Models
Bruce Gluckman, Pennsylvania State University, USA

Thursday, May 25

MS153

Variational Principles in Mechanics

8:30 AM-10:30 AM

Room:White Pine

As one of the techniques of global analysis, variational principles are known to be of fundamental importance in mechanics and physics. This minisymposium will discuss some of the contemporary trends in variational principles. The lectures will focus on the variational methods associated with fluid dynamics, fluid-structure interaction, and variational integrators for both finite- and infinite- dimensional mechanical systems.

Organizer: Dmitry Zenkov
North Carolina State University, USA

8:30-8:55 Variational Discretization for Fluid-structure Interactions
Vakhtang Putkaradze, University of Alberta, Canada

9:00-9:25 A Variational Lagrangian Formulation for Nonequilibrium Thermodynamics
Francois Gay-Balmaz, Ecole Normale Superieure, France

9:30-9:55 Interpolation on Symmetric Spaces via the Generalized Polar Decomposition
Melvin Leok, University of California, San Diego, USA

10:00-10:25 Explicit High-Order Symplectic Integration of Arbitrary Hamiltonians
Molei Tao, Georgia Institute of Technology, USA

Coffee Break

10:30 AM-11:00 AM

Room:Golden Cliff

Thursday, May 25

IP6

Stochastic Arnold Diffusion of Deterministic Systems

11:00 AM-11:45 AM

Room:Ballroom

Chair: Evelyn Sander, George Mason University, USA

In 1964, V. Arnold constructed an example of a nearly integrable deterministicsystem exhibiting instabilities. In the 1970s, physicist B. Chirikov coined the term for this phenomenon “Arnold diffusion”, where diffusion refers to stochastic nature of instability. One of the most famous examples of stochastic instabilities for nearly integrable systems is dynamics of Asteroids in Kirkwood gaps in the Asteroid belt. They were discovered numerically by astronomer J. Wisdom. During the talk we describe a class of nearly integrable deterministic systems, where we prove stochastic diffusive behavior. Namely, we show that distributions given by deterministic evolution of certain random initial conditions weakly converge to a diffusion process. This result is conceptually different from known mathematical results, where existence of “diffusing orbits” is shown. This work is based on joint papers with O. Castejon, M. Guardia, J. Zhang, and K. Zhang.

Vadim Kaloshin
University of Maryland, USA

Lunch Break

11:45 AM-1:15 PM

Attendees on their own

Thursday, May 25

MS154

Recent Advances in the Stability of Travelling Waves - Part I of II

1:15 PM-3:15 PM

Room:Ballroom 1

For Part 2 see MS167

Nonlinear interactions in a wide variety of models can result in the propagation of fronts, pulses, wavetrains and other more complicated patterns. The speakers in this minisymposium will highlight new advances in the study of stability and dynamical properties of travelling waves in nonlinear partial differential equations.

Organizer: Robert Marangell

The University of Sydney, Australia

Organizer: Peter van Heijster

Queensland University of Technology, Australia

Organizer: Matt Holzer

George Mason University, USA

1:15-1:40 Stability of Nozaki-Bekki Holes Near the Nonlinear Schrödinger Limit

Margaret Beck, Boston University, USA; Toan Nguyen, Pennsylvania State University, USA; *Bjorn Sandstede,* Brown University, USA; Kevin Zumbrun, Indiana University, USA

1:45-2:10 Modulational Stability of Quasiperiodic Solutions to Hamiltonian PDEs

Jared Bronski, University of Illinois at Urbana-Champaign, USA

2:15-2:40 Computation and Stability of Patterns in Second Order Evolution Equations

Wolf-Juergen Beyn, Universität Bielefeld, Germany; Denny Otten, Bielefeld University, Germany; *Jens Rottmann-Matthes,* Karlsruhe Institute of Technology, Germany

2:45-3:10 Application of the Maslov Index to the Stability of Traveling Waves

Paul Cornwell, Brown University and University of North Carolina, Chapel Hill, USA; Chris Jones, University of North Carolina, Chapel Hill, USA

Thursday, May 25

MS155

Advances in Network Synchronization - Part I of II

1:15 PM-3:15 PM

Room:Ballroom 2

For Part 2 see MS168

Synchronization of network-coupled dynamical systems has become a bedrock area of research in both the nonlinear dynamics and complex networks communities, with applications ranging from improving signaling between reproductive cycles of cells to stabilizing the dynamics of large-scale power grids. In this minisymposium we will bring together experts in the field to report on the recent advances in the theoretical aspects of network synchronization, as well as discuss the practical applications of this new theory in real-world scenarios. The mini symposium will be organized into two parts, roughly corresponding to (i) synchronization in network of heterogeneous phase oscillators and (ii) synchronization in networks of identical chaotic oscillators. Specific topics will include analytical methods and low-dimensional descriptions of the dynamics of coupled oscillator networks, classification of chimera states, identification of synchronization clusters using network symmetries, and control and optimization of coupled oscillator networks.

Organizer: Per Sebastian Skardal

Trinity College, USA

Organizer: Jie Sun

Clarkson University, USA

Organizer: Dane Taylor

University of North Carolina at Chapel Hill, USA

continued in next column

1:15-1:40 Optimal Synchronization of Complex Networks

Dane Taylor, University of North Carolina at Chapel Hill, USA; Per Sebastian Skardal, Trinity College, USA; Jie Sun, Clarkson University, USA

1:45-2:10 Synchronization in Lattices of Interacting Quantum Dipoles

Juan G. Restrepo, University of Colorado Boulder, USA

2:15-2:40 Unexpected Patterns: Chimera States on Networks

Daniel M. Abrams, Northwestern University, USA

2:45-3:10 Control and Optimization of Phase and Chaotic Oscillator Networks

Per Sebastian Skardal, Trinity College, USA

Thursday, May 25

MS156

Applications of Koopman Operator Theory in Dynamical Systems: from Traffic through Power Grid to Molecular Dynamics - Part I of II

1:15 PM-3:15 PM

Room:Ballroom 3

For Part 2 see MS169

The Koopman operator approach to dynamical systems has been applied to fluid mechanics and enjoyed success due to its model-reduction capability that captured complex coherent dynamics better than previous techniques. The approach is experiencing a high degree of co-development between theorems, numerical approaches (algorithms) and applications in physics, biology and engineering. In fact, very interesting questions are arising for researchers on theory and algorithms side from practical applications in diverse domains. The initial applications relied on the assumption that observables are in the span of eigenfunctions. However, Koopman operator can have continuous spectrum and that is important in applications like turbulence, power grid, and traffic described in talks by Duraisamy and Glaz (turbulence), Susuki and Chakraborty (power grid), and Avilla (traffic), respectively. Dynamical systems in molecular dynamics contain stochastic effects, described in talk by Noe and physiology applications contain stochastic inputs and delays, as evidenced in talk by Macesic. Kutz describes applications in which the underlying dynamical system is a partial differential equation, and the underlying Koopman operator theory is in its infancy. Thus, the two-part minisymposium will contribute to the overall goal of advancing the Koopman operator approach by fostering interaction between theory, numerical algorithms and applications.

continued in next column

Organizer: Igor Mezic
University of California, Santa Barbara, USA

Organizer: Steven Brunton
University of Washington, USA

1:15-1:40 Koopman Theory, Observables and Sparse Regression for PDE's

Nathan Kutz, University of Washington, USA

1:45-2:10 Analysis of Freeway Traffic Using Koopman Operator Methods

Allan Avila, University of California, Santa Barbara, USA

2:15-2:40 Koopman Operators for Reduced Order Modeling of Nonlinear Dynamical Systems

Karthik Duraisamy, University of Michigan, USA

2:45-3:10 Baroreflex Physiology Using Koopman Mode Analysis

Senka Macesic, University of Rijeka, Croatia; Igor Mezic, University of California, Santa Barbara, USA; Maria Fonoberova, AIMdyn, Inc., USA; Nelida Crnjaric-Zic, Rijeka University, Croatia; Zlatko Drmac, University of Zagreb, Croatia; Aleksandr Andrejcuk, University of Rijeka, Croatia

Thursday, May 25

MS157

Neuronal Modulation, Robustness and Homeostasis - Part I of II

1:15 PM-3:15 PM

Room:Primrose A

For Part 2 see MS170

Rhythmic and excitable neuronal behaviors underlie many brain functions and are modulated continually, across disparate scales ranging from receptors and channels to entire networks, in response to environmental and intrinsic conditions. In parallel, homeostatic mechanisms act to preserve features of neuronal activity needed for functionality. Understanding the mechanisms of neuronal modulation and robustness is a key frontier in neuroscience to which recent developments in dynamical systems are well suited to contribute. This minisymposium will address modeling and mathematical analyses relevant to modulation and robustness of neuronal activity and homeostasis. It will span a wide range of topics, from interdisciplinary contributions highlighting present experimental challenges to formal mathematical methods relating to dynamics and parameter-dependence of multiscale nonlinear systems.

Organizer: Alessio Franci
Universidad Nacional de Mexico, Mexico

Organizer: Jonathan E. Rubin
University of Pittsburgh, USA

1:15-1:40 Feedback, Singularities and Singular Perturbations in Robust Neuromodulation

Alessio Franci, Universidad Nacional de Mexico, Mexico; Guillaume Drion, University of Liege, Belgium; Rodolphe Sepulchre, University of Cambridge, United Kingdom

continued on next page

Thursday, May 25

MS157

Neuronal Modulation, Robustness and Homeostasis - Part I of II

1:15 PM-3:15 PM

continued

1:45-2:10 Folded Saddle Nodes: Understanding Transitions Between Activity Patterns in a Coupled Neuron Model

Kerry-Lyn Roberts, University of Sydney, Australia

2:15-2:40 Dual-Mechanism Firing Rate Homeostasis Stabilizes Multiple Firing Rate Statistics

Jonathan Cannon, Brandeis University, USA

2:45-3:10 Model Formulation and Experimental Challenges in Underactuated Neurocontrol

Jason Ritt, Massachusetts Institute of Technology, USA; Anirban Nandi, Washington University, USA; ShiNung Ching, Washington University in St. Louis, USA

Thursday, May 25

MS158

Stochastic Processes in Heterogeneous Environments - Part I of II

1:15 PM-3:15 PM

Room:Primrose B

For Part 2 see MS171

The MS will address the random transport mechanisms used by biological, social and physical systems to effectively communicate and function. Specifically, how individual particles or agents navigate complex spatial regions, with heterogeneous distributions of obstacles and barriers, and reliably locate target sites. The speakers will address 3 main areas: 1. The role of geometry and target site heterogeneity in dictating the timescale of critical biological events, such as immune system recognition. This is a multiscale spatiotemporal PDE problem. Several speakers will address progress from applying singular perturbation methodologies to obtain reduced discrete energy systems in which heterogeneities can be considered as point singularities. 2. Discrete optimization and boundary homogenization. Several speakers will consider the global optimization problem of finding extremal configurations of target site distributions from reduced discrete energy formulations. Results on the homogenization of these discrete energies in the limit of large number of sources will be discussed. 3. Computational simulation of nanoscale heterogeneities and determination of emergent macroscale properties is challenging and presents difficulties for common discretization methods. Boundary element approaches have recently shown great promise in addressing these problems and several speakers will present recent developments in this direction.

Organizer: Alan E. Lindsay
University of Notre Dame, USA

Organizer: Justin C. Tzou
University of British Columbia, Canada

continued in next column

1:15-1:40 Local and Global Optimization of Particle Locations on the Sphere: Models, Applications, Mathematical Aspects, and Computations

Alexei F. Cheviakov, University of Saskatchewan, Canada

1:45-2:10 Numerical Computation of Locally and Globally Energy-Minimizing Spherical Designs

Wesley J. Ridgway, University of Saskatchewan, Canada

2:15-2:40 Mean First Passage Time with Space-dependent Diffusion

Theodore Kolokolnikov, Dalhousie University, Canada

2:45-3:10 Boundary Homogenization of a Spherical Target and Berg-Purcell Revisited

Alan E. Lindsay, University of Notre Dame, USA; Michael Ward, University of British Columbia, Canada; Andrew J. Bernoff, Harvey Mudd College, USA

Thursday, May 25

MS159

Nonlinear Time Series Data Analysis - Part I of II

1:15 PM-3:15 PM

Room:Maybird

For Part 2 see MS172

An observable time-ordered data series encapsulates information about the underlying system from which it is generated. Nonlinear time series data analysis is concerned with techniques that allows one to understand the dynamics of the underlying system from this information. These techniques are carefully crafted to deal with nonlinear behavior. In recent years, this area has experienced a tremendous development, leading to powerful methods that can be successfully used in all branches of science and engineering. However, there are important issues that still are not adequate addressed, requiring a more intensive research effort. Among them are the handling of time series of short length, a proper treatment for nonstationarity, and the determination of causality relationships from a set of time series. This minisymposium brings together researchers to present recent progress and developments, as well as to focus on the perspectives of how to handle the ongoing challenges of the area.

Organizer: Elbert E. Macau

Laboratory for Computing and Applied Mathematics and Brazilian Institute for Space Research, Brazil

Organizer: Michael Small

University of Western Australia, Australia

1:15-1:40 From Symbolic Dynamics to Ordinal Partition Networks: Constructing Proxies of the Dynamical System from Observed Time Series

Michael Small, Michael McCullough, Konstantinos Sakellariou, Thomas Stemler, and David Walker, University of Western Australia, Australia

1:45-2:10 Nonlinear Stochastic Models for Irregular Time Series: Empirical Model Reduction and Multilayer Stochastic Models

Michael Ghil, Ecole Normale Superieure de Paris, France, and University of California, Los Angeles, USA; Mickael Chekroun, Dmitri Kondrashov, and Andreas Groth, University of California, Los Angeles, USA

2:15-2:40 Representing Time Series with Uncertainties and Identification of Abrupt Transitions

Bedartha Goswami, Potsdam Institute for Climate Impact Research and Free University of Berlin, Germany; Aljoscha Rheinwalt, University of Potsdam, Germany; Niklas Boers, Ecole Normale Supérieure, France; Norbert Marwan, Potsdam Institute for Climate Impact Research, Germany; Jobst Heitzig, Potsdam University, Germany; Sebastian Breitenbach, Ruhr-Universitat Bochum, Germany; Juergen Kurths, Potsdam Institute for Climate Impact Research, Germany

2:45-3:10 Determining the Kolmogorov-Sinai Entropy from Ordinal Patterns

Antonio Politi, University of Aberdeen, United Kingdom

continued in next column

Thursday, May 25

MS160

Mathematical Physiology and Medicine - Part I of II

1:15 PM-3:15 PM

Room:Magpie B

For Part 2 see MS173

Nonlinear dynamical system theory lies in the core of computational or mathematical physiology research. In recent years, there has been a growing interest in applying dynamical system to the field of mathematical physiology and medicine. In this session, we will focus on projects that apply mathematical modeling to attain a better understanding of physiological mechanisms; in some cases, that understanding is then leveraged to determine the best therapeutic approach to combat a given disease. This session will bring together applied mathematician, computational scientists, mathematical modelers and engineers to focus on the modeling and computations of the dynamics of complex biological systems across different scales. At the cellular scale, speakers will discuss modeling results concerning the interactions between cell signaling and cell mechanism, and modeling cancer cell networks. At the organ scale, speakers will highlight recent advances in modeling physiological conditions (including the immune system, blood clotting, and renal blood flow) and in modeling pathophysiological conditions (including peripheral arterial disease, tuberculosis, and drug delivery).

Organizer: Ning Wei

Duke University, USA

Organizer: Anita T. Layton

Duke University, USA

continued on next page

Thursday, May 25

MS160

Mathematical Physiology and Medicine - Part I of II

1:15 PM-3:15 PM

continued

1:15-1:40 Assessing the Contribution of Distinct Vascular Segments in Peripheral Arterial Disease

Julia Arciero, Indiana University - Purdue University Indianapolis, USA

1:45-2:10 Modeling, Analysis, and Experiment Design for Syk-Mediated Signalling Events in B Cells

Reginald Mcgee, The Ohio State University, USA; *Gregery Buzzard*, Purdue University, USA

2:15-2:40 Dynamic Modeling of Tuberculosis Granuloma Activation

Steven Ruggiero, Minu Pilvankar, and *Ashlee N. Ford Versypt*, Oklahoma State University, USA

2:45-3:10 Multi-scale Model of Breast Cancer Predicts Response to Anti-angiogenic Therapies

Stacey Finley, University of Southern California, USA

Thursday, May 25

MS161

Random Walks and Anomalous Transport - Part I of II

1:15 PM-3:15 PM

Room:Wasatch B

For Part 2 see MS174

A significant progress in understanding the phenomenon of anomalous transport has been achieved on the background of random walk models. The goal of the minisymposium is to present recent advances in this field. The talks include the description of models based on different kinds of random walks, including the continuous time random walk, walks in an expanding medium, and Levy walks. The applications spread from anomalous diffusion in biological cells and cellular flows to subdiffusion-reaction processes and laser cooling.

Organizer: Alexander Nepomnyashchy

Technion Israel Institute of Technology, Israel

Organizer: Vladimir A. Volpert

Northwestern University, USA

1:15-1:40 Subdiffusion with Reactions and Forces

Christopher N. Angstmann and *Bruce I. Henry*, University of New South Wales, Australia

1:45-2:10 Diffusion and Walks in an Expanding Medium

Santos B. Yuste and Enrique Abad, Universidad de Extremadura, Spain; Carlos Escudero, Universidad Autonoma de Madrid, Spain; Felipe Le Vot, Universidad de Extremadura, Spain

2:15-2:40 Levy Walks: from Lineland to Higher Dimensions

Vasily Zaburdaev, Max Planck Institute for Physics of Complex Systems, Germany

2:45-3:10 Slow Subdiffusion-Reaction Equation

Tadeusz Kosztolowicz, Jan Kochanowski University, Poland

Thursday, May 25

MS162

Distributed Sensing and Prediction of Dynamic and Uncertain Environments - Part I of II

1:15 PM-3:15 PM

Room:Superior B

For Part 2 see MS175

Improved modeling and prediction of fluid dynamics is needed to better understand ocean and atmospheric transport. Major recent advances in coherent structure detection, reduced-order models, uncertainty quantification, data assimilation, optimal path planning, and adaptive sampling are providing increased understanding of transport phenomena.The purpose of this minisymposium is to expose the audience to recent progress and developments, as well as to bring together researchers developing new mathematical methods and applications for use in understanding material transport in geophysical flows.

Organizer: Eric Forgoston

Montclair State University, USA

Organizer: Ani Hsieh

Drexel University, USA

1:15-1:40 Quantifying Material Transport in Geophysical Flows

Eric Forgoston, Montclair State University, USA; Ani Hsieh, Drexel University, USA; Philip Yecko, Cooper Union, USA

1:45-2:10 Stochastic Parametrization in Wave Breaking and Weathering Processes

Juan M. Restrepo, Oregon State University, USA; Jorge Ramirez, Universidad Nacional de Colombia, Colombia

2:15-2:40 A Stratified Three Dimensional Model for Ocean Flows That Includes Internal Waves

Henry Chang, Helga S. Huntley, and Denny Kirwan, University of Delaware, USA

2:45-3:10 Geophysical Transport Structure, Reduced Order Modeling, and Connections with Field Experiments

Shane D. Ross, Virginia Tech, USA

Thursday, May 25

MS163

Computational Models of Neuronal Connectivity in the Brain - Part I of II

1:15 PM-3:15 PM

Room:Superior A

For Part 2 see MS176

The structural and functional connectivity of neurons in the brain play an important role in a variety of cognitive processes, but the relationship between this organization and such cognitive processes is still not yet well known. Several approaches can be taken to investigate and better understand how connectivity and network structure relate to neuronal activity. One such approach is to develop a realistic neuronal network model including several types of chemical and electrical coupling and use the model to determine the effect of connectivity on network dynamics. Another approach is to use reconstruction methods on experimental data to extract potential structural connectivity and their functional roles. This two-part minisymposium will include talks that address both of these approaches for understanding network connectivity in several areas of the brain.

Organizer: Pamela B. Pyzza
Ohio Wesleyan University, USA

Organizer: Jennifer Crodelle
Rensselaer Polytechnic Institute, USA

1:15-1:40 Individual and Population Models of Insect Olfaction

Pamela B. Pyzza, Ohio Wesleyan University, USA; Gregor Kovacic, Rensselaer Polytechnic Institute, USA; David Cai, Shanghai Jiao Tong University, China and Courant Institute of Mathematical Sciences, New York University, USA

1:45-2:10 High Dimensional Two-sample Test on Neuronal Data

Zhiqin J. Xu, New York University, USA

2:15-2:40 Dynamics Underlying the Orientation Selectivity in Mouse V1

Wei Dai, Shanghai Jiaotong University, China

2:45-3:10 Oscillations in a Parkinsonian Network

Michael Caiola, Emory University, USA

Thursday, May 25

MS164

Control of Cardiac Arrhythmias - Part I of II

1:15 PM-3:15 PM

Room:Wasatch A

For Part 2 see MS177

Cardiac arrhythmias are abnormal heart rhythms underlying complex spatiotemporal electromechanical activity. Spiral and scroll waves are nonlinear patterns known to exist in excitable and oscillatory media such as cardiac tissue. Those patterns act as fast cardiac activation sources that are detrimental to health and some that can lead to death. The control of these rapid and complex nonlinear activities to revert to normal heart electrical activation is thus of primary importance. Different suboptimal approaches are used in clinics that are ranging from pharmacological treatment to defibrillation. All of these approaches are with severe limitations and further development are needed to increase their success rates. This minisymposium provides a sampling of the current work in the control of arrhythmias based on new mathematical modeling and experimental research.

Organizer: Philippe Comtois
Université de Montréal, Canada

Organizer: Stefan Luther
Max Planck Institute for Dynamics and Self-Organization, Germany

1:15-1:40 Alternans in Action Potential Amplitude and Not in Duration As a Mechanism for Conduction Block and the Initiation of Fibrillation

Diandian Diana Chen and Flavio H. Fenton, Georgia Institute of Technology, USA

1:45-2:10 Closed-Loop Feedback Control of Cardiac Alternans in the Heart

Alena Talkachova and Kanchan Kulcarni, University of Minnesota, USA; Sharon Zlochiver, Tel Aviv University, Israel

2:15-2:40 Modeling Framework to Delineate Optimized Drug Action for Atrial Spiral Wave Termination

Philippe Comtois, Université de Montréal, Canada

2:45-3:10 Adaptive Control of Chaotic Dynamics in Excitable Media

Thomas Lilienkamp, Stefan Luther, and Ulrich Parlitz, Max Planck Institute for Dynamics and Self-Organization, Germany

continued in next column

Thursday, May 25

MS165

Connecting Dynamic Models to Data: Estimation, Uncertainty, Related Statistical Methods - Part I of II

1:15 PM-3:15 PM

Room:Magpie A

For Part 2 see MS178

The need to model biological data is fueling the development of powerful new mathematical and statistical tools and techniques for using dynamic models as statistical models. This minisymposium will highlight recent methodological advances from the interface of mathematics, statistics, and the natural sciences. These advances include: identifiability and uncertainty analysis, functional data analysis, and extensions of traditional statistical frameworks (e.g. mixed effects models) for dynamic models. Talks will also examine how uncertainty can affect model predictions, dynamics, and inference of key quantities (e.g. important mechanisms or fundamental quantities like the basic reproduction number for a disease).

Organizer: Ariel Cintron-Arias
East Tennessee State University, USA

Organizer: Marisa Eisenberg
University of Michigan, USA

Organizer: Paul J. Hurtado
University of Nevada, Reno, USA

1:15-1:40 Identifiability and Parameter Estimation in Modeling Biological Dynamics
Marisa Eisenberg, University of Michigan, USA

1:45-2:10 Goodness of Fit in Differential Equation Models: Misspecified Rates Or Misspecified States?
Giles Hooker, Cornell University, USA

2:15-2:40 Structural and Practical Identifiability of Stochastic, Mechanistic Cancer Models
Andrew Brouwer, University of Michigan, USA

2:45-3:10 Identifiability of Linear Compartmental Models
Nicolette Meshkat, North Carolina State University, USA

Thursday, May 25

MS166

Algebraic and Topological Approaches to the N-Body and N-Vortex Problems - Part I of II

1:15 PM-3:15 PM

Room:White Pine

For Part 2 see MS179

This minisymposium will explore current research in celestial mechanics and the N-vortex problem with a particular focus on algebraic and topological methods. While the study of the N-body problem has resulted in significant applications to astronomy and spacecraft navigation, it has also been a fruitful setting for the development of new ideas in dynamical systems. The related N-vortex problem is a widely used model for providing finite-dimensional approximations to vorticity evolution in fluid dynamics. Some of the most important solutions to either problem are periodic in nature. Among this class of solutions, analyzing the structure and stability of simple, rigidly rotating orbits known as relative equilibria (or central configurations) leads to a greater understanding of the complexities in the full problem. Recently, ideas from computational algebraic geometry (e.g., Groebner bases and BKK Theory), as well as topology (e.g., the Morse index), have been successfully applied to the study of relative equilibria, helping answer questions on the finiteness, existence, and stability of these special solutions. Topological arguments have also been used to prove the existence of other types of periodic orbits, such as solutions with simultaneous binary collisions. Many of these ideas generalize to other mechanical systems with power-law potential functions. This session brings together new and established researchers to discuss these and other related topics.

Organizer: Gareth E. Roberts
College of the Holy Cross, USA

continued in next column

1:15-1:40 Morse Theory and Stability of Relative Equilibria in the Planar N-Vortex Problem
Gareth E. Roberts, College of the Holy Cross, USA

1:45-2:10 Existence, Stability, and Symmetry of Relative Equilibria with a Dominant Vortex
Alanna Hoyer-Leitzel, Mount Holyoke College, USA

2:15-2:40 Remarks on the Central Configurations of Four Bodies
Manuele Santoprete, Wilfrid Laurier University, Canada

2:45-3:10 Central Configurations of the N-Body Problem with Generalized Potentials
Marshall Hampton, University of Minnesota, Duluth, USA

Coffee Break

3:15 PM-3:45 PM

Room:Golden Cliff

Thursday, May 25

MS167

Recent Advances in the Stability of Travelling Waves - Part II of II

3:45 PM-5:45 PM

Room:Ballroom 1

For Part 1 see MS154

Nonlinear interactions in a wide variety of models can result in the propagation of fronts, pulses, wavetrains and other more complicated patterns. The speakers in this minisymposium will highlight new advances in the study of stability and dynamical properties of travelling waves in nonlinear partial differential equations.

Organizer: Robert Marangell

The University of Sydney, Australia

Organizer: Peter van Heijster

Queensland University of Technology, Australia

Organizer: Matt Holzer

George Mason University, USA

3:45-4:10 Coherent Structures in Run-and-Tumble Processes

Arnd Scheel, University of Minnesota, Minneapolis, USA

4:15-4:40 Stability of Fronts in a Diffusive Model for Porous Media Combustion

Anna Ghazaryan, Miami University, USA; Stephane Lafortune, College of Charleston, USA; Peter McLarnan, Miami University, USA

4:45-5:10 Determining the Critical Spectrum About the Origin Using Lin's Method

Björn De Rijk, Universität Stuttgart, Germany

5:15-5:40 Absolute Instabilities of Travelling Waves Solutions in a Keller-Segel Model

Paige Davis, Queensland University of Technology, Australia

Thursday, May 25

MS168

Advances in Network Synchronization - Part II of II

3:45 PM-5:45 PM

Room:Ballroom 2

For Part 1 see MS155

Synchronization of network-coupled dynamical systems has become a bedrock area of research in both the nonlinear dynamics and complex networks communities, with applications ranging from improving signaling between reproductive cycles of cells to stabilizing the dynamics of large-scale power grids. In this minisymposium we will bring together experts in the field to report on the recent advances in the theoretical aspects of network synchronization, as well as discuss the practical applications of this new theory in real-world scenarios. The minisymposium will be organized into two parts, roughly corresponding to (i) synchronization in network of heterogeneous phase oscillators and (ii) synchronization in networks of identical chaotic oscillators. Specific topics will include analytical methods and low-dimensional descriptions of the dynamics of coupled oscillator networks, classification of chimera states, identification of synchronization clusters using network symmetries, and control and optimization of coupled oscillator networks.

Organizer: Per Sebastian Skardal

Trinity College, USA

Organizer: Jie Sun

Clarkson University, USA

Organizer: Dane Taylor

University of North Carolina at Chapel Hill, USA

continued in next column

3:45-4:10 Using Symmetries and Equitable Partitions Together to Find All Synchronization Clusters and Their Stability

Louis M. Pecora, Naval Research Laboratory, USA; Francesco Sorrentino, University of New Mexico, USA; Aaron M. Hagerstrom, University of Maryland, USA; Rajarshi Roy and Thomas E. Murphy, University of Maryland, College Park, USA

4:15-4:40 Controlling Synchronous Patterns in Complex Network of Coupled Chaotic Oscillators

Xingang Wang, National University of Singapore, Singapore

4:45-5:10 Synchronization in Networks with Multiple Interaction Layers

Jesus Gomez-Gardenes, Universidad de Zaragoza, Spain; Charo I. del Genio, University of Warwick, United Kingdom; Stefano Boccaletti, CNR, Italy; Ivan Bonamssa, Bar-Ilan University, Israel

5:15-5:40 Chimera States in Continuous Media

Zachary G. Nicolaou, Hermann Riecke, and Adilson E. Motter, Northwestern University, USA

Thursday, May 25

MS169

Applications of Koopman Operator Theory in Dynamical Systems: from Traffic through Power Grid to Molecular Dynamics - Part II of II

3:45 PM-5:45 PM

Room:Ballroom 3

For Part 1 see MS156

The Koopman operator approach to dynamical systems has been applied to fluid mechanics and enjoyed success due to its model-reduction capability that captured complex coherent dynamics better than previous techniques. The approach is experiencing a high degree of co-development between theorems, numerical approaches (algorithms) and applications in physics, biology and engineering. In fact, very interesting questions are arising for researchers on theory and algorithms side from practical applications in diverse domains. The initial applications relied on the assumption that observables are in the span of eigenfunctions. However, Koopman operator can have continuous spectrum and that is important in applications like turbulence, power grid, and traffic described in talks by Duraisamy and Glaz (turbulence), Susuki and Chakraborty (power grid), and Avilla (traffic), respectively. Dynamical systems in molecular dynamics contain stochastic effects, described in talk by Noe and physiology applications contain stochastic inputs and delays, as evidenced in talk by Macesic. Kutz describes applications in which the underlying dynamical system is a partial differential equation, and the underlying Koopman operator theory is in its infancy. Thus, the two-part minisymposium will contribute to the overall goal of advancing the Koopman operator approach by fostering interaction between theory, numerical algorithms and applications.

continued in next column

Organizer: Igor Mezic
University of California, Santa Barbara, USA

Organizer: Steven Brunton
University of Washington, USA

3:45-4:10 Assessment of Voltage Collapse Phenomena in Power Grids Based on Continuous Spectrum of the Koopman Operator

Yoshihiko Susuki, Osaka Prefecture University, Japan; Kyoichi Sako and Fredrik Raak, Kyoto University, Japan; Takashi Hikihara, Kyoto University, Japan

4:15-4:40 Koopman Operator Theory, Memory Effects, and Fractional Order Dynamical Systems

Adam Svenkeson and Bryan Glaz, Army Research Laboratory, USA

4:45-5:10 A Data-Driven Distributed Algorithm for Nonlinear Mode Estimation in Power Systems

Aranya Chakrabortty, North Carolina State University, USA; Yoshihiko Susuki, Osaka Prefecture University, Japan

5:15-5:40 Finding Slow Modes and Accessing Very Long Timescales in Molecular Dynamics

Frank Noe, Freie Universität Berlin, Germany

Thursday, May 25

MS170

Neuronal Modulation, Robustness and Homeostasis - Part II of II

3:45 PM-5:45 PM

Room:Primrose A

For Part 1 see MS157

Rhythmic and excitable neuronal behaviors underlie many brain functions and are modulated continually, across disparate scales ranging from receptors and channels to entire networks, in response to environmental and intrinsic conditions. In parallel, homeostatic mechanisms act to preserve features of neuronal activity needed for functionality. Understanding the mechanisms of neuronal modulation and robustness is a key frontier in neuroscience to which recent developments in dynamical systems are well suited to contribute. This minisymposium will address modeling and mathematical analyses relevant to modulation and robustness of neuronal activity and homeostasis. It will span a wide range of topics, from interdisciplinary contributions highlighting present experimental challenges to formal mathematical methods relating to dynamics and parameter-dependence of multiscale nonlinear systems.

Organizer: Alessio Franci
Universidad Nacional de Mexico, Mexico

Organizer: Jonathan E. Rubin
University of Pittsburgh, USA

3:45-4:10 Chaos, Spike-Adding, and Mixed-Mode Oscillations in a Nonlinear Neuronal Model with Resets

Jonathan E. Rubin, University of Pittsburgh, USA; Justyna Signerska-Rynkowska, Gdansk University of Technology, Poland; Jonathan D. Touboul, Collège de France, France; Alexandre Vidal, University of Evry-Val-d'Essonne, France

continued on next page

Thursday, May 25

MS170

Neuronal Modulation, Robustness and Homeostasis - Part II of II

3:45 PM-5:45 PM

continued

4:15-4:40 A Singulartity Theory Approach to Homeostasis

Martin Golubitsky, The Ohio State University, USA; Ian Stewart, University of Warwick, United Kingdom

4:45-5:10 Phase-Locking in a Neuronal Networks with Synaptic Depression

Zeynep Akcay, Queensborough Community College, USA; Xinxian Huang, Farzan Nadim, and *Amitabha Bose,* New Jersey Institute of Technology, USA

5:15-5:40 Temperature Sensitivity of PO/AH Neurons

Martin Wechselberger, University of Sydney, Australia; Timothy Roberts, University of Sydney, Australia

Thursday, May 25

MS171

Stochastic Processes in Heterogeneous Environments - Part II of II

3:45 PM-5:45 PM

Room:Primrose B

For Part 1 see MS158

The MS will address the random transport mechanisms used by biological, social and physical systems to effectively communicate and function. Specifically, how individual particles or agents navigate complex spatial regions, with heterogeneous distributions of obstacles and barriers, and reliably locate target sites. The speakers will address 3 main areas: 1. The role of geometry and target site heterogeneity in dictating the timescale of critical biological events, such as immune system recognition. This is a multiscale spatiotemporal PDE problem. Several speakers will address progress from applying singular perturbation methodologies to obtain reduced discrete energy systems in which heterogeneities can be considered as point singularities. 2. Discrete optimization and boundary homogenization. Several speakers will consider the global optimization problem of finding extremal configurations of target site distributions from reduced discrete energy formulations. Results on the homogenization of these discrete energies in the limit of large number of sources will be discussed. 3. Computational simulation of nanoscale heterogeneities and determination of emergent macroscale properties is challenging and presents difficulties for common discretization methods. Boundary element approaches have recently shown great promise in addressing these problems and several speakers will present recent developments in this direction.

continued in next column

Organizer: Alan E. Lindsay
University of Notre Dame, USA

Organizer: Justin C. Tzou
University of British Columbia, Canada

3:45-4:10 Kinetic Monte Carlo Methods for Computing First Capture Time Distributions in Models of Diffusive Absorption

Daniel Schmidt and Andrew J. Bernoff, Harvey Mudd College, USA; Alan E. Lindsay, University of Notre Dame, USA

4:15-4:40 Effects of Cell Geometry on Reversible Vesicular Transport

Bhargav R. Karamched, University of Utah, USA

4:45-5:10 First-Passage Time to Clear the Way for Receptor-Ligand Binding in a Crowded Environment

Jay Newby, University of North Carolina at Chapel Hill, USA

5:15-5:40 Metastable States for an Aggregation Model with Noise

Joep Evers and Theodore Kolokolnikov, Dalhousie University, Canada

Thursday, May 25

MS172

Nonlinear Time Series Data Analysis - Part II of II

3:45 PM-5:15 PM

Room:Maybird

For Part 1 see MS159

An observable time-ordered data series encapsulates information about the underlying system from which it is generated. Nonlinear time series data analysis is concerned with techniques that allows one to understand the dynamics of the underlying system from this information. These techniques are carefully crafted to deal with nonlinear behavior. In recent years, this area has experienced a tremendous development, leading to powerful methods that can be successfully used in all branches of science and engineering. However, there are important issues that still are not adequate addressed, requiring a more intensive research effort. Among them are the handling of time series of short length, a proper treatment for nonstationarity, and the determination of causality relationships from a set of time series. This minisymposium brings together researchers to present recent progress and developments, as well as to focus on the perspectives of how to handle the ongoing challenges of the area.

Organizer: Elbert E. Macau

Laboratory for Computing and Applied Mathematics and Brazilian Institute for Space Research, Brazil

Organizer: Michael Small

University of Western Australia, Australia

3:45-4:10 Recurrency Density Enchanced Approach for Time Series Analysis

Elbert E. Macau, Laboratory for Computing and Applied Mathematics and Brazilian Institute for Space Research, Brazil

4:15-4:40 Using Recurrences to Detect Non Stationary Behavior of Time Series

Sergio R. Lopes, Federal University of Paraná, Brazil

4:45-5:10 Network Inference Meets Nonlinear Time Series: Challenges and Solutions

Bjoern Schelter and Marco Thiel, University of Aberdeen, United Kingdom

Thursday, May 25

MS173

Mathematical Physiology and Medicine - Part II of II

3:45 PM-5:45 PM

Room:Magpie B

For Part 1 see MS160

Nonlinear dynamical system theory lies in the core of computational or mathematical physiology research. In recent years, there has been a growing interest in applying dynamical system to the field of mathematical physiology and medicine. In this session, we will focus on projects that apply mathematical modeling to attain a better understanding of physiological mechanisms; in some cases, that understanding is then leveraged to determine the best therapeutic approach to combat a given disease. This session will bring together applied mathematician, computational scientists, mathematical modelers and engineers to focus on the modeling and computations of the dynamics of complex biological systems across different scales. At the cellular scale, speakers will discuss modeling results concerning the interactions between cell signaling and cell mechanism, and modeling cancer cell networks. At the organ scale, speakers will highlight recent advances in modeling physiological conditions (including the immune system, blood clotting, and renal blood flow) and in modeling pathophysiological conditions (including peripheral arterial disease, tuberculosis, and drug delivery).

Organizer: Ning Wei

Duke University, USA

Organizer: Anita T. Layton

Duke University, USA

continued in next column

3:45-4:10 A Computational Model of Hemostasis

Nicholas Danes and Karin Leiderman, Colorado School of Mines, USA

4:15-4:40 Drug Delivery to the Brain: Mathematical Challenges in Breaking the Blood-Brain Barrier

Ami Radunskaya, Pomona College, USA

4:45-5:10 Bifurcation Analysis of Calcium Oscillations in the Afferent Arteriole Model of Smooth Muscle Cells

Ning Wei and Anita T. Layton, Duke University, USA

5:15-5:40 Modelling the Interplay Between Cell Signalling and Cell Mechanics

Cole Zmurchok, University of British Columbia, Canada

Thursday, May 25

MS174

Random Walks and Anomalous Transport - Part II of II

3:45 PM-5:15 PM

Room:Wasatch B

For Part 1 see MS161

A significant progress in understanding the phenomenon of anomalous transport has been achieved on the background of random walk models. The goal of the minisymposium is to present recent advances in this field. The talks include the description of models based on different kinds of random walks, including the continuous time random walk, walks in an expanding medium, and Levy walks. The applications spread from anomalous diffusion in biological cells and cellular flows to subdiffusion-reaction processes and laser cooling.

Organizer: Alexander Nepomnyashchy

Technion Israel Institute of Technology, Israel

Organizer: Vladimir A. Volpert

Northwestern University, USA

3:45-4:10 Anomalous Diffusion in Membranes and Cytoplasm of Biological Cells

Ralf Metzler, Universität Potsdam, Germany

4:15-4:40 A Fractional Kinetic Process Describing the Intermediate Time Behaviour of Cellular Flows

Martin Hairer, University of Warwick, United Kingdom; Gautam Iyer, Carnegie Mellon University, USA; Leonid Koralov, Princeton University, USA; *Alexei Novikov*, Pennsylvania State University, USA; Zsolt Pajor-Gyulai, New York University, USA

4:45-5:10 Anomalous Dispersion of Particles in Steady Two-dimensional Flows

Michael Zaks, Humboldt State University, Germany; Alexander Nepomnyashchy, Technion Israel Institute of Technology, Israel

Thursday, May 25

MS175

Distributed Sensing and Prediction of Dynamic and Uncertain Environments - Part II of II

3:45 PM-5:45 PM

Room:Superior B

For Part 1 see MS162

Improved modeling and prediction of fluid dynamics is needed to better understand ocean and atmospheric transport. Major recent advances in coherent structure detection, reduced-order models, uncertainty quantification, data assimilation, optimal path planning, and adaptive sampling are providing increased understanding of transport phenomena.The purpose of this minisymposium is to expose the audience to recent progress and developments, as well as to bring together researchers developing new mathematical methods and applications for use in understanding material transport in geophysical flows.

Organizer: Eric Forgoston

Montclair State University, USA

Organizer: Ani Hsieh

Drexel University, USA

3:45-4:10 Optimizing Vehicle Autonomy in Geophysical Flows

Ani Hsieh, Drexel University, USA; *Shibabrat Naik*, Virginia Tech, USA; Dhanushka Kularatne, Drexel University, USA; Subhrajit Bhattacharya, Lehigh University, USA; Eric Forgoston, Montclair State University, USA

4:15-4:40 Active Matter in Time-Periodic Flows: Swimming with Gradients

Paulo E. Arratia, University of Pennsylvania, USA

4:45-5:10 Adaptive Learning and Prediction of Motion of Controlled Lagrangian Particles

Fumin Zhang and Sungjin Cho, Georgia Institute of Technology, USA

5:15-5:40 Lagrangian Stochastic Prediction and Data Assimilation

Pierre F. Lermusiaux, *Chinmay S. Kulkarni*, Florian Feppon, and Arkopal Dutt, Massachusetts Institute of Technology, USA

Thursday, May 25

MS176

Computational Models of Neuronal Connectivity in the Brain - Part II of II

3:45 PM-5:45 PM

Room:Superior A

For Part 1 see MS163

The structural and functional connectivity of neurons in the brain play an important role in a variety of cognitive processes, but the relationship between this organization and such cognitive processes is still not yet well known. Several approaches can be taken to investigate and better understand how connectivity and network structure relate to neuronal activity. One such approach is to develop a realistic neuronal network model including several types of chemical and electrical coupling and use the model to determine the effect of connectivity on network dynamics. Another approach is to use reconstruction methods on experimental data to extract potential structural connectivity and their functional roles. This two-part minisymposium will include talks that address both of these approaches for understanding network connectivity in several areas of the brain.

Organizer: Pamela B. Pyzza

Ohio Wesleyan University, USA

Organizer: Jennifer Crodelle

Rensselaer Polytechnic Institute, USA

3:45-4:10 Mathematical Model of a Network Containing Electrotonic Junctions Between Excitatory Neurons in the Adult Cortex

Jennifer Crodelle and Gregor Kovacic, Rensselaer Polytechnic Institute, USA; David Cai, Courant Institute of Mathematical Sciences, New York University, USA

continued on next page

Thursday, May 25

MS176

Computational Models of Neuronal Connectivity in the Brain - Part II of II

3:45 PM-5:45 PM

continued

4:15-4:40 Emergence of a Balanced Core Through Dynamical Computation in Inhomogeneous Neuronal Networks

Qinglong Gu, Shanghai Jiaotong University, China

4:45-5:10 Spike Triggered Regression on Neuronal Network Reconstruction

Yaoyu Zhang, Courant Institute New York University, USA and New York University Abu Dhabi, United Arab Emirates

5:15-5:40 Neuronal Network Reconstruction by Transfer Entropy

Zhongqi Tian, Shanghai Jiao Tong University, China

Thursday, May 25

MS177

Control of Cardiac Arrhythmias - Part II of II

3:45 PM-5:45 PM

Room:Wasatch A

For Part 1 see MS164

Cardiac arrhythmias are abnormal heart rhythms underlying complex spatiotemporal electromechanical activity. Spiral and scroll waves are nonlinear patterns known to exist in excitable and oscillatory media such as cardiac tissue. Those patterns act as fast cardiac activation sources that are detrimental to health and some that can lead to death. The control of these rapid and complex nonlinear activities to revert to normal heart electrical activation is thus of primary importance. Different suboptimal approaches are used in clinics that are ranging from pharmacological treatment to defibrillation. All of these approaches are with severe limitations and further development are needed to increase their success rates. This minisymposium provides a sampling of the current work in the control of arrhythmias based on new mathematical modeling and experimental research.

Organizer: Philippe Comtois

Université de Montréal, Canada

Organizer: Stefan Luther

Max Planck Institute for Dynamics and Self-Organization, Germany

3:45-4:10 New Insights into the Termination of Unpinned Spiral Waves Using Low-Energy Electric Field Pulses

Niels Otani, Rochester Institute of Technology, USA; Valentin Krinski, Max Planck Institute for Dynamics and Self-Organization, Germany; Shuyue Han and Kayleigh Wheeler, Rochester Institute of Technology, USA; Stefan Luther, Max Planck Institute for Dynamics and Self-Organization, Germany

4:15-4:40 Wave Control by Cooperative Excitation of Cardiac Tissue

Thomas Niedermayer and Pavel Buran, Physikalisch-Technische Bundesanstalt, Germany; Sergio Alonso, UPC, Spain; Markus Baer, Physikalisch-Technische Bundesanstalt, Germany

4:45-5:10 Controlling the Dynamics of Cardiac Tissue During Ventricular Fibrillation

Henrik tom Woerden, Max Planck Institute for Dynamics and Self-Organization, Germany

5:15-5:40 Modeling and Estimation of Dynamical Variables in a Cardiac Cell Model

Laura Munoz, Claire Charron, and Kalyan Pusarla, Rochester Institute of Technology, USA

continued in next column

Thursday, May 25

MS178

Connecting Dynamic Models to Data: Estimation, Uncertainty, Related Statistical Methods - Part II of II

3:45 PM-5:45 PM

Room:Magpie A

For Part 1 see MS165

The need to model biological data is fueling the development of powerful new mathematical and statistical tools and techniques for using dynamic models as statistical models. This minisymposium will highlight recent methodological advances from the interface of mathematics, statistics, and the natural sciences. These advances include: identifiability and uncertainty analysis, functional data analysis, and extensions of traditional statistical frameworks (e.g. mixed effects models) for dynamic models. Talks will also examine how uncertainty can affect model predictions, dynamics, and inference of key quantities (e.g. important mechanisms or fundamental quantities like the basic reproduction number for a disease).

Organizer: Ariel Cintron-Arias
East Tennessee State University, USA

Organizer: Marisa Eisenberg
University of Michigan, USA

Organizer: Paul J. Hurtado
University of Nevada, Reno, USA

3:45-4:10 Modeling Differential Transmission Characteristics of Whitefly-Transmitted Cassava Viruses
Ariel Cintron-Arias, East Tennessee State University, USA

4:15-4:40 Using a Mathematical Model and Likelihood Methods to Assess Contagion in Mass Killings and School Shootings
Sherry Towers, Arizona State University, USA

4:45-5:10 Comparative Estimation of Parameters for Dengue and Chikungunya in Costa Rica from Weekly Reported Data
Fabio Sanchez, University of Costa Rica, Costa Rica

5:15-5:40 Extra High-Dimensional Linear ODE Model Selection and Parameter Estimation: A Matrix-Based Approach
Hulin Wu, University of Texas, Houston, USA

Thursday, May 25

MS179

Algebraic and Topological Approaches to the N-Body and N-Vortex Problems - Part II of II

3:45 PM-5:45 PM

Room:White Pine

For Part 1 see MS166

This minisymposium will explore current research in celestial mechanics and the N-vortex problem with a particular focus on algebraic and topological methods. While the study of the N-body problem has resulted in significant applications to astronomy and spacecraft navigation, it has also been a fruitful setting for the development of new ideas in dynamical systems. The related N-vortex problem is a widely used model for providing finite-dimensional approximations to vorticity evolution in fluid dynamics. Some of the most important solutions to either problem are periodic in nature. Among this class of solutions, analyzing the structure and stability of simple, rigidly rotating orbits known as relative equilibria (or central configurations) leads to a greater understanding of the complexities in the full problem. Recently, ideas from computational algebraic geometry (e.g., Groebner bases and BKK Theory), as well as topology (e.g., the Morse index), have been successfully applied to the study of relative equilibria, helping answer questions on the finiteness, existence, and stability of these special solutions. Topological arguments have also been used to prove the existence of other types of periodic orbits, such as solutions with simultaneous binary collisions. Many of these ideas generalize to other mechanical systems with power-law potential functions. This session brings together new and established researchers to discuss these and other related topics.

Organizer: Gareth E. Roberts
College of the Holy Cross, USA

continued in next column

3:45-4:10 High Energy Scattering: Orbit Structure
Richard Montgomery, University of California, Santa Cruz, USA

4:15-4:40 Remarks on the N-Body Dynamics on Surfaces of Revolution
Cristina Stoica, Wilfrid Laurier University, Canada

4:45-5:10 Towards a Restricted N-Body Stability Result
Skyler Simmons, Southern Utah University, USA

5:15-5:40 Topological Existence of Periodic Orbits in a Two-Center Symmetric Pair Problem
Lennard F. Bakker and Mitchell Sailsbery, Brigham Young University, USA

Intermission

5:45 PM-6:00 PM

Closing Remarks and Red Sock Award Announcements

6:00 PM-6:15 PM

Room:Ballroom

Thursday, May 25

IP7

Interactions, Deformations and Bifurcations of Singular Patterns

6:15 PM-7:00 PM

Room:Ballroom

Chair: Chris K.R.T. Jones, University of North Carolina, Chapel Hill, USA

Singular patterns appear in multiscale systems. These systems exhibit the rich behavior of general systems, their singular nature provides a structure by which this may be understood. Moreover, many natural phenomena are modeled by such systems. I will discuss the strong cross-fertilization between applications and the development of mathematical theory. Unravelling the nature of patterns exhibited by specific chemical or ecological models goes hand in hand with uncovering novel generic destabilization mechanisms as the 'Hopf dance'. Understanding realistic patterns requires analytical descriptions of deformations, bifurcations and annihilation of interacting localized structures -- from an ecological point of view preferably under varying (climatological) circumstances. Through this, mathematics may explain why desertification sometimes is a sudden catastrophic event, while it is a gradual process in other situations.

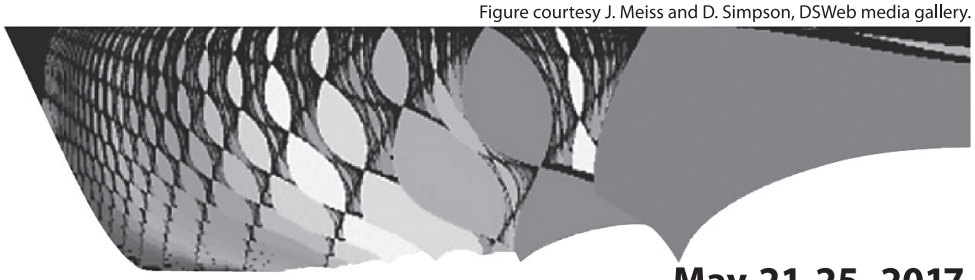
Arjen Doelman

Leiden University, Netherlands

DS17 Abstracts

2017 SIAM Conference on Applications of Dynamical Systems

Figure courtesy J. Meiss and D. Simpson, DSWeb media gallery.



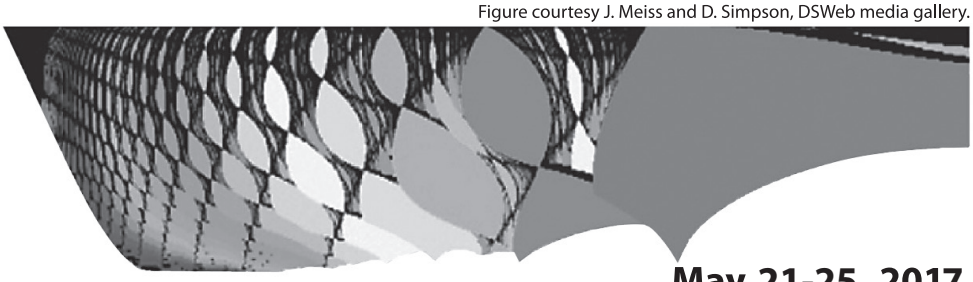
May 21-25, 2017
Snowbird Ski and Summer Resort
Snowbird, Utah, USA

Abstracts are printed as submitted by the authors.

Organizer and Speaker Index

2017 SIAM Conference on Applications of Dynamical Systems

Figure courtesy J. Meiss and D. Simpson, DSWeb media gallery.



May 21-25, 2017
Snowbird Ski and Summer Resort
Snowbird, Utah, USA

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

Notes

DS17 Budget

Conference Budget
SIAM Conference on Dynamical Systems
May 21-25, 2017
Snowbird, UT

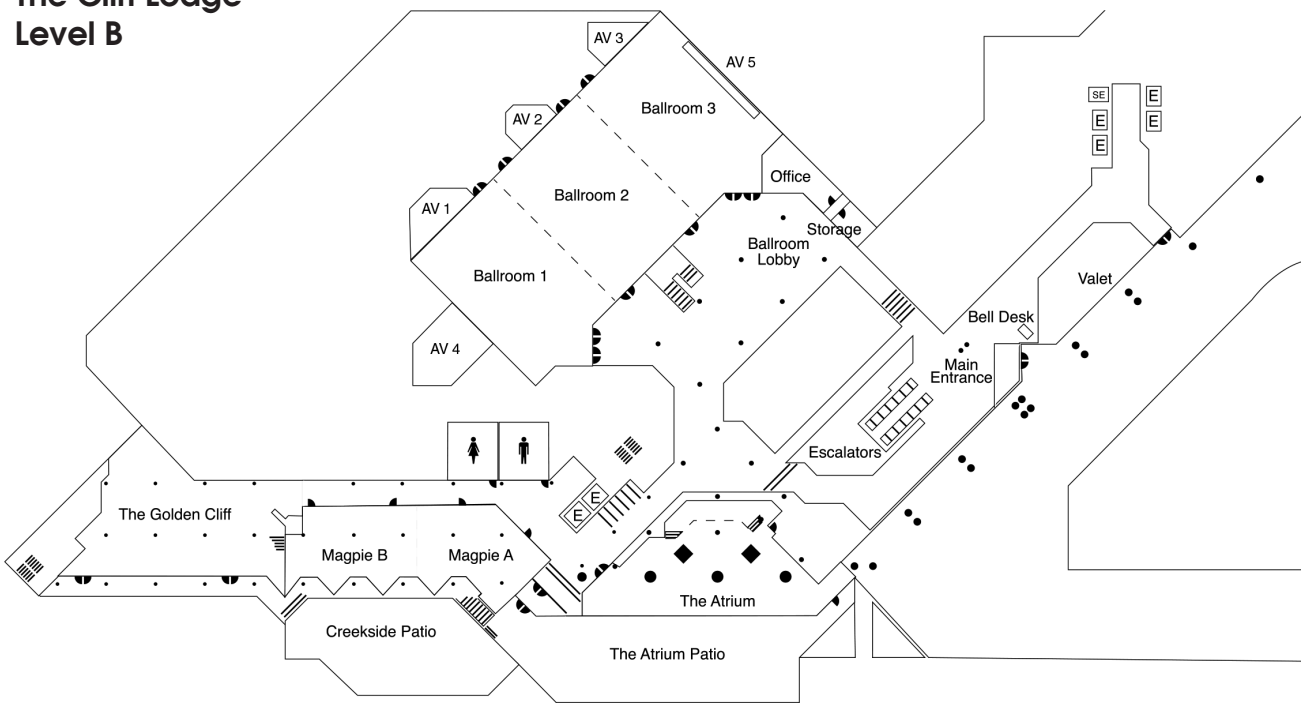
Expected Paid Attendance	780	
Revenue		
Registration Income		$226,080
	Total	$226,080
Expenses		
Printing		$6,900
Organizing Committee		$6,500
Invited Speakers		$21,100
Food and Beverage		$41,700
AV Equipment and Telecommunication		$27,600
Advertising		$8,300
Conference Labor (including benefits)		$53,775
Other (supplies, staff travel, freight, misc.)		$15,600
Administrative		$19,189
Accounting/Distribution & Shipping		$10,488
Information Systems		$19,284
Customer Service		$7,226
Marketing		$11,152
Office Space (Building)		$7,371
Other SIAM Services		$7,682
	Total	$263,867
Net Conference Expense		-$37,787
Support Provided by SIAM		$37,787
		$0

Estimated Support for Travel Awards not included above:

Early Career and Students	55	$41,250

Snowbird Ski and Summer Resort

The Cliff Lodge Level B



The Cliff Lodge Level C