## **Final Program and Abstracts**

# SIAM Conference on Applications of Dynamical Systems

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



Sponsored by the SIAM Activity Group on Dynamical Systems (SIAG/DS)

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, sponsors special sessions at SIAM meetings, organizes a biennial conference, and awards biennial prizes—the Jürgen Moser Lecture and the J. D. Crawford Prize. 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.



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## Organizing Committee Co-Chairs

Jonathan Dawes University of Bath, United Kingdom Vivien Kirk University of Auckland, New Zealand

## Organizing Committee

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Marcelo Viana IMPA, Brazil

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## **SIAM Registration Desk**

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

> Saturday, May 21 4:00 PM - 8:00 PM

> **Sunday, May 22** 7:15 AM - 5:30 PM

**Monday, May 23** 8:00 AM - 5:30 PM

**Tuesday, May 24** 8:00 AM - 5:30 PM

Wednesday, May 25 8:00 AM - 5:30 PM

**Thursday, May 26** 8:00 AM - 12:30 PM

## **Hotel Address**

Snowbird Ski and Summer Resort Snowbird, UT 84092-9000 Toll free reservations: 800-453-3000 (US and Canada) Fax: +1-801-947-8227 Direct telephone: +1-801-742-2222 http://www.snowbird.com

## Hotel Telephone Number

To reach an attendee or to leave a message, call +1-801-742-2222. The hotel operator can either connect you with the SIAM registration desk or to the attendee's room. Messages taken at the SIAM registration desk will be posted to the message board located in the registration area.

## Hotel Check-in and Check-out Times

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

## 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, please contact Camp Snowbird at +1-801-933-2256 for fee information and to determine space availability.

## 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.

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### Corporate/Institutional Affiliate

Palo Alto Research Center

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List current April 2011

## **Funding Agency**

SIAM and the Conference Organizing Committee wish to extend their thanks and appreciation to the U.S. National Science Foundation for its support of this conference.



## **Funding Agency Panel**

Tuesday, May 24 12:45 PM - 1:45 PM Ballroom

### **Co-Chairs**:

Steven Shaw Michigan State University, USA

Hans G. Kaper Argonne National Laboratory and Georgetown University, USA

### Panelists:

Jeff Rogers Defense Advanced Research Projects Agency, USA

Karin Remington National Institutes of Health, USA

Eduardo Misawa National Science Foundation, USA

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SIAM members save up to \$120 on full registration for the 2011 SIAM Conference on SIAM Conference on Applications of Dynamical Systems (DS11)! Join your peers in supporting the premier professional society for applied mathematicians and computational scientists. SIAM members receive subscriptions to *SIAM Review* and *SIAM News* 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 (\$120 for a *Non-Member* and \$60 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 \$10 to join the SIAM Activity Group on Dynamical Systems (SIAG/DS). As a SIAG/DS member, you are eligible for an additional \$10 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.

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

The plenary session room will have two overhead projectors, two screens, and one data projector. All other breakout rooms will have one screen and one data projector.

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

If you have questions regarding availability of equipment in the meeting room of your presentation, or to request an overhead projector for your session, please see a SIAM staff member at the registration desk.

## **E-mail Access**

E-mail stations will be available to attendees during registration hours. The Cliff Lodge at Snowbird offers wireless Internet access to hotel guests in the lodging and public areas of the hotel at no additional charge.

## **Registration Fee Includes**

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

The poster session is scheduled for Tuesday, May 24, 2011 at 8:30 PM. Presenters are requested to put up their posters between 8:00 PM and 8:30 PM on Tuesday. Poster displays must be removed at 10:30 PM, the end of the poster session. Boards and push pins will be available to presenters beginning Tuesday, May 24, at 8:00 PM. SIAM is not responsible for discarded posters.

## 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. If a SIAM books representative is not available, completed order forms and payment (credit cards are preferred) may be taken to the SIAM registration desk. The books table will close at 10:05 AM on Thursday, May 26.

## Table Top Displays

Oxford University Press 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:

Sven Leyffer, SIAM Vice President for Programs (vpp@siam.org)

## Get-togethers

Saturday, May 21
 Welcome Reception
 6:00 PM - 8:00 PM

8:15 PM - 9:00 PM



Monday, May 23
 Business Meeting
 (open to SIAG/DS Members)



*Complimentary beer and wine will be served.* 

 Tuesday, May 24
 Poster Session and Dessert Reception
 8:30 PM - 10:30 PM



## Please Note

SIAM is not responsible for the safety and security of attendees' computers. Do not leave your laptop computers unattended. Please remember to turn off your cell phones, pagers, etc. 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.

# Save the Date!

2013 SIAM Conference on Application of Dynamical Systems

May 19 – May 23, 2013 Snowbird Ski and Summer Resort Snowbird, Utah, USA

## **Invited Plenary Speakers**

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

### Sunday, May 22

11:45 AM - 12:30 PM

**IP1** Will the Climate Change Mathematics?

**Christopher Jones,** University of North Carolina at Chapel Hill, USA & University of Warwick, United Kingdom

### 2:00 PM - 2:45 PM

IP2 From Newton's Cradle to New Materials Chiara Daraio, California Institute of Technology, USA

### Monday, May 23

### 11:45 AM - 12:30 PM

IP3 How Can We Model the Regulation of Stress Hormones? Stafford Lightman, University of Bristol, United Kingdom

### 2:00 PM - 2:45 PM

IP4 Climate Sensitivity, Feedback and Bifurcation: From Snowball Earths to the Runaway Greenhouse Raymond T. Pierrehumbert, University of Chicago, USA

### Tuesday, May 24 11:45 AM - 12:30 PM

IP5 Robust and Generic Dynamics: A Phenomenon/mechanism CorrespondenceEnrique Pujals, Instituto Nacional de Matematica Pura e Aplicada, Brazil

### 2:00 PM - 2:45 PM

IP6 Models and Control of Collective Spatio-Temporal Phenomena in Power Grids Michael Chertkov, Los Alamos National Laboratory, USA

## **Invited Plenary Speakers**

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

Wednesday, May 25

11:45 AM - 12:30 PM

IP7 Pattern Formation and Partial Differential Equations

Felix Otto, Max Planck Institute for Mathematics in the Sciences, Germany

### 2:00 PM - 2:45 PM

IP8 Mathematical Models for Tissue Engineering ApplicationsSarah Waters, University of Oxford, United Kingdom

## Thursday, May 26

11:55 AM - 12:40 PM

IP9 Moving Pattern Formation from the Real World to the Lab, and the Reverse Stephen Morris, University of Toronto, Canada

## **Prizes and Special Lecture**

The Prize Presentations and Special Lectures will take place in the Ballroom.

Sunday, May 22 Prize Presentations 8:15 PM - 8:30 PM

Jürgen Moser Lecture 8:30 PM – 9:15 PM

### SIAM Activity Group on Dynamical Systems Prizes

J. D. Crawford Prize

Eric Vanden-Eijnden, Courant Institute of Mathematics Sciences, New York University, USA

## Jürgen Moser Lecture: The Many Facets of Chaos

James A. Yorke, University of Maryland, College Park, USA

# **SIAM Activity Group on Dynamical Systems (SIAG/DS)**

www.siam.org/activity/ds



## **ACTIVITIES INCLUDE:**

- DSWeb portal •
- Special sessions at SIAM meetings
- **Biennial conference**
- Jürgen Moser Lecture
- J. D. Crawford Prize
- DSWeb Student Competition for tutorials

## **BENEFITS OF SIAG/DS MEMBERSHIP:**

- Listing in the SIAG's online-only membership directory
- Additional \$10 discount on registration at SIAM Conference on Dynamical Systems (excludes students)
- 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:

- \$10 per year
- · Student members can join two activity groups for free!

## 2010-11 SIAG/DS OFFICERS

Chair: Alan Champneys, University of Bristol Vice Chair: Steven Shaw, Michigan State University Program Director: Vivien Kirk, University of Auckland Secretary and DS Magazine Chief Editor: Jens

Rademacher, Centrum Wiskunde & Informatica

## TO JOIN:

SIAG/DM: my.siam.org/forms/join siag.htm SIAM: www.siam.org/joinsiam

DSWeb Portal Editor-in-Chief: Lennaert van Veen, University of Ontario Institute of Technology DSWeb Magazine Managing Editor: Kresimir Josic, University of Houston

**SIAM Conference on Applications of Dynamical Systems** nd D. Simpson, DSWeb media gallery

A GREAT WAY

dynamical systems.

TO GET INVOLVED! Collaborate and interact with mathematicians and applied scientists whose work involves

May 22 - 26, 2011 Snowbird Ski and Summer Resort Snowbird, Utah USA

# **Final Program**

# SIAM Conference on Applications of Dynamical Systems

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



May 22 - 26, 2011 Snowbird Ski and Summer Resort Snowbird, Utah USA

# Saturday, May 21

## Registration

4:00 PM-8:00 PM Room:Ballroom Foyer

6:00 PM-8:00 PM

## Welcome Reception



Room: Ampitheatre Lobby Terrace

# Sunday, May 22

Registration 7:15 AM-5:30 PM Room:Ballroom Foyer Sunday, May 22

## MS1 Mixing in Geophysics and Engineering

8:20 AM-10:00 AM

### Room:Ballroom I

Mixing in fluids is a fundamental phenomenon that generates persistent interests and efforts in its scientific understanding and engineering application, especially the enhanced mixing of scalars, such as temperature, chemical concentration and etc., beyond molecular diffusion by various mechanical, geophysical or biological mechanisms. This minisymposium intends to incorporate some recent analyses, simulations and experiments to provide new insights on these common themes. In particular, topics will include flow optimization for stirring-induced mixing, biogenic mixing, wind driven circulation in the ocean surface mixed layer and underwater oil plumes.

Organizer: Zhi Lin

University of Minnesota, Twin Cities, USA

### 8:20-8:40 Optimal Stirring for Passive Scalar Mixing

*Charles R. Doering*, University of Michigan, Ann Arbor, USA; Zhi Lin, University of Minnesota, USA; Jean-Luc Thiffeault, University of Wisconsin, Madison, USA

### 8:45-9:05 Topological Detection of Lagrangian Coherent Structures

Jean-Luc Thiffeault, University of Wisconsin, Madison, USA; Michael Allshouse, Massachusetts Institute of Technology, USA

### 9:10-9:30 Langmuir Circulation, Mixing, and Instabilities in the Ocean Surface Boundary Layer

*Greg Chini*, University of New Hampshire, USA; Ke Li, University of Wisconsin, USA; Zhexuan Zhang and Ziemowit Malecha, University of New Hampshire, USA; Keith Julien, University of Colorado at Boulder, USA

9:35-9:55 Internal Trapping of Bodies, Plumes and Jets in a Stratified Fluid: A Theoretical and Experimental Study *Richard McLaughlin*, University of

North Carolina at Chapel Hill, USA

## MS2 Fluctuations, Tunneling, and Chaos in Quantum and Wave Systems

8:20 AM-10:00 AM

### Room:Ballroom II

Classically chaotic behavior can lead to surprising results when transplanted to a quantum or wave- dynamical system. The phenomena often have no classical counterpart or are qualitatively different. We focus on statistical fluctuations in conductance, tunneling and many-body systems. These include graphene quantum dots with chaotic scattering dynamics found in many graphene-based devices; quantum tunneling rates which fluctuate wildly for regular systems, but vary very little in chaotic systems; and atomic Bose-Einstein Condensates with a classical phase space complexity that is encoded in the quantum statistics of the atomic population and in the fluctuations of the scattering cross section.

Organizer: Louis M. Pecora Naval Research Laboratory, USA

Organizer: Edward Ott University of Maryland, USA

### 8:20-8:40 Chaos Regularization of Quantum Tunneling Rates

Louis M. Pecora, Naval Research Laboratory, USA

### 8:45-9:05 Theory of Chaos Regularization of Tunneling

*Edward Ott*, Ming Jer Lee, and Thomas M. Antonsen, University of Maryland, USA; Louis Pecora, Dong-Ho Wu, and Hoshik Lee, U.S. Naval Research Laboratory, USA

### 9:10-9:30 Relativistic Quantum Chaos in Graphene Systems

*Ying-Cheng Lai*, Arizona State University, USA

#### 9:35-9:55 Many Body Quantum Chaos in Atomic Bose-Einstein Condensates in a Few Well System

*Tsampikos Kottos*, Wesleyan University, USA Sunday, May 22

## MS3

## Analysis of Pattern Formation in Interacting Particle Models

8:20 AM-10:00 AM

### Room:Ballroom III

The dynamical behavior of systems that consist of many individual particles, each reacting through relatively simple rules to the state of its immediate neighbourhood, has a number of applications, from traffic and pedestrian flows to the dynamical behavior of swarms, or the formation of spatial patterns in segregating granular media. In this minisymposium we will survey a range analytical and numerical techniques, focussing on emerging mathematical approaches and new developments.

Organizer: Poul G. Hjorth Technical University of Denmark, Denmark

8:20-8:40 A Primer of Swarm Equilibria

*Chad M. Topaz*, Macalester College, USA; Andrew J. Bernoff, Harvey Mudd College, USA

### 8:45-9:05 Analysis of Emerging Structures in Particle Models

Jens Starke, Technical University of Denmark, Denmark; Rainer Berkemer, AKAD Hochschule Stuttgart, Germany; Olivier Corradi and Poul G. Hjorth, Technical University of Denmark, Denmark

### 9:10-9:30 Accelerating Agent-Based Computation of Complex Urban Systems

*Yo Zou*, Princeton University, USA; Roger Ghanem, University of Southern California, USA

### 9:35-9:55 Exact Order Parameter Theory for Patterns and Mode Interactions in Driven Granular Systems

Meheboob Alam, and Priyanka Shukla, Jawaharlal Nehru Centre for Advanced Scientific Research, India

### Sunday, May 22

## MS4 Combinatorial Neurodynamics - Part I of III

8:20 AM-10:00 AM

Room:Magpie A

### For Part 2 see MS15

Neuronal networks feature a rich variety of complex spatio-temporal phenomena. The formation of patterns of neuronal activity is shaped by the interplay of the dynamical properties of the individual neurons and the structure of connections between them. It is therefore important to study the contribution of the network topology to the dynamics. The goal of this minisymposium is to highlight the role of the ideas, language, and the methods of discrete mathematics (and, in particular, of the algebraic graph theory) in the analysis of neuronal networks.

Organizer: Georgi S. Medvedev Drexel University, USA

#### 8:20-8:40 Excitable Networks: Spontaneous Spiking, Synchrony, and Waves

Georgi S. Medvedev, Drexel University, USA

### 8:45-9:05 Collective Decision Making in the Two-Alternative Forced-Choice Task: A Coupled Stochastic Differential Equations Model

*Ioannis Poulakakis*, University of Delaware, USA; Luca Scardovi, Technische Universität München, Germany; Naomi E. Leonard, Princeton University, USA

### 9:10-9:30 Eigenvalues of Graphs Sebastian Cioaba, University of

Delaware, USA

### 9:35-9:55 Temporal Features in Insect Olfactory System: Dynamics on a Directed Graph

Alla Borisyuk, University of Utah, USA

# MS5

## Multiple Time Scale Dynamics: from Theory to Biological Applications

8:20 AM-10:00 AM

### Room:Magpie B

Systems with different time scales are commonplace in many scientific areas, in particular, in biological problems. The mathematical modelling of such situations involve singularly perturbed equations, e.g., (non)smooth differential equations, partial differential equations, etc ... In this session, we give a panorama of recent advances in slow-fast dynamical systems and related typical phenomena such as canard solutions, mixed-mode oscillations, bursting oscillations. The aim is to span different theoretical frameworks: smooth ODEs, nonsmooth ODEs, PDEs, as well as to present recent developments in the mathematical modelling of cellular activity, in particular, in endocrine cells and neuronal bursters.

Organizer: Mathieu Desroches University of Bristol, United Kingdom

Organizer: Mike R. Jeffrey University of Bristol, United Kingdom

### 8:20-8:40 Mixed Mode Oscillations Underly Bursting in Pituitary Cells *Richard Bertram*, Florida State University, USA

### 8:45-9:05 Canards and Bifurcation Delays of Spatially Homogeneous and Inhomogeneous Types in Reactiondiffusion Equations

*Tasso J. Kaper*, Boston University, USA; Peter De Maesschalck, Hasselt University, Belgium; Nikola Popovic, University of Edinburgh, United Kingdom

# 9:10-9:30 Exploring Torus Canards in a Simple Neuron Model

Mark Kramer, Boston University, USA

### 9:35-9:55 Canard à l'orange: A New Recipe for Multiple Time Scales

Mathieu Desroches and Mike R. Jeffrey, University of Bristol, United Kingdom

### Sunday, May 22

## MS6

## Infinite Dimensional Models in Mathematical Epidemiology

8:20 AM-10:00 AM

### Room: Wasatch A

Advanced modeling of the transmission dynamics of infectious diseases often requires the application of infinite dimensional dynamical systems, typically due to heterogeneity (when a population is structured by age, size, spatial position or any relevant characteristics). Many structured models can be formulated as delay differential equations, but time delays may arise during the modeling process as well. In either case an adequate model can be defined as a dynamical system in an appropriate function space. This session provides an overview of recent applications of infinite dimensional models to various situations in mathematical epidemiology.

Organizer: Gergely Röst University of Szeged, Hungary

Organizer: Rongsong Liu University of Wyoming, USA

### 8:20-8:40 Impact of Heterogeneity on the Dynamics of SEIR Epidemic Models

*Zhisheng Shuai*, University of Victoria, Canada

#### 8:45-9:05 Interactions Among Virulence, Coinfection and Drug Resistance in a Complex Life-cycle Parasite

Dashun Xu, Southern Illinois University, USA

### 9:10-9:30 Spread of Avian Influenza in Networks of Wild Bird Migratory Pathways

*Lydia Bourouiba*, Massachusetts Institute of Technology, USA

### 9:35-9:55 Spatiotemporal Distributions of Migratory Birds: Patchy Models with Delay

Rongsong Liu, University of Wyoming, USA

Sunday, May 22

# MS7

## Nonlinear Waves: From Spectral Study to Nonlinear Dynamics

### 8:20 AM-10:00 AM

### Room: Wasatch B

This minisymposium will highlight recent developments regarding the spectral, linear and nonlinear stability of waves. In particular, it will bring together work on a variety of techniques, such as the Evans function and Krein signature, both of which have proven to be useful tools for determining to the location and/or number of unstable eigenvalues, and in several applications, including solitary water waves and transition fronts for Cahn-Hilliard.

Organizer: Margaret Beck Boston University, USA

Organizer: Toan Nguyen Brown University, USA

### 8:20-8:40 Asymptotic Linear Stability of Solitary Water Waves

Robert Pego, Carnegie Mellon University, USA

#### 8:45-9:05 Stability of Transition Front Solutions in Cahn-Hilliard Systems Peter Howard, Texas A&M University, USA

# 9:10-9:30 The Evans Function and the Weyl-Titchmarsh Function

Yuri Latushkin, University of Missouri, Columbia, USA; Alim Sukhtayev, University of Missouri, Columbia, USA

### 9:35-9:55 A Signature-Detecting Evans Function: The Krein Matrix

Todd Kapitula, Calvin College, USA

## MS8 Multiscale Effects in Stochastic Long Time Dynamics

8:20 AM-10:00 AM

### Room:Maybird

Noise is ubiquitous in nature and influences the behavior of many dynamical systems. Even weak noise can have a profound effect on the dynamics on a appropriate long time scale. Therefore, understanding this effect is important for analyzing and computing long time dynamics of stochastically perturbed dynamical systems. A lot of effort has been put in recent years towards the development of analytical and computational tools for the study of stochastic dynamical systems, with particular emphasis to high dimensional problems with multiple scales. The goal of this minisymposium is to bring together experts working on the analysis and development of numerical algorithms for the study of multiscale stochastic dynamical systems.

### Organizer: Dirk Blömker Universitaet Augsburg, Germany

Organizer: Greg Pavliotis Imperial College London, United Kingdom

8:20-8:40 Analysis and Numerics for SPDEs with Multiple Scales

*Greg Pavliotis*, Imperial College London, United Kingdom

#### 8:45-9:05 Numerical Methods for Stochastic Bio-chemical Reacting Networks with Multiple Time Scales *Liu Di*, Michigan State University, USA

### 9:10-9:30 Stochastic Similarity Ultimately Emerges from Some Stochastic Reaction, Advection, Diffusion Equations

Anthony J. Roberts, University of Adelaide, Australia

#### 9:35-9:55 Simplifying the Dynamical Description of Complex Stochastic Systems

*Lee DeVille*, University of Illinois at Urbana-Champaign, USA

### Sunday, May 22

## MS9

## Dynamics of Disordered Nonlinear Lattices: Anderson Localization vs. Chaos

### 8:20 AM-10:00 AM

### Room:Superior A

Anderson localization is a general effect of absence of spreading of waves in linear disordered media due to discreteness of spectrum and exponential localization of eigenmodes. By considering waves of large amplitudes, one encounters nonlinearity that may destroy the localization due to chaotization of the modes. Although this question has already been addressed numerically, experimentally, and mathematically, a full understanding is still elusive. Speakers in this session will discuss recent progress in study of disordered nonlinear lattices with emphasis on asymptotic and scaling properties of weak chaos (close to KAM regime) in large Hamiltonian systems, and implications for energy transport.

### Organizer: Arkady Pikovsky University of Potsdam, Germany

### 8:20-8:40 Wave Dynamics in Nonlinear Disordered Media - A Coin with Many Faces

Sergej Flach, and *Joshua Bodyfelt*, Max Planck Institute for Physics of Complex Systems, Germany

#### 8:45-9:05 Scaling of Energy Spreading in Strongly Nonlinear Disordered Lattices

Mario Mulansky, University of Potsdam, Germany

#### 9:10-9:30 Emergence of Generalized Gibbs Distribution in Quantum FPU Problem

*Rafael Hipolito*, City University of New York, College of Staten Island, USA

### 9:35-9:55 Scaling Properties of Weak Chaos in Nonlinear Disordered Lattices

Arkady Pikovsky, University of Potsdam, Germany; Shmuel Fishman, Technion, Haifa, Israel

## Sunday, May 22

## MS10 Collective Effects in Coupled Oscillator Systems

8:20 AM-10:00 AM

### Room:Superior B

Networks of coupled oscillators constitute an important branch of nonlinear dynamics. The purpose of this minisymposium is to discuss nontrivial collective effects in the dynamics of such systems due to interplay of noise and coupling. The emphasis will be made on detailed analysis by means of recent analytical tools like Ott-Antonsen ansatz for globally coupled phase oscillators. New results and viewpoints on collective dynamics of oscillator networks will be presented and discussed in detail. A brief overview of the subject will be given in the first half of the first talk.

Organizer: Michael Rosenblum Universität Potsdam, Germany

Organizer: Hiroya Nakao Kyoto University, Japan

### 8:20-8:40 Complex Dynamics of Oscillator Ensembles after Breakup of Synchrony

Michael Rosenblum, Universität Potsdam, Germany

### 8:45-9:05 Collective Enhancement of Temporal Precision in Networks of Noisy Oscillators

Hiroshi Kori, Ochanomizu University, Japan; Yoji Kawamura, Japan Agency for Marine-Earth Science and Technology, Japan; Naoki Masuda, University of Tokyo, Japan

#### 9:10-9:30 Collective Phase Response of Macroscopic Rhythms in Coupled Oscillator Ensembles

Hiroya Nakao, Kyoto University, Japan; Yoji Kawamura, Japan Agency for Marine-Earth Science and Technology, Japan

### 9:35-9:55 Non-universal Results in Noise-induced Common Firing in Active Rotators

*Raul Toral*, IFISC CISC-UIB Palma de Mallorca, Spain; Luis F. Lafuerza and Pere Colet, IFISC, CSIC-UIB, Spain

## MS11 Symmetry in Variational Problems and Differential Equations

8:20 AM-10:00 AM

### Room: White Pine

A number of phenomena in mechanics, physics, and optimal control have a variational nature. This minisymposium will concentrate on the modern trends in variational techniques and their applications to dynamics, and in particular, on the use of variational methods in combination with symmetry. The talks will discuss invariant flows, Darboux integrability, symmetry reduction, and higher-order variational integrators. Applications include conservation laws, integrable systems, including integrable PDE's, and symmetry-preserving numerical methods for controlled mechanical systems.

Organizer: Irina Kogan North Carolina State University, USA

Organizer: Dmitry Zenkov North Carolina State University, USA

8:20-8:40 Darboux Integrability--A Historical Survey

Ian Anderson, Utah State University, USA

8:45-9:05 Invariant Variational Problems and Invariant Flows

Peter Olver, University of Minnesota, USA

### 9:10-9:30 Higher-Order Variational Integrators Using Prolongation-Collocation

Melvin Leok and Tatiana Shingel, University of California, San Diego, USA

### 9:35-9:55 Variational Calculus in Invariant Frames

Irina Kogan, North Carolina State University, USA

## Intermission

10:00 AM-10:05 AM

Sunday, May 22

## **CP1** Molecular Modelling

10:05 AM-11:05 AM

Room:Maybird

Chair: Vakhtang Putkaradze, Colorado State University

10:05-10:20 Geometric Mechanics of Molecules with Non-Local Interactions Vakhtang Putkaradze, Colorado State University, USA

### 10:25-10:40 Internal Lever Arm Model for Myosin II

Andras Bibo, Budapest University of Technology and Economics, Hungary

### 10:45-11:00 Modeling DNA Overstretching at the Basepair Level Attila G. Kocsis, Budapest University

of Technology and Economics, Hungary; David Swigon, University of Pittsburgh, USA

### Sunday, May 22

## CP2 Population Dynamics I

10:05 AM-11:05 AM

Room:Ballroom II

Chair: Ernest Barany, New Mexico State University, USA

### 10:05-10:20 Cell Population Dynamics: Bifurcation Theory Reveals Emergent Behaviour

Petros Mina, Mario Di Bernardo, Krasimira Tsaneva-Atanasova, and Nigel Savery, University of Bristol, United Kingdom

### 10:25-10:40 Bifurcations in Models of Evolution of Polymorphism

*Ernest Barany*, New Mexico State University, USA

#### 10:45-11:00 Dynamics of Infection Spreading in Adaptive Networks with Communities

*Ilker Tunc*, The College of William & Mary, USA; Leah Shaw, College of William & Mary, USA

## CP3 Inter-Cellular Processes

10:05-10:25 AM

Room:Ballroom III

Chair: Todd Young, Ohio University, USA

### 10:05-10:20 Cell Cycle Synchronization vs. Clustering

Erik M. Boczko, Vanderbilt University, USA; Bastien Fernandez, Centre de Physique Théorique - CNRS, France; *Todd Young* and Richard Buckalew, Ohio University, USA Sunday, May 22

## CP4

## Mesoscales in Complex Networks I

10:05 AM-11:05 AM

Room:Magpie A

Chair: Ernesto Estrada, University of Strathclyde, United Kingdom

#### 10:05-10:20 Communicability, Centrality and Communities in Complex Networks

*Ernesto Estrada*, University of Strathclyde, United Kingdom

#### 10:25-10:40 Clustering of Networks with Mesoscaled Structure Through Multilevel Networks

Regino Criado, Julio Flores, Alejandro García del Amo, Jesús Gómez-Gardeñes, and Miguel Romance, Universidad Rey Juan Carlos, Spain

### 10:45-11:00 Dynamics in Modular Networks at the Mesoscale Level

Juan A. Almendral and Inmaculada Leyva, Universidad Rey Juan Carlos, Spain; Daqing Li, Bar-Ilan University, Israel; Irene Sendina-Nadal, Universidad Rey Juan Carlos, Spain; Javier M. Buldu, Rey Juan Carlos University, Spain; Shlomo Havlin, Bar-Ilan University, Israel; Stefano Boccaletti, CNR, Italy

### Sunday, May 22

## CP5

Fluids I

10:05 AM-11:05 AM

Room:Superior B

Chair: Juan M. Lopez, Arizona State University, USA

# 10:05-10:20 Vortex Sheet Model for a Turbulent Mixing Layer

*Ujjayan Paul* and Roddam Narasimha, Jawaharlal Nehru Centre for Advanced Scientific Research, India

### 10:25-10:40 Vortex Generation by An Oscillatory Magnetic Obstacle

Morten Brøns, Technical University of Denmark, Denmark

### 10:45-11:00 Optimal Harmonic Response in a Confined Bödewadt Boundary Layer Flow

Juan M. Lopez, Arizona State University, USA; Younghae Do, Kyungpook National University, Korea; Francisco Marques, Universidad Politecnica de Catalunya, Spain

## CP6 Partial Differential Equations I

10:05 AM-11:05 AM

10:05 AM-11:05 A

### Room: Wasatch B

Chair: Thomas Bellsky, Michigan State University, USA

### 10:05-10:20 Asymptotic Analysis of a Specific Type of Multi-Bump Blowup Solutions of the Ginzburg-Landau Equation

*Vivi Rottschafer*, Leiden University, Netherlands

#### 10:25-10:40 Stability of Periodic-Wave Solutions in the Parametrically Driven Damped Nonlinear Schroedinger Equation

*Igor Barashenkov* and Maxim Molchan, University of Cape Town, South Africa

### 10:45-11:00 Nonlinear Asymptotic Stability for a Generalized Gierer-Meinhardt Model

*Thomas Bellsky*, Michigan State University, USA; Keith Promislow, Michigan State University, USA

### Sunday, May 22

## CP7 Delay Differential Equations 10:05 AM-11:05 AM

Room:Superior A

Chair: Jan Sieber, University of Portsmouth, United Kingdom

#### 10:05-10:20 Periodic Orbits in Differential Equations with State-Dependent Delay

Jan Sieber, University of Portsmouth, United Kingdom

### 10:25-10:40 Cavitation in Tissue under High-Intensity Focused Ultrasound

David Sinden, Eleanor Stride, and Nader Saffari, University College London, United Kingdom

### 10:45-11:00 Some Effects of the Gamma Distribution on the Dynamics of a Scalar Delay Differential Equation

*Israel Ncube*, Memorial University, Newfoundland, Canada; Sue Ann Campbell, University of Waterloo, Canada

### Sunday, May 22

## CP8

### Numerical Methods

10:05 AM-10:45 AM

Room: Wasatch A

Chair: Thorsten Riess, Universität Konstanz, Germany

#### 10:05-10:20 Computing N-Heteroclinic EtoP Orbits Near Non-Reversible Homoclinic Snaking

Thorsten Riess, Universität Konstanz, Germany

#### 10:25-10:40 On the Numerical Integration of One Nonlinear Parabolic Equation

Mikheil Tutberidze, Ilia State University, Georgia

2011 SIAM Conference on Dynamical Systems

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# CP9

## Dynamics in Social Sciences

10:05 AM-11:05 AM

### Room:Ballroom I

Chair: Michael Busch, University of California, Santa Barbara, USA

#### 10:05-10:20 Why Ignoring Your Darwinian Fitness May be Adaptive: Evolutionary Dynamics of Movement Strategies in the Presence of Realistic Constraints

*Theodore E. Galanthay* and Samuel Flaxman, University of Colorado, USA

### 10:25-10:40 Information Propagation Models and Social Networks

Michael Busch and Jeff Moehlis, University of California, Santa Barbara, USA

### 10:45-11:00 Modelling the Dynamics of Decision-Making on Networks

Nick McCullen and Mikhail Ivanchenko, University of Leeds, United Kingdom; Vladimir Shalfeev, Nizhny Novgorod State Technical University, Russia; Alastair M. Rucklidge, University of Leeds, United Kingdom; Tim Foxon and William Gale, University of Leeds, United Kingdom

### Sunday, May 22

## **CP10** Hamiltonian and Volume Preserving Dynamics

10:05 AM-11:05 AM

### Room:Magpie B

Chair: Levi DeVries, University of Maryland, USA

#### 10:05-10:20 Existence and Stability of Symmetric Periodic Sbc Orbits in the Planar Pairwise Symmetric Four-Body Problem

Lennard F. Bakker and Tiancheng Ouyang, Brigham Young University, USA; Duokui Yan, Nankai University, China; Skyler Simmons, Brigham Young University, USA

# 10:25-10:40 From Systematic Search to Systematic Proof

Marcos Rodriguez and Roberto Barrio, University of Zaragoza, Spain

#### 10:45-11:00 Improving Hurricane Forecasts Using Unmanned Aircraft: Motion Coordination in a Strong Flowfield

Levi DeVries and Angela Maki, University of Maryland, USA; Doug Koch and Sharan Majumdar, University of Miami, USA; Derek A. Paley, University of Maryland, USA Sunday, May 22 CP11 CANCELLED 10:05 AM-11:05 AM

## Coffee Break

11:05 AM-11:35 AM



Room:Golden Cliff

### **Opening Remarks**

11:35 AM-11:45 AM

Room:Ballroom

## **IP1** Will the Climate Change Mathematics?

11:45 AM-12:30 PM

### Room:Ballroom

Chair: Alan R. Champneys, University of Bristol, United Kingdom

Computational models of the Earth system lie at the heart of modern climate science. Concerns about their predictions have been illegitimately used to undercut the case that the climate is changing and this has put dynamical systems in an awkward position. It is important that we extricate ourselves from this situation as climate science. whose true objective is to build an understanding of how the climate works, badly needs our expertise. I will discuss ways that we, as a community, can contribute by highlighting some of the major outstanding questions that drive climate science, and I will outline their mathematical dimensions. I will put a particular focus on the issue of simultaneously handling the information coming from data and models. I will argue that this balancing act will impact the way in whch we formulate problems in dynamical systems.

Christopher Jones University of North Carolina at Chapel Hill, USA & University of Warwick, United Kingdom

Lunch Break 12:30 PM-2:00 PM Attendees on their own

### Sunday, May 22

## IP2 From Newton's Cradle to New Materials

2:00 PM-2:45 PM

Room:Ballroom

Chair: Steve Shaw, Michigan State University, USA

The bouncing beads of Newton's cradle fascinate children and executives alike, but their symmetric dance hides complex nonlinear dynamic behavior. Lift a bead on one side off a chain of a few suspended beads, let it swing back: one bead bounces off on the other side. Do the same with a long chain of beads: several beads bounce off on the other side. This represents an example of nonlinear wave dynamics, which can be exploited for a variety of engineering applications. By assembling grains in crystals or layers in composites such that they support nonlinear waves, we are developing new materials and devices with unique properties. We have constructed acoustic lenses that allow sound to travel as compact bullets that can be used in medical applications, have developed new materials for absorbing explosive blasts, and are exploring new ways to test aircraft wings and bone implants nondestructively with the help of nonlinear waves.

Chiara Daraio California Institute of Technology, USA

### Intermission

2:45 PM-3:00 PM

### Sunday, May 22

## MS12

## Theory and Computation of Lagrangian Coherent Structures - Part I of II

3:00 PM-4:40 PM

Room:Ballroom I

### For Part 2 see MS23

Lagrangian Coherent Structures (LCS) are distinguished invariant surfaces that act as cores of observable trajectory patterns in dynamical systems. As such, LCS extend the classic concept of hyperbolic invariant manifolds to finitetime experimental and numerical data sets. This two-part minisymposium brings together theoreticians and computational experts to survey the current state of the art and challenges in LCS analysis. Part I reviews various aspects of LCS theory with an emphasis on recent analytic results, while Part II focuses on progress in the numerical computation and visualization of LCS.

Organizer: Sanjeeva Balasuriya Connecticut College, USA

Organizer: Xavier M. Tricoche Purdue University, USA

Organizer: George Haller McGill University, Canada

### 3:00-3:20 Lagrangian Coherent Structures: An Overview and Recent Analytic Results

*George Haller*, McGill University, Canada

### 3:25-3:45 Transport in Time-dependent Dynamical Systems: Finite-time Coherent Sets and Applications to Geophysical Fluid Flow

Gary Froyland and Naratip Santitissadeekorn, University of New South Wales, Australia; Adam Monahan, University of Victoria, Canada

3:50-4:10 Coherent Structures and Transport in Transitory Systems

Brock Mosovsky and James D. Meiss, University of Colorado at Boulder, USA

4:15-4:35 Boundaries of Unsteady Lagrangian Coherent Structures Sanjeeva Balasuriya, Connecticut College, USA

# MS13

## Data Assimilation in Weather, Climate, and Biomathematics - Part I of II

3:00 PM-4:40 PM

### Room:Ballroom II

### For Part 2 see MS24

'Data assimilation' refers to a class of algorithms by which initial conditions for a complex spatiotemporal model are estimated from empirical measurements and model forecasts. DA is an essential part of numerical weather prediction, but applications to climate modeling and biomathematics are becoming important. Whereas modern observing networks provide meteorologists with a nearly continuous data stream, many climate, ocean, and biological models must contend with sparse measurements that are spatially and temporally averaged over uncertain scales. This mini-symposium will address some mathematical issues associated with applications of data assimilation in a general context (Part I) and in the context of modeling Earth's atmosphere (Part II).

Organizer: Chris Danforth University of Vermont, USA

Organizer: Christopher Jones University of North Carolina at Chapel Hill, USA & University of Warwick, United Kingdom

Organizer: Eric J. Kostelich Arizona State University, USA

3:00-3:20 Non-Gaussian Ensemble Data Assimilation

Brian R. Hunt, University of Maryland, USA

continued in next column

### 3:25-3:45 ECCO -- Estimating the Circulation and Climate of the Ocean

*Gael Forget* and Patrick Heimbach, Massachusetts Institute of Technology, USA; Rui Ponte, Atmospheric and Environmental Research, USA; Carl Wunsch, Massachusetts Institute of Technology, USA

### 3:50-4:10 Correcting Forcing and Stratification Errors in a Estuary System Using an Ensemble Kalman Filter

Matthew J. Hoffman, Johns Hopkins University, USA

### 4:15-4:35 Data Assimilation for Cancer Forecasting

*Eric J. Kostelich*, Arizona State University, USA

### Sunday, May 22

## MS14 Nonlinear Phenomena in Granular Chains

3:00 PM-4:40 PM

### Room:Ballroom III

Over the past decade, there has been an explosion of interest focused on the study of granular chains. These media come not only in different varieties (homogeneous, heterogeneous, disordered), but can be tailored to have tunable nonlinear responses. The tunability of granular chains is valuable not only for basic studies of the underlying physics but also in potential engineering applications, including shock absorbing layers, acoustic lenses and sound scramblers. In that light, and in connection also to the plenary talk by Professor Chiara Daraio, the aim of this minisymposium is to explore the frontiers of our current understanding of such granular media.

### Organizer: Georgios Theocharis California Institute of Technology, USA

Organizer: Panayotis Kevrekidis University of Massachusetts, Amherst, USA

### 3:00-3:20 Nonlinear Resonance Phenomena in Granular Dimers with no Pre-Compression

Alexander F. Vakakis, Yuli Starosvetsky, and K. R. Jayaprakash, University of Illinois at Urbana-Champaign, USA

### 3:25-3:45 Wave Propagation in Chains of Beads with Hertzian Contacts and the *p*-Schrödinger Equation

*Guillaume James*, Université de Grenoble and CNRS, France

# 3:50-4:10 Granular Chains: The Binary Collision Approximation

Katja Lindenberg and Upendra Harbola, University of California, San Diego, USA; Alexandre Rosas, Universidade Federal da Paraiba, Brazil; A. H. Romero, CINVESTAV-IPN, Queretaro, Mexico

### 4:15-4:35 Tailoring Stress Propagation in Granular Media: Effects of Particle and System Geometry

*Duc Ngo* and Chiara Daraio, California Institute of Technology, USA

## MS15 Combinatorial

Neurodynamics - Part II of III

3:00 PM-4:40 PM

### Room:Magpie A

### For Part 1 see MS4 For Part 3 see MS26

Neuronal networks feature a rich variety of complex spatio-temporal phenomena. The formation of patterns of neuronal activity is shaped by the interplay of the dynamical properties of the individual neurons and the structure of connections between them. It is therefore important to study the contribution of the network topology to the dynamics. The goal of this minisymposium is to highlight the role of the ideas, language, and the methods of discrete mathematics (and, in particular, of the algebraic graph theory) in the analysis of neuronal networks.

Organizer: Georgi S. Medvedev Drexel University, USA

Organizer: Vladimir Itskov University of Nebraska, Lincoln, USA

**3:00-3:20** Connectivity vs. Dynamics in a Simple Model of Neuronal Networks *Winfried Just*, Ohio University, USA;

David H. Terman, Ohio State University, USA; Sungwoo Ahn, Indiana University-Purdue University Indianapolis (IUPUI), USA

### 3:25-3:45 Random Graphs and Sleepwake Dynamics

Janet Best, Deena Schmidt, and Boris Pittel, Ohio State University, USA; Mark Blumberg, University of Iowa, USA

# 3:50-4:10 Network Dynamics on Random Graphs

Deena Schmidt, Janet Best, and Boris Pittel, Ohio State University, USA; Mark Blumberg, University of Iowa, USA

#### 4:15-4:35 Neural Networks Computing Relaxations of Hard Combinatorial Problems

Christopher Hillar, Mathematical Sciences Research Institute, USA Sunday, May 22

## MS16 Central Pattern Generators -Part I of II

3:00 PM-4:40 PM

Room:Magpie B

### For Part 2 see MS136

Neuronal circuits called central pattern generators (CPGs) underlie many rhythmic motor outputs in animals. CPGs incorporate many features that render them attractive for dynamical systems analysis. While their outputs are dynamically complex and emerge through interactions among network components, their structure makes CPG models amenable to mathematical analysis. In this session, speakers will discuss dynamics of neurons and networks in CPGs for locomotion. respiration, and digestion, including issues of multistability, feedback, and network topology effects.

Organizer: Justin Dunmyre University of Pittsburgh, USA

Organizer: Jonathan E. Rubin University of Pittsburgh, USA

3:00-3:20 Pattern-generating Neurons and Pattern-generating Circuits: Phenomena, Signficance, and Problems for Analysis *Brian Mulloney*, University of

California, Davis, USA

3:25-3:45 Phase Resetting Properties of Half-Center Oscillators

*Tim Lewis* and Jiawei Zhang, University of California, Davis, USA

3:50-4:10 Influence of Sensory Feedback on Central Pattern Generation During Stepping – Dynamics Near An Oscillatory Domain

Silvia Gruhn and Tibor Toth, University of Cologne, Germany

4:10-4:35 CPGs and Stability of Locomotion: How Neural Feedback Enhances Cockroach Running

Joshua Proctor, and Philip Holmes, Princeton University, USA

### Sunday, May 22

## MS17 Periodic Orbits in Classical and Quantum Dynamics

## 3:00 PM-4:40 PM

### Room: Wasatch A

Periodic orbits, being dense in a chaotic phase space, provide a basic framework with which to characterize chaotic systems. This is true not only for classical dynamics, but also for quantum dynamics, when viewed from the semiclassical perspective. This minisymposium highlights recent advances using periodic orbits to elucidate both classical transport and quantum dynamics.

Organizer: Kevin A. Mitchell

University of California, Merced, USA

Organizer: Predrag Cvitanovic Georgia Institute of Technology, USA

3:00-3:20 Periodic Orbits and Transport in Mixed Phase Spaces *Kevin A. Mitchell*, University of California, Merced, USA

3:25-3:45 How Well Can One Resolve the State Space of a Chaotic Flow?

Predrag Cvitanovic and Domenico Lippolis, Georgia Institute of Technology, USA

3:50-4:10 Periodic Motions and their Classical Invariants in Quantum Chaos

*Florentino Borondo*, Universidad Autonoma de Madrid, Spain

4:15-4:35 Bunching of Periodic Orbits and Universality in Quantum Chaos

Alexander Altland, University of Cologne, Germany; Petr Braun and Fritz Haake, Universität Duisburg-Essen, Germany; Stefan Heusler, Universität Münster, Germany; *Sebastian Mueller*, University of Bristol, United Kingdom

## MS18 Epidemiology, Population Dynamics and Networks I

3:00 PM-4:15 PM

### Room: Wasatch B

This minisymposium is about mathematical models for the spread of infectious diseases. The talks concern effects of variabilities of abiotic determinants: spatial heterogeneities or seasonal variations. Particular emphasis is give on how the network structure and the multi-scale dynamics have an effect on the epidemic spreading. Methods of controlling and reducing the epidemic impact, such as vaccination and genetic methods, will also be discussed. Actual applications will be considered.

Organizer: Stefanella Boatto Universidade Federal do Rio De Janeiro, Brazil

### 3:00-3:20 Genetic Control of Vectorborne Diseases: Artificial Selection and Heterogeneity of the Immune Response in Mosquitoes

*Claudio Struchiner*, Oswaldo Cruz Foundation, Brazil

### 3:25-3:45 Stochastic Effects in Infection Dynamics: Simulations and Analytical Models

Ganna Rozhnova, University of Lisbon, Portugal and University of Manchester, United Kingdom; Ana Nunes, University of Lisbon, Portugal

#### 3:50-4:10 Pandemic Influenza Vaccination Timing in a Population Dynamical Model

Jessica M. Conway, University of British Columbia, Canada; Ashleigh Tuite, University of Toronto, Canada; Rafael Meza and Babak Pourbohloul, University of British Columbia, Canada Sunday, May 22

## MS19 Evolving Dynamical Networks - Part I of II 3:00 PM-4:40 PM

5:00 PIVI-4:40 PIVI

### Room:Maybird

### For Part 2 see MS30

In many biological, ecological and engineering networks the coupling strength and the network topology can vary in time. In addition, the networks can adapt their structure in response to node dynamics. This minisymposium focuses on the mathematical analysis and various applications of dynamical networks whose coupling structure evolves over time, on a time scale that ranges from fast to slow.

Organizer: Igor Belykh Georgia State University, USA

Organizer: Mario Di Bernardo University of Bristol, United Kingdom

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

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

### 3:00-3:20 Asymptotic Behavior of Stochastically Blinking Systems

Martin Hasler, Swiss Federal Institute of Technology-Lausanne Switzerland; Vladimir Belykh, University of Nizhny Novgorod, Russia; Igor Belykh, Georgia State University, USA

# 3:25-3:45 The Climate System as a Network of Networks

Juergen Kurths, Potsdam Institute for Climate Impact Research and Humboldt University Berlin, Germany; J. Donges, N. Marwan, and Y. Zou, Humboldt University Berlin, Germany

### 3:50-4:10 On Synchronization Over Numerosity-constrained Networks with Application to Animal Grouping *Maurizio Porfiri*, Polytechnic Institute of

New York University, USA

### 4:15-4:35 Intermittent Synchronization in Adaptive Networks of Coupled Oscillators

Juan G. Restrepo, Dane Taylor, and Per Sebastian Skardal, University of Colorado at Boulder, USA

## Sunday, May 22

# MS20

## Rheology and Fluctuations of Sheared Soft Sphere Models near Jamming

3:00 PM-4:40 PM

### Room:Superior A

Many complex fluids exhibit nontrivial rheology: their flow is not described by the Navier-Stokes equation. Complex fluids often also exhibit instabilities and nonlinear behavior not found for regular fluids, but analysis is often based on ad-hoc phenomenological models. This symposium reviews the recent advances for systems of soft spheres (soft colloids, wet foams), for which close to the jamming point ideas developed for static packings can be extended to derive the scaling exponents and rheology under shear. Experiments on soft colloids confirm many of these features; velocity correlations and avalanches in such models are also nontrivial.

Organizer: Wim van Saarloos Leiden University, Netherlands

3:00-3:20 Non-Newtonian Rheology of Sheared Soft Sphere Systems near the Jamming Point: An Introduction *Wim van Saarloos*, Leiden University,

Netherlands

### 3:25-3:45 Microfluidic Rheology and Dynamical Heterogeneity of Soft Colloids above and below Jamming

Douglas Durian, Kerstin Nordstrom, and Emilie Verneuil, University of Pennsylvania, USA; Jerry P. Gollub, Haverford College, USA

#### 3:50-4:10 Asymmetries and Velocity Correlations in Shearing Media *Peter Olsson*, Umeå University, Sweden

4:15-4:35 Avalanches and Diffusion in Model Bubble Rafts Near Jamming Craig Maloney, Carnegie Mellon University, USA

## **MS21** Modeling and Analysis of **Oceanic Phytoplankton** Growth

3:00 PM-4:40 PM

### Room:Superior B

Phytoplankton forms the basis of the aquatic food chain. The dynamical behavior of phytoplankton blooms is affected by environmental conditions and, conversely, affects the environment. Most prominently, plankton blooms act as large-scale carbon pumps, removing tens of gigatons of carbon dioxide from the atmosphere per year through photosynthesis. Recent results suggest that these blooms can exhibit much more complex (possibly chaotic) dynamics than previously thought, especially when their growth is co-limited by both light and nutrients. This minisymposium presents recent research carried out in that direction.

### Organizer: Antonios Zagaris University of Twente, Netherlands

Organizer: Arjen Doelman Leiden University, Netherlands

### 3:00-3:20 Emergence and Annihilation of Localized Structures in a Phytoplankton-nutrient System

Antonios Zagaris, University of Twente, Netherlands

#### 3:25-3:45 A Weakly Nonlinear Model for Phytoplankton Pattern Formation in **Estuaries**

Huib de Swart, Utrecht University, The Netherlands

### 3:50-4:10 Bistability in Vertical Distributions of Phytoplankton in a Stratified Water Column

Kohei Yoshiyama, University of Tokyo, Japan

### 4:15-4:35 A Game-theoretic Approach to the Vertical Distribution of **Phytoplankton**

Jarad Mellard, University of Kansas, USA

# Sunday, May 22

## **MS22 Geometric Mechanics** 3:00 PM-4:40 PM

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 framework to address a broad range of issues, such as numerical integration and qualitative dynamics. In particular, topics represented include nonholonomic mechanics, discrete dynamics, and recent progress in the three body problem. This provides a unique opportunity for mathematicians, applied mathematicians, and engineers to come together and explore their common interest in the geometric approach to mechanics.

Organizer: Jared M. Maruskin San Jose State University, USA

### 3:00-3:20 Automatically Generated Variational Integrators

George Patrick, University of Saskatchewan, Canada

### 3:25-3:45 From Brakes-to-Syzygy in the Three-Body Problem

Richard Montgomery, University of California, Santa Cruz, USA

### 3:50-4:10 Frame Selection in **Nonholonomic Mechanics**

Jared M. Maruskin, San Jose State University, USA

### 4:15-4:35 Structure-Preserving Integrators for Chaplygin Systems

Dmitry Zenkov and Cameron Lynch, North Carolina State University, USA

### **Coffee Break**

4:40 PM-5:10 PM Room:Golden Cliff

### Organizer: Sanjeeva Balasuriya Connecticut College, USA

of LCS.

Oraanizer: Xavier M. Tricoche Purdue University, USA

Organizer: George Haller McGill University, Canada

#### 5:10-5:30 Efficient Computation of Lagrangian Coherent Structures for Interactive Visual Analysis in **Computational Fluid Dynamics** Xavier M. Tricoche, Purdue University,

USA

### 5:35-5:55 An Eulerian Approach for Computing the Finite Time Lyapunov Exponent

Shingyu Leung, Hong Kong University of Science and Technology, Hong Kong

### 6:00-6:20 Ridge Surface Methods for the Visualization of LCS

Ronald Peikert, ETH Zürich, Switzerland

### 6:25-6:45 Fast Computation of Time-Varying Finite Time Lyapunov **Exponents**

Steven L. Brunton and Clarence Rowley, Princeton University, USA

### 2011 SIAM Conference on Dynamical Systems

Theory and Computation

of Lagrangian Coherent

Lagrangian Coherent Structures (LCS) are

distinguished invariant surfaces that act as

cores of observable trajectory patterns in

dynamical systems. As such, LCS extend

the classic concept of hyperbolic invariant

manifolds to finite-time experimental

part minisymposium brings together

theoreticians and computational experts

to survey the current state of the art and

various aspects of LCS theory with an

while Part II focuses on progress in the

numerical computation and visualization

emphasis on recent analytic results,

challenges in LCS analysis. Part I reviews

and numerical data sets. This two-

Structures - Part II of II

5:10 PM-6:50 PM

Room:Ballroom I

For Part 1 see MS12

Sunday, May 22

**MS23** 



## **MS24**

## Data Assimilation in Weather, Climate, and Biomathematics - Part II of II

5:10 PM-6:50 PM

### Room:Ballroom II

### For Part 1 see MS13

'Data assimilation' refers to a class of algorithms by which initial conditions for a complex spatiotemporal model are estimated from empirical measurements and model forecasts. DA is an essential part of numerical weather prediction, but applications to climate modeling and biomathematics are becoming important. Whereas modern observing networks provide meteorologists with a nearly continuous data stream, many climate, ocean, and biological models must contend with sparse measurements that are spatially and temporally averaged over uncertain scales. This minisymposium will address some mathematical issues associated with applications of data assimilation in a general context (Part I) and in the context of modeling Earth's atmosphere (Part II).

Organizer: Chris Danforth University of Vermont, USA

Organizer: Christopher Jones University of North Carolina at Chapel Hill, USA & University of Warwick, United Kingdom

Organizer: Eric J. Kostelich Arizona State University, USA

5:10-5:30 Variance Limiting Kalman Filtering: Controlling Covariance Overestimation and Model Error

Lewis Mitchell and Georg Gottwald, University of Sydney, Australia; Sebastian Reich, Universität Potsdam, Germany continued in next column

### 5:35-5:55 Lagrangian Data Assimilation for Nonlinear Ocean Process Models

Elaine Spiller, Marquette University, USA

6:00-6:20 Forecasting Regime Changes in a Chaotic Toy Climate *Kameron D. Harris* and Chris Danforth, University of Vermont, USA

### 6:25-6:45 Effects of Nonlinear Saddles and Centers on Data Assimilation

Amit Apte, TIFR Centre, Bangalore, India; Christopher Jones, University of North Carolina at Chapel Hill, USA & University of Warwick, United Kingdom

### Sunday, May 22

## MS25 Different Faces of Mixing 5:10 PM-6:50 PM

### Room:Ballroom III

In the current minisimposium we address theoretical, numerical, and experimental aspects of mixing from micro- to industrial-size scale in both fluid and granular flow. Two speakers will discuss mixing in tilted tanks, which will illustrate the common and distinct features of mixing in granular (Ivan Christov) vs. fluid (Thomas Ward) systems. The evolution of adiabatic 2-D structures will be discussed in both settings and it will be further theoretically investigated (Dmitri Vainchtein). Special attention will be paid to the survival of coherent structures in the presence of inertia (Herman Clercx and Thomas Ward) and appearance of specifically 3-D features.

Organizer: Dmitri Vainchtein Temple University, USA

#### 5:10-5:30 Formation of Coherent Structures by Fluid Inertia in 3D Laminar Flows

Herman Clercx and Michel Speetjens, Eindhoven University of Technology, Netherlands

### 5:35-5:55 Mixing in a Tilted Rotating Tank

Thomas Ward, North Carolina State University, USA

### 6:00-6:20 3D Aspects of Mixing and Transport in Tumbled Granular Flow

Ivan C. Christov, Richard M Lueptow, and Julio M Ottino, Northwestern University, USA; Rob Sturman, University of Leeds, United Kingdom; Stephen Wiggins, University of Bristol, United Kingdom

### 6:25-6:45 Adiabatic Mixing: Improved Invariants and Refined Boundaries

Dmitri Vainchtein and Alimu Abudu, Temple University, USA

## MS26 Combinatorial Neurodynamics -Part III of III

5:10 PM-6:50 PM

### Room:Magpie A

### For Part 2 see MS15

Neuronal networks feature a rich variety of complex spatio-temporal phenomena. The formation of patterns of neuronal activity is shaped by the interplay of the dynamical properties of the individual neurons and the structure of connections between them. It is therefore important to study the contribution of the network topology to the dynamics. The goal of this minisymposium is to highlight the role of the ideas, language, and the methods of discrete mathematics (and, in particular, of the algebraic graph theory) in the analysis of neuronal networks.

### Organizer: Georgi S. Medvedev Drexel University, USA

Organizer: Vladimir Itskov University of Nebraska, Lincoln, USA

### 5:10-5:30 Using Feed-forward Maps to Explore the Role of Synaptic Dynamics in a Reciprocally Inhibitory Network

Farzan Nadim and Myongkeun Oh, New Jersey Institute of Technology, USA

#### 5:35-5:55 Dynamical Moment Neuronal Network: Model and Approach

Wenlian Lu, Fudan University, China; Jianfeng Feng, Warwick University, United Kingdom

### 6:00-6:20 Networks of Phaseamplitude Neural Oscillators

*Kyle C. Wedgwood* and Stephen Coombes, University of Nottingham, United Kingdom

### 6:25-6:45 Combinatorics of Stable Sets and Learning in Recurrent Networks

Vladimir Itskov, University of Nebraska, Lincoln, USA

### Sunday, May 22

## MS27 Nonlinear Stability of Localized Structures

5:10 PM-6:50 PM

### Room:Magpie B

Localized structures are ubiquitous in nature, occurring in a multitude of systems in chemistry, physics and biology. The stability properties of these structures describe their persistence in the presence of perturbations. Nonlinear stability is particularly challenging involving a methodological extension of linear stability analysis. This minisymposium features a collection of talks by four leading researchers in this field, each having a different approach to the problem. Hence, we expect both an interesting exposition of the state-ofthe-art and a platform for communication among experts.

Organizer: Martina Chirilus-Bruckner

Boston University, USA

Organizer: Peter van Heijster Brown University, USA

### 5:10-5:30 Nonlinear Stability for a Model of a Source-type Defect

*Margaret Beck*, Boston University, USA; Toan Nguyen and Bjorn Sandstede, Brown University, USA; Kevin Zumbrun, Indiana University, USA

# 5:35-5:55 Stability of the Line Soliton of the KP-II Equation in $L^2(R_X \times T_V)$

*Tetsu Mizumachi*, Kyushu University, Japan; Nikolay Tzvetkov, Universite de Cergy-Pontoise, France

### 6:00-6:20 Nonlinear Stability of Fronts and Pulses for a Class of Reactiondiffusion Systems that Arise in Chemical Reaction Models

Anna Ghazaryan, Miami University and University of Kansas, USA; Yuri Latushkin, University of Missouri, Columbia, USA; Stephen Schecter, North Carolina State University, USA

### 6:25-6:45 Geometric Evolution of Structured Interfaces

Keith Promislow, Michigan State University, USA

### Sunday, May 22

## MS28 Controlling Neurons 5:10 PM-6:50 PM

Room: Wasatch A

There is by now a long, fruitful history of using dynamical systems techniques to understand the dynamics of individual neurons and neural populations. More recently, there has been growing interest in the control of neural populations, as motivated by applications such as deep brain stimulation treatment for Parkinson's disease, in which current is injected into the appropriate brain region to try to modify the behavior of a neural population in order to relieve the tremors associated with this disease. Talks in this session will address different approaches for controlling neurons.

Organizer: Jeff Moehlis University of California, Santa Barbara, USA

Organizer: Ali Nabi University of California, Santa Barbara, USA

### 5:10-5:30 Model Based Control of Seizures and Parkinson's Disease

Steven J. Schiff, Pennsylvania State University, USA

# 5:35-5:55 Stimulation and Information in the Peripheral Nervous System

*Eric Shea-Brown*, University of Washington, USA

### 6:00-6:20 Synchronization Control of Interacting Oscillatory Ensembles by Mixed Nonlinear Delayed Feedback

*Oleksandr Popovych* and Peter A. Tass, Research Centre Juelich, Germany

### 6:25-6:45 Optimal Control for Globally Coupled Neural Networks

Ali Nabi and Jeff Moehlis, University of California, Santa Barbara, USA

## MS29 Epidemiology, Population Dynamics and Networks II

### 5:10 PM-6:50 PM

### Room: Wasatch B

This minisymposium is about mathematical models for the spread of infectious diseases in large communities and/or over different countries. The talks concern effects of variabilities of abiotic determinants: spatial heterogeneities or seasonal variatons. Particular emphasis is give on how the network and the multiscale dynamics have an effect on the epidemic spreading. General models will also be discussed and actual applications will be considered.

Organizer: Roberto A. Kraenkel Instituto de Física Teórica, Brazil

Organizer: Claudio Struchiner Oswaldo Cruz Foundation, Brazil

### 5:10-5:30 Investigating the Spatiotemporal Dynamics of Pandemic Influenza in Europe

Marco Ajelli and Stefano Merler, Bruno Kessler Foundation, Italy

### 5:35-5:55 The Role of Immunity and Seasonality in Cholera Epidemics

*Roberto A. Kraenkel*, Instituto de Física Teórica, Brazil; Rosangela Sanchez and Claudia Pio Ferreira, Universidade Estadual Paulista, Brazil

#### 6:00-6:20 A Toy Model for Epidemics in Rio de Janeiro: The Importance of the Network Structure

Stefanella Boatto, Universidade Federal do Rio De Janeiro, Brazil; Francisco C. Santos, New University of Lisbon, Portugal; Lucas Stolerman, Federal University of Rio de Janerio, Brazil; Claudia Codeco, Fundação Oswaldo Cruz, Brazil; Renata Stella Khouri, Federal University of Rio de Janerio, Brazil

6:25-6:45 Multiscale Networks and the Spatial Spread of Infectious Diseases *Vittoria Colizza*, INSERM, Paris, France

and ISI Foundation, Torino, Italy

### Sunday, May 22

## MS30 Evolving Dynamical Networks - Part II of II

5:10 PM-6:50 PM

Room:Maybird

### For Part 1 see MS19

In many biological and engineering networks the coupling strength and the network topology can vary in time. In addition, the networks can adapt their structure in response to node dynamics. This minisymposium focuses on the mathematical analysis and various applications of dynamical networks whose coupling structure evolves over time, on a time scale that ranges from fast to slow.

Organizer: Igor Belykh Georgia State University, USA

Organizer: Mario Di Bernardo University of Bristol, United Kingdom

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

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

### 5:10-5:30 Evolving Dynamical Networks for Synchronization: Analysis and Emergent Properties

Mario Di Bernardo and *Thomas Gorochowski*, University of Bristol, United Kingdom

5:35-5:55 Adaptive Networks and the Spontaneous Emergence of Modularity and Heterogeneity Stefano Boccaletti, CNR, Italy

6:00-6:20 Period Doubling and Macroscopic Chaos in a Time-varying Network of Globally Coupled Phase Oscillators

Paul So, George Mason University, USA

6:25-6:45 Creating Delay-tolerant Networked Dynamical Systems via Designing the Network Graphs

*Rifat Sipahi* and Wei Qiao, Northeastern University, USA

### Sunday, May 22

## MS31 Nontwist Hamiltonian Systems: Theory and Applications

5:10 PM-6:50 PM

### Room:Superior A

This minisymposium brings together researchers from several different countries to present the latest developments in the subject of nontwist Hamiltonian systems with an emphasis on the study of transition to chaos and global transport in these systems. In recent years, more and more physical systems have been found that locally violate a non-degeneracy condition, e.g., reversed magnetic shear configurations in test fusion reactors. In addition to the mathematical challenges resulting from the absence of the twist condition, these systems display a wealth of new phenomena whose mathematical origins and impact on physical models are being investigated.

Organizer: Alexander Wurm Western New England College, USA

Organizer: P.J. Morrison University of Texas at Austin, USA

### 5:10-5:30 Transition to Global Transport in Nontwist Area-preserving Maps: Recent Results

Alexander Wurm, Western New England College, USA

# 5:35-5:55 Transport Barrier In The Nontwist Standard Map

*Ibere L. Caldas* and Jose D. Szezech, University of Sao Paulo, Brazil; Sergio Lopes and Ricardo L. Viana, Federal University of Paraná, Brazil; P.J. Morrison, University of Texas at Austin, USA

continued on next page

# MS31

## Nontwist Hamiltonian Systems: Theory and Applications

5:10 PM-6:50 PM

continued

#### 6:00-6:20 Interplay of Magnetic Shear and Resonances in Magnetic Fusion Devices

Marie-Christine Firpo, Ecole Polytechnique, Palaiseau, France; Dana Constantinescu, University of Craiova, Romania

### 6:25-6:45 Gyroaverage Effects on Separatrix Reconnection and Destruction of Shearless Kam Barriers in Non-Twist Systems

Diego Del-Castillo-Negrete, Oak Ridge National Laboratory, USA; Julio J. Martinell, National Autonomous University of Mexico, Mexico Sunday, May 22

## MS32 Biomimetic Robotics 5:10 PM-6:50 PM

Room:Superior B

A recent trend in the analysis of animal behavior has involved the construction biomimetic robots that include animal like sensors, actuators and neural circuit controllers and analysis of their dynamics during interaction with the environment. Development of such robots allows the investigator to instantiate hypotheses and to test their operation in a vehicle. The minisymposium focuses on the problems of nonlinear control with synthetic neurobiological networks, its modulation with sensory inputs and physical implementation of biomimetic robot.

Organizer: Joseph Ayers Northeastern University, USA

Organizer: Nikolai Rulkov University of California, San Diego, USA

#### 5:10-5:30 Controlling the Zoo: A Conservative Control Model for Biomimetic Robots

Joseph Ayers, Northeastern University, USA

#### 5:35-5:55 Using Robotic Models to Test Animal Networks and Hypothesized Connections

Roger Quinn, Case Western Reserve University, USA

6:00-6:20 Synthetic CPG Controller for Real-time Implementation of Locomotion Activity and Control System in Swimming Lamprey-base Robot

*Nikolai Rulkov*, University of California, San Diego, USA

### 6:25-6:45 Implementation of Neuronal Networks for Reactive Autonomy

Anthony Westphal, Northeastern University, USA Sunday, May 22

## MS33 Dynamics of Scroll Waves 5:10 PM-6:50 PM

Room: White Pine

Scroll waves are nonlinear dissipative patterns, three-dimensional extensions of spiral waves, and are observed in a variety of active media including heart muscle where they correspond to dangerous arrhythmias. Study of their dynamics by experimental, numerical and analytical approaches goes back nearly forty years. Recent advances in all three directions have revealed new aspects that may change the established concepts of filament tension and interaction of filaments with each other, with medium inhomogeneities and with external factors. The minisymposium gives a small sampling of the current state of the problem and brings together experimentalists and theoreticians working on scroll waves.

Organizer: Vadim N. Biktashev University of Liverpool, United Kingdom

### 5:10-5:30 Applications of Asymptotic Theory to Scroll Wave Dynamics

Vadim N. Biktashev, Irina Biktasheva, and Stuart W. Morgan, University of Liverpool, United Kingdom; Narine Sarvazyan, George Washington University, USA

### 5:35-5:55 Pinning of Scroll Waves in Excitable Systems

*Oliver Steinbock*, Florida State University, USA

### 6:00-6:20 Interaction of Scroll Waves in the Presence and Absence of External Gradients

Marcus Hauser, Otto-von-Guericke University, Magdenburg, Germany

### 6:25-6:45 Scroll Wave Break-up and Filament Turbulence

Jörn Davidsen, University of Calgary, Canada

## Dinner Break 6:50 PM-8:15 PM Attendees on their own

2011 SIAM Conference on Dynamical Systems

# Prize Presentations

Juergen Moser and J. D. Crawford

8:15 PM-8:30 PM Room:Ballroom

## Juergen Moser Lecture:

## The Many Facets of Chaos

8:30 PM-9:15 PM

### Room:Ballroom

Chair: Alan R. Champneys, University of Bristol, United Kingdom

Chaos reveals itself differently in different situations. Understanding its many aspects or facets will help in creating innovative models. My talk will illustrate how different facets of chaos lead us in different directions in my recent works on:

• HIV population dynamics;

- determining the current state of the atmosphere (for weather prediction);
- genome assembly (determining the sequence of ACGT's for a species);

• partial control of chaos.

James A. Yorke University of Maryland, USA

# Monday, May 23

Registration 8:00 AM-5:30 PM Room:Ballroom Foyer

## MS34 Mathematical Models of Paleoclimate

8:30 AM-10:10 AM

Room:Ballroom I

Mathematical models have proved useful for understanding climates of the geologic past. This minisymposium will explore some of these models on time scales of 100 million years to 10 thousand years.

Organizer: Richard McGehee University of Minnesota, USA

Organizer: Mary Lou Zeeman Bowdoin College and Cornell University, USA

#### 8:30-8:50 Using Mathematical Models of Varying Complexity to Study the Great Snowball Earth Events

Dorian S. Abbot, University of Chicago, USA

### 8:55-9:15 A Paleoclimate Model of Ice-Albedo Feedback

*Richard McGehee*, University of Minnesota, USA

9:20-9:40 Relaxations Oscillations in a Simple Ocean-Box Model Modulated by Zonal Insolation - a Possible Mechanism for Dansgaard-Oeschger Events

*Raj Saha*, University of North Carolina, USA

### 9:45-10:05 Dynamics of An Energy Balance Model

Esther Widiasih, University of Arizona, USA

## Monday, May 23

## **MS35**

## Reconstruction and Analysis of Individual Dynamics in Bio-groups

### 8:30 AM-10:10 AM

### Room:Ballroom II

The problem area is the application of mathematics and dynamical systems to (1) quantitatively reconstruct the motion of individuals in complex bio-groups and (2) invert these data to identify and validate predictive models of collective motion. This research has significant applications ranging from improved understanding of complexity in natural systems to the design of multi- agent robotic systems. Current directions of research include the use of computer vision and estimation theory to identify and track individuals in dynamic, dense groups; and the use of detection theory and statistical physics to analyze trajectories. The scope will range from fish schools to mosquito swarms.

Organizer: Derek A. Paley University of Maryland, USA

### 8:30-8:50 Reconstruction and Analysis of Individual Dynamics in Fish Schools and Mosquito Swarms

Derek A. Paley and Sachit Butail, University of Maryland, USA

# 8:55-9:15 Tracking Fish Schools in 2D with Real-time Applications

Daniel T. Swain, Naomi E. Leonard, and Iain Couzin, Princeton University, USA

9:20-9:40 Deconfliction in Biological and Bio-inspired Coordinated Control *Kristi Morgansen*, University of Washington, USA

### 9:45-10:05 Learning Hybrid Controllers from Animal Tracking

*Tucker Balch*, Georgia Institute of Technology, USA

## MS36 Traveling Waves in Partially Parabolic Systems

### 8:30 AM-10:10 AM

### Room:Ballroom III

"Partially parabolic systems" have diffusion in some equations and no diffusion in others. Examples include nerve impulse equations, chemical reaction or combustion equations in which some reactants are solids, and population-interaction equations in which some populations cannot diffuse. Traveling fronts or pulses are often important solutions of such equations. Issues include proving stability when linearized operators are not sectorial; whether traveling waves and their stability properties persist when small diffusion is added; and when it is safe to ignore small diffusion terms. Speakers include researchers who have focused on some of these issues and others whose work touches on them.

### Organizer: Stephen Schecter

North Carolina State University, USA

#### 8:30-8:50 Stability of Traveling Waves for Parabolic and Partially Parabolic Combustion Problems

Anna Ghazaryan, Miami University and University of Kansas, USA; Yuri Latushkin, University of Missouri, Columbia, USA; *Stephen Schecter*, North Carolina State University, USA

### 8:55-9:15 Traveling Waves in the Buffered FHN System

Je-Chiang Tsai, National Chung Cheng University, Taiwan

### 9:20-9:40 Traveling Waves for Reaction-convection-diffusion Systems

Dan Marchesin, Instituto Nacional de Matematica Pura e Aplicada, Brazil; Alexei A. Mailybaev, Moscow State University, Russia; Julio D. Machado Silva, Instituto Nacional de Matematica Pura e Aplicada, Brazil

### 9:45-10:05 Long-time Behavior and Approximation of Nonlinear Waves

Jens Rottmann-Matthes, Bielefeld University, Germany

## Monday, May 23

## MS37 Dynamics of Heteroclinic Cycles and Networks

8:30 AM-10:10 AM

### Room:Magpie A

Heteroclinic cycles can occur robustly in systems with symmetries or other constraints. Heteroclinic networks are the union of several heteroclinic cycles, and dynamics near heteroclinic networks can be very complicated. As well as introducing the research area, this minisymposium will address the stability of heteroclinic networks, the nature of their basins of attraction, what might occur when the heteroclinic network loses stability, how trajectories switch between visiting different parts of the network, and how the itinerary of a trajectory passing close to the network might reliably encode 'memory items' in neuronal networks.

Organizer: Claire M. Postlethwaite University of Auckland, New Zealand

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

# 8:30-8:50 Switching on a Heteroclinic Network

*Claire M. Postlethwaite*, University of Auckland, New Zealand; Alastair M. Rucklidge, University of Leeds, United Kingdom; Vivien Kirk, University of Auckland, New Zealand; Mary Silber, Northwestern University, USA; Emily Lane, National Institute of Water and Atmospheric Research, New Zealand

### 8:55-9:15 Homoclinic Cycles: Dynamics and Bifurcations

Ale Jan Homburg, University of Amsterdam, The Netherlands

# 9:20-9:40 Universal Computation by Switching in Neural Networks

Fabio Schittler Neves, Max Planck Institute for Dynamics and Self-Organization, Germany; Marc Timme, Max-Planck Institut fuer Stroemungsforschung, Germany

### 9:45-10:05 Stability Indices for Heteroclinic Networks

Peter Ashwin, University of Exeter, United Kingdom; Olga Podvigina, Institute of Earthquake Prediction Theory & Math Geophysics, Russia

### Monday, May 23

## MS38 Stochastic Dynamics in Biological Systems at Different Scales

8:30 AM-10:10 AM

### Room:Magpie B

Randomness plays an important role in determining the behavior of biological systems. Not only can noise change the qualitative behavior of complex biological systems but often can play an important role in driving the dynamics. Tools ranging from ordinary differential equations, stochastic differential equations and Markov models are employed to study the role of stochasticity. Each speaker will present research on the role of randomness at a different scale; we look at molecular motors within a cell, migration of individual cells and collective dynamics of a group of cells in a network.

Organizer: Badal Joshi Duke University, USA

### 8:30-8:50 Collective Dynamics of Processive Molecular Motors

Avanti Athreya, Duke University, USA; John Fricks, Pennsylvania State University, USA; Pete Kramer, Rensselaer Polytechnic Institute, USA; *Scott McKinley*, University of Florida, USA

### 8:55-9:15 Stochastic Inference of Cell Migration Phenotypes

Richard Allen, University of North Carolina, Chapel Hill, USA; Christopher Welch, University of North Carolina, USA; Klaus Hahn and Tim Elston, University of North Carolina at Chapel Hill, USA

# 9:20-9:40 A General Markov Model for Pole Formation

Badal Joshi, Duke University, USA; Scott McKinley, University of Florida, USA; Michael C. Reed, Duke University, USA

### 9:45-10:05 Analytical Theory for Cascade Formation in Clustered Scale-Free Neuronal Network Model

Katherine Newhall, *Peter R. Kramer*, and Gregor Kovacic, Rensselaer Polytechnic Institute, USA; Max Shkarayev, College of William & Mary, USA; David Cai, Shanghai Jiao Tong University, China and Courant Institute of Mathematical Sciences, New York University, USA

## MS39

### Applications of Differential Equations and Dynamical Systems in Immunology and Medicine - Part I of III

8:30 AM-9:45 AM

### Room: Wasatch A

### For Part 2 see MS50

Many biomedical processes including tumor growth, cardio-vascular disease, infection, and healing are mediated by immunologic mechanisms. The study of nonlinear differential equations arises in the endeavor to characterize many complex processes observed in immunology and medical applications. This mini-symposium is dedicated to research and analysis of mathematical models of such phenomena. It is believed that the features of solutions such as instabilities, bifurcations, symmetries, and blow-up can provide insight into the nature of the underlying bio-physical mechanisms. Such insight will contribute to the understanding and treatment of disease and its spread.

Organizer: Laura Ritter Southern Polytechnic State University, USA

Organizer: Akif Ibragimov Texas Tech University, USA

Organizer: Jay R. Walton Texas A&M University, USA

### 8:30-8:50 Ensemble Modeling of Human Immune Response to IAV Infection

*Baris Hancioglu*, Virginia Polytechnic Institute & State University, USA; Gilles Clermont and David Swigon, University of Pittsburgh, USA

#### 8:55-9:15 The Dynamics of Foreign Body Reaction Models in 2-dimensions

*Jianzhong Su*, University of Texas at Arlington, USA

### 9:20-9:40 A Mathematical Model of Ischemic Wound Healing

*Chuan Xue* and Avner Friedman, Ohio State University, USA; Chandan Sen, The Ohio State University Medical Center, USA Monday, May 23

## **MS40**

Dynamical System Methods for Design and Operation of Sustainable Buildings - Part I of II

8:30 AM-10:10 AM

## Room:Wasatch B

### For Part 2 see MS51

Energy consumption is a global concern for scientists and engineers as building operation accounts for approximately 40% of this consumption in developed economies. Efficient design and operation is essential to reduce this consumption. This twopart minisymposia will investigate the dynamics of high performance buildings and how current design and analysis tools are being used to make buildings more efficient. We report on efforts to quantify how uncertainty or component failures propagate through wholebuilding models, zoning concerns when defining models, model reduction for capturing relevant dynamics, Lagrangian coherent structures and multiple steady state analysis of airflows, and some of the current challenges to future design tools.

Organizer: Bryan Eisenhower University of California, Santa Barbara, USA

Organizer: Amit Surana United Technologies Research Center, USA

#### 8:30-8:50 Challenges and Numerical Consideration in Building Energy Modeling

Michael Wetter and *Wangda Zuo*, Lawrence Berkeley National Laboratory, USA

### 8:55-9:15 Uncertainty and Sensitivity Analysis in Building Models

Bryan Eisenhower, University of California, Santa Barbara, USA

continued in next column

### 9:20-9:40 Model-based Failure Mode Effect Analysis in High Performance Buildings

Kevin Otto, Robust Systems and Strategy, USA

### 9:45-10:05 Lagrangian Coherent Structures Based Analysis of Building Airflows

*Amit Surana*, Sunil Ahuja, and Satish Narayanan, United Technologies Research Center, USA

## MS41 Dynamics in Systems Biology - Part I of II

8:30 AM-10:10 AM

### Room:Maybird

### For Part 2 see MS52

Dynamical system theory has proven to be a fundamental tool to describe fundamental processes in cell biology. In this minisymposium, we address how the theories of dynamical systems and stochastic processes provide key insight into two questions of utmost biological importance, robustness and coordination. In Part I, we will discuss how dynamics can ensure robustness to fluctuations and how to characterize robustness of a biological model to parameter changes. In Part II, we will consider how spatial coordination can be achieved in intra-cell and cell-tocell communication, and development. Special emphasis will be put on integrating theoretical predictions with experimental results.

Organizer: Marc Lefranc Universite de Lille 1, France

Organizer: Marco Thiel University of Aberdeen, United Kingdom

### 8:30-8:50 Robustness of Circadian Clocks to Daylight Fluctuations: Hints from Picoeukaryote Ostreococcus Tauri

Quentin Thommen, Benjamin Pfeuty, and Pierre-Emmanuel Morant, Universite de Lille 1, France; Florence Corellou, Observatoire Océanologique de Banyuls, France; François-Yves Bouget, CNRS, France; *Marc Lefranc*, Universite de Lille 1, France

### 8:55-9:15 Translational Regulation of Gene Expression

*M. Carmen Romano*, Luca Ciandrini, and Ian Stansfield, University of Aberdeen, United Kingdom

continued in next column

### 9:20-9:40 Ribosome Traffic During Protein Synthesis

David Broomhead, University of Manchester, United Kingdom

### 9:45-10:05 Identifiability and Observability Analysis for Experimental Design in Nonlinear Dynamical Models in Systems Biology

Andreas Raue and Clemens Kreutz, University of Freiburg, Germany; Ursula Klingmueller, German Cancer Research Center, Germany; Jens Timmer, University of Freiburg, Germany Monday, May 23

## MS42 Exploring High-dimensional Chaos with Characteristic Lyapunov Vectors

8:30 AM-10:10 AM

### Room:Superior A

Characteristic Lyapunov vectors (CLVs) carry the dynamical information of the system: they are intrinsic, independent of the scalar product, and invariant under time reversal. However, until recently, it was not known how to compute CLVs efficiently in large systems. Over the last 50 years, these computational difficulties have made researchers to replace genuine CLVs by other, less useful and incomplete quantifiers, easier to compute but with doubtful meaning. Very novel computational algorithms have recently allowed to compute truly covariant CLVs in complex high-dimensional systems. The session will cover applications of CLV including correlations of CLVs, hydrodynamic modes, and hyperbolicity of extended dynamical systems, among others.

Organizer: Juan M. Lopez Instituto de Física de Cantabria (IFCA), Spain

Organizer: Antonio Politi CNR, Italy

8:30-8:50 Characterisitc Lyapunov Vectors: Critical Overview and State of the Art

*Diego Pazo*, Instituto de Física de Cantabria (IFCA), Spain

### 8:55-9:15 Efficient Computation of Characteristic Lyapunov Vectors in Spatially Extended Systems

*Christopher L. Wolfe*, Scripps Institution of Oceanography, USA; Roger Samelson, Oregon State University, USA

#### 9:20-9:40 Lyapunov Analysis and Hyperbolicity of Extended Dynamical Systems

Hong-Liu Yang and *Gunter Radons*, Chemnitz University of Technology, Germany

9:45-10:05 Structure and Dynamic Localization of Characteristic Lyapunov Vectors in Anharmonic Hamiltonian Lattices

Mauricio Romero-Bastida, Instituto Politécnico Nacional, Mexico

## MS43 Criticality and Dynamic Range in Neuronal Networks

### 8:30 AM-10:10 AM

### Room:Superior B

Recent experiments and several models suggest that neuronal networks may operate in a critical regime, balanced at the boundary between ordered and disordered dynamics. This minisymposium will provide an overview of current research on the origin and implications of criticality for information processing. Topics will include experimental studies connecting criticality with optimized dynamic range and neural synchrony, as well as theoretical studies of the effect of network topology on the dynamic range of neuronal networks, and how criticality can emerge in a biologically realistic neural model.

### Organizer: Juan G. Restrepo University of Colorado at Boulder, USA

Organizer: Woodrow L. Shew *National Institutes of Health, USA* 

### 8:30-8:50 Neuronal Avalanches and Optimized Information Processing in Cortical Neural Networks

*Woodrow L. Shew*, National Institutes of Health, USA

### 8:55-9:15 Predicting Criticality and Dynamic Range in Complex Networks: Effects of Topology

*Daniel Larremore*, University of Colorado at Boulder, USA

### 9:20-9:40 Criticality and Dynamic Network Reconfiguration in Human Brain fMRI and MEG Recordings

Manfred G. Kitzbichler, University of Cambridge, United Kingdom

### 9:45-10:05 Self-organized Criticality in Adaptive Neural Networks

*Thilo Gross*, Max Planck Institute for Physics of Complex Systems, Germany

### Monday, May 23

## MS44 Nonlinear Dynamics of Cardiac Electrophysiology

8:30 AM-10:10 AM

### Room:White Pine

The heart is an excitable system, with a wave of electrical activity triggering a calcium-mediated contraction process. The electrical waves arise from local reactions within the cell and across the cell membrane that produce propagating action potentials. Cardiac tissue can support a rich variety of dynamics, including bifurcations and spiral waves. This minisymposium will present some of the latest discoveries of complex behavior in cardiac tissue using results obtained from numerical integration of mathematical models as well as experimental data.

Organizer: Elizabeth M. Cherry Rochester Institute of Technology, USA

### 8:30-8:50 Alternans and Nonlinear Dynamics in Cardiac Tissue

*Elizabeth M. Cherry*, Rochester Institute of Technology, USA; Flavio H. Fenton, Cornell University, USA

### 8:55-9:15 Temperature Effects on Spatial Patterns of Cardiac Alternans

Alessio Gizzi, University Campus Biomedico of Rome, Italy; Elizabeth
M. Cherry, Rochester Institute of Technology, USA; Stefan Luther, Max-Planck-Institute for Dynamics and Self-Organization, Germany; Simonetta Filippi, University of Rome La Sapienza, Italy; Flavio Fenton, Cornell University, USA

# 9:20-9:40 Spatio-Temporal Dynamics of Alternans in the Heart

Alena Talkachova, University of Minnesota, USA

### 9:45-10:05 Spiking and Bursting in an Autonomous Model of Mouse Ventricular Myocytes

*Vladimir E. Bondarenko* and Andrey Shilnikov, Georgia State University, USA Monday, May 23 Intermission 10:10 AM-10:15 AM

## CP12 Bifurcation Theory

10:15 AM-11:15 AM

Room: Wasatch B

Chair: Hartmut Erzgraber, University of Exeter, United Kingdom

#### 10:15-10:30 Analyzing the Bifurcations of Ergodic Tori Using a Second Poincaré Section

Soumitro Banerjee, Indian Institute of Science Education and Research, India; Damian Giaouris, Newcastle University, United Kingdom

### 10:35-10:50 Modelling and Dynamics of Lasers Coupled by a Passive Resonator

*Hartmut Erzgraber* and Sebastian M. Wieczorek, University of Exeter, United Kingdom

### 10:55-11:10 Multiple Time Scale Dynamics in the Gyorgyi and Field Models of the Belousov-Zhabotinsky Reaction

Christopher J. Scheper and John Guckenheimer, Cornell University, USA

## CP13 Data Assimilation

10:15 AM-11:15 AM

### Room:Ballroom I

Chair: Andrew M. Fraser, Los Alamos National Laboratory, USA

#### 10:15-10:30 Dynamics of the Data Assimilation Linked Ecosystem Carbon Model (dalec)

Anna M. Chuter, University of Surrey, United Kingdom

#### 10:35-10:50 Quantifying Uncertainty in Climate Change Science Through Empirical Information Theory

Boris Gershgorin and Andrew Majda, Courant Institute of Mathematical Sciences, New York University, USA

### 10:55-11:10 The Dynamic Radiation Environment Assimilation Model Project (dream)

Humberto C. Godinez and *Andrew M. Fraser*, Los Alamos National Laboratory, USA Monday, May 23

## CP14 Stochastics I

10:15 AM-11:15 AM

Room:Superior A

Chair: Xiaowen Li, Beijing Normal University, China and University of Maryland, USA

### 10:15-10:30 Scalable Parallel Physical Random Number Generator Based on a Superluminescent LED

Xiaowen Li, Beijing Normal University, China and University of Maryland, USA; Adam B. Cohen, University of Maryland, USA; Thomas E. Murphy, University of Maryland, College Park, USA; Rajarshi Roy, University of Maryland, USA

#### 10:35-10:50 Optimal Phase Response Curve for Synchronization of Limit-Cycle Oscillators.

Shigefumi Hata and Hiroya Nakao, Kyoto University, Japan

#### 10:55-11:10 Dynamics and Bifurcations of Stochastic Mean-Field Equations

Jonathan D. Touboul, INRIA, France

### Monday, May 23

## CP15 Partial Differential Equations II

10:15 AM-11:15 AM

Room:Superior B

Chair: Rouslan Krechetnikov, University of California, Santa Barbara, USA

### 10:15-10:30 On the Origin and Nature of Finite-Amplitude Instabilities in Physical Systems

Rouslan Krechetnikov, University of California, Santa Barbara, USA

10:35-10:50 Analytical Time and Frequency Cause-and-Effect Analyses Using Volterra Series Ashraf Omran and Brett Newman, Old Dominion University, USA

### 10:55-11:10 Low-Dimensional Models and Anomaly Detection for TCPlike Networks Using the Koopman Operator

Ryan Mohr and Igor Mezic, University of California, Santa Barbara, USA

## **CP16 CANCELLED** 10:15 AM-11:15 AM

Monday, May 23

CP17

Fluids II

10:15 AM-11:15 AM

Room:Maybird

Chair: Mohsen Gheisarieha, Virginia Polytechnic Institute & State University, USA

### 10:15-10:30 An Arbitrary Stokes Flow in and Around a Liquid Sphere

Sripadmavati Bhavaraju, University of Hyderabad, India

#### 10:35-10:50 Low Dimensional Models for Optimal Streaks in the Blasius Boundary Layer

Maria Higuera, Universidad Politécnica de Madrid, Spain; Jose Vega, Universidad Politécnica de Madrid, Spain

#### 10:55-11:10 Stirring and Mixing in a Stokes' Flow: Topological Chaos, Almost Invariant Sets, and Lobe Dynamics

Mohsen Gheisarieha and Mark Stremler, Virginia Polytechnic Institute & State University, USA Monday, May 23

## CP18 Population Dynamics II

10:15 AM-10:55 AM

Room:Magpie A

Chair: Anuraj Singh, Indian Institute of Technology, Roorkee, India

### 10:15-10:30 Effect of Delay in a Lotka-Volterra Type Predator-Prey Model with a Transmissible Disease in the Predator Species

Sabiar Rahaman, Social Science and Humanities Society, India; Sabuddin Sarwardi, Aliah University, India; Mainul Haque, University of Nottingham, United Kingdom

#### 10:35-10:50 Complexity in a Prey-Predator Delayed Model with Modified Leslie-Gower and Holling-Type II Schemes

Anuraj Singh and Sunita Gakkhar, Indian Institute of Technology Roorkee, India

## CP19 Neuroscience I

10:15 AM-11:15 AM

Room:Ballroom II

Chair: Jian-Young Wu, Georgetown University, USA

### 10:15-10:30 Illusory Persistent States in a Model of Visual Motion Perception

James Rankin, Olivier Faugeras, Émilien Tlapale, Romain Veltz, and Pierre Kornprobst, INRIA Sophia Antipolis, France

### 10:35-10:50 Patterns of Excitation Waves in Cerebral Cortex

Jian-Young Wu, Georgetown University, USA

### 10:55-11:10 Hebbian Learning in Hopfield Networks Leads to Reaction-Diffusion Equations on Geometrical Shapes.

Mathieu N. Galtier and Olivier Faugeras, INRIA Sophia Antipolis, France; Paul C. Bressloff, University of Utah, USA and University of Oxford, United Kingdom Monday, May 23

## CP20 Oscillators I

10:15 AM-11:15 AM

### Room:Ballroom III

Chair: Alexey Kuznetsov, Indiana University - Purdue University Indianapolis, USA

### 10:15-10:30 Phase Oscillator Networks with Star-Like Coupling: Bifurcation Analysis

Oleksandr Burylko, Ukraine National Academy of Sciences, Ukraine; Yakov Kazanovich, Russian Academy of Sciences, Russia; *Roman M. Borisyuk*, University of Plymouth, United Kingdom

# 10:35-10:50 Sensitivity Analysis of Phase Response Curves

Pierre Sacré and Rodolphe Sepulchre, Université de Liège, Belgium

# 10:55-11:10 Dynamical Properties of the Repressilator Model

Alexey Kuznetsov, Indiana University -Purdue University Indianapolis, USA Monday, May 23

## **CP21**

## Mesoscales in Complex Networks II

10:15 AM-11:15 AM

Room:Magpie B

Chair: Irene Sendina-Nadal, Universidad Rey Juan Carlos, Spain

### 10:15-10:30 Structural Properties and Models for Multilevel Networks

Miguel Romance, Regino Criado, Julio Flores, and Alejandro Garcia del Amo, Universidad Rey Juan Carlos, Spain; Jesus Gomez-Gardenes, Universidad de Zaragoza, Spain

### 10:35-10:50 Complex Networks Mesoscopically Characterized by IPO: Courtship Grammar Beyond Chance

*Ruedi Stoop*, Institute of Neuroinformatics ETHZ/UNIZH, Switzerland

### 10:55-11:10 Unveiling Multifunctional Proteins by Means of the Synchronization Properties of the PPI Network

Irene Sendina-Nadal, Universidad Rey Juan Carlos, Spain; Yanay Ofran, Bar-Ilan University, Israel; Juan A. Almendral, Javier Buldu, and Inmaculada Leyva, Universidad Rey Juan Carlos, Spain; Daqing Li and Shlomo Havlin, Bar-Ilan University, Israel; Stefano Boccaletti, CNR, Italy

# **CP22**

## **Dynamical Systems I**

10:15 AM-11:15 AM

### Room: Wasatch A

Chair: Joshua Garland, University of Colorado at Boulder, USA

### 10:15-10:30 Prediction of Computer **Dynamics**

Joshua T. Garland and Elizabeth Bradley, University of Colorado at Boulder, USA

#### 10:35-10:50 The Iterated Traveler's Dilemma: Seeking Stability in An **Unstable Action Space**

Philip Dasler and Predrag Tosic, University of Houston, USA

### 10:55-11:10 Statistics of Branched Flow Structure in Optical Media

*Xuan Ni*, Wenxu Wang, and Ying-Cheng Lai, Arizona State University, USA

## Coffee Break



Room:Golden Cliff

### Monday, May 23

## IP3

## How Can We Model the Regulation of Stress Hormones?

11:45 AM-12:30 PM

### Room:Ballroom

Chair: Carson C. Chow, National Institutes of Health and University of Pittsburgh, USA

Daily and monthly rhythms of hormones are well recognised. Less well known are the more rapid ultradian changes which are a characteristic of most biologically active hormone systems. We have looked at the regulation of the stress hormones – glucocorticoids – secreted by the adrenal glands. It has always been assumed that the episodic release of these hormones was a result of some form of pulse generator in the brain. A dispassionate look at this system however, revealed that there was a feedforward: feedback relationship between the pituitary gland and the adrenal gland providing scope for a peripheral oscillating hormonal system. The background to this system and the biological testing of our mathematical predictions will be described.

Stafford Lightman University of Bristol, United Kingdom

Lunch Break 12:30 PM-2:00 PM Attendees on their own

### Monday, May 23

## IP4

## Climate Sensitivity, Feedback and Bifurcation: From Snowball Earths to the **Runaway Greenhouse**

2:00 PM-2:45 PM

### Room:Ballroom Chair: Marv Lou Zeeman. Bowdoin College and Cornell University, USA

The concept of climate sensitivity lays at the heart of assessment of the magnitude of the imprint of human activities on the Earth's climate. Most commonly, the "climate" is represented by a simple projection such as a global mean temperature, and we wish to know how this changes in response to changes in a single control parameter -usually atmospheric CO2 concentration. This problem is an instance of a broad class of related problems in parameter dependence of dynamical systems. I will discuss the shortcomings of the traditional linear approach to this problem, particularly in light of the spurious "runaway" states produced when feedback becomes large. The extension to include nonlinear effects relates in a straightforward way to bifurcation theory. I will discuss explicit examples arising from ice-albedo, water vapor, and cloud feedbacks. Finally, drawing on the logistic map as an example, I will discuss the problem of defining climate sensitivity for problems exhibiting structural instability.

Raymond T. Pierrehumbert University of Chicago, USA

Intermission 2:45 PM-3:00 PM

## **MS45**

Arctic Sea Ice and Climate Change: Bifurcations in Mathematical and Computational Models

### 3:00 PM-4:40 PM

### Room:Ballroom I

This minisymposium focuses on investigations of Arctic sea ice loss, with increases in greenhouse gases, within models that range in complexity from low order dynamical systems to state-of-the- art global climate models. Questions concerning evidence for multistability, bifurcations, and threshold behavior associated with seasonally varying Arctic sea ice will be addressed. In the case of low-order models these questions can be tackled analytically using tools of dynamical systems. However, there are enormous challenges in using these results to determine whether comparable bifurcations or tipping points occur in large scale global climate model simulations. These challenges will be highlighted.

Organizer: Dorian S. Abbot University of Chicago, USA

Organizer: Mary C. Silber Northwestern University, USA

#### 3:00-3:20 Rapid Sea Ice Loss in Climate Model Simulations of a Changing Arctic

Marika Holland, National Center for Atmospheric Research, USA

#### 3:25-3:45 Factors Controlling the Stability of the Sea Ice Cover

Ian Eisenman, California Institute of Technology, USA

#### 3:50-4:10 Bifurcation Analysis of a Low-order Model of Arctic Sea Ice *Mary C. Silber*, Northwestern

University, USA; Dorian S. Abbot and Raymond T. Pierrehumbert, University of Chicago, USA

### 4:15-4:35 Sea Ice as a Discrete Map

*Kay Huebner*, Max Planck Institute for Meteorology, Hamburg, Germany

## Monday, May 23

## **MS46**

Dynamics of Spatially Extended Structures in Higher Order Systems - Part I of II

### 3:00 PM-4:40 PM

## Room:Ballroom II

For Part 2 see MS57

Many physical applications including reaction-diffusion systems, phase separation in charged polymer-solvent interactions, and ion channels are modeled by higher order systems of equations which display a range of dynamics beyond that of lower order counterparts. In higher space dimension the interaction of spots, curvature driven evolution of bilayers and pore-like solutions leads to complex bifurcations and challenging stability problems. This minisymposium will present that latest developments in this emerging field.

Organizer: Keith Promislow Michigan State University, USA

Organizer: Gurgen Hayrapetyan Michigan State University, USA

3:00-3:20 The Dynamics and Stability of Localized Spot Patterns for the Gray-Scott model in Two Dimensions *Michael Ward*, University of British Columbia, Canada; Wan Chen,

Oxford University, United Kingdom

### 3:25-3:45 Geometric Evolution of bi-layers in the Functionalized Cahn-Hilliard Equation

*Gurgen Hayrapetyan*, Michigan State University, USA

### 3:50-4:10 The Pearling Instability in Polymer Electrolyte Solutions

Arjen Doelman, Leiden University, Netherlands; Greg Hayrapetyan, Michigan State University, USA; Keith Promislow, Michigan State University, USA

### 4:15-4:35 Energetic Variational Approaches in Ionic Fluids and Ion Channels

*Chun Liu*, Pennsylvania State University, USA

### Monday, May 23

## MS47 Piecewise Isometries: Applications and Theory

3:00 PM-4:40 PM

### Room:Ballroom III

Recently, piecewise isometries (PWIs) have emerged as a branch of dynamical systems. They exhibit complex and intricate dynamics, despite a lack of hyperbolicity, and having zero Lyapunov exponents and zero topological entropy. In applications, PWIs have been found to play a role in areas as diverse as digital filter design and the mixing of granular matter. Discontinuities play a significant role in the dynamics of PWIs, their growth, classification and characterization reveal both understanding and open problems. The speakers of this minisymposium will address the application of PWIs in engineering and science and the role of discontinuities.

Organizer: Rob Sturman University of Leeds, United Kingdom

Organizer: Ivan C. Christov Northwestern University, USA

# 3:00-3:20 Dynamics and Applications of Piecewise Isometries

*Rob Sturman*, University of Leeds, United Kingdom

### 3:25-3:45 Singularities of Invertible Planar Piecewise Rotations

Byungik Kahng, University of North Texas, USA

### 3:50-4:10 Interval Exchange Discontinuity Growth and Group Actions

Chris Novak, University of Michigan, Dearborn, USA

#### 4:15-4:35 Applications of Piecewise Isometries in Electronic Engineering Jonathan Deane, University of Surrey,

Jonathan Deane, University of Surrey, United Kingdom
## MS48 A Glimpse of Stochastic Dynamics - Part I of II

3:00 PM-4:40 PM

#### Room:Magpie A

## For Part 2 see MS59

Nonlinear systems are often under random influences. The uncertainties may be due to external fluctuations or unresolved scales. These random influences may affect system evolution at various spatial and temporal scales, sutbly or profundly. Taking uncertainty into account is essential in modeling various complex phenomena in biological, physical and chemical systems. The objective of this minisymposium is to bring together experts from multiple disciplines with complementary views and approaches to stochastic dynamics in the context of applications.

Organizer: Jinqiao Duan Illinois Institute of Technology, USA

## 3:00-3:20 An Overview of Stochastic Dynamics

Manfred Denker, Pennsylvania State University, USA

#### 3:25-3:45 Connection Between Discrete Stochastic Cell-based Models and Nonlinear Diffusion Equations

Mark Alber, University of Notre Dame, USA

#### 3:50-4:10 Derivation of SPDEs for Correlated Random Walks and SDEs for Sunspot Activity

*Edward J. Allen*, Ummugul Bulut, Elife Dogan, and Chisum Huff, Texas Tech University, USA

#### 4:15-4:35 Impact of Noise on Invariant Manifolds

Jinqiao Duan, Illinois Institute of Technology, USA

## Monday, May 23

## **MS49**

Time Averages of Observables: Theory, Numerics, and Applications - Part I of II

3:00 PM-4:40 PM

## Room:Magpie B

## For Part 2 see MS60

Recently, averaging-based methods for analyzing dynamical systems have been gaining attention as indicated in the plenary talks of Igor Mezic (DS09) and Christopher Jones (DS11). In this minisymposium, we connect to these plenaries and explore diverse and novel methods for obtaining a range of beneficial information that one can extract from averaging purposefully chosen observables. Specifically, we will (1) discuss the theory behind several time-averaging methods for identifying coherent structures and building models, (2) consider numerical analysis issues that arise with these methods, and (3) present applications of the methods in the analysis of systems such as ocean flows and power systems.

Organizer: Marko Budisic University of California, Santa Barbara, USA

#### 3:00-3:20 Time Averaged Observables in Dynamical System Analysis: An Overview

Marko Budisic, University of California, Santa Barbara, USA

#### 3:25-3:45 Variations on a Harmonic Analysis and Ergodic Theory Based Method for Analyzing Fluid Flows Sherry Scott, Marquette University, USA

# 3:50-4:10 Shadowing the Trajectories of Molecular Dynamics

Paul Tupper, Simon Fraser University, Canada

### 4:15-4:35 Convergence of Long Time Numerical Averages of SDEs

Jonathan C. Mattingly, Duke University, USA

## Monday, May 23

## **MS50**

## Applications of Differential Equations and Dynamical Systems in Immunology and Medicine - Part II of III

3:00 PM-4:40 PM

Room: Wasatch A

## For Part 1 see MS39 For Part 3 see MS61

Many biomedical processes including tumor growth, cardio-vascular disease, infection, and healing are mediated by immunologic mechanisms. The study of nonlinear differential equations arises in the endeavor to characterize many complex processes observed in immunology and medical applications. This minisymposium is dedicated to research and analysis of mathematical models of such phenomena. It is believed that the features of solutions such as instabilities, bifurcations, symmetries, and blow-up can provide insight into the nature of the underlying bio-physical mechanisms. Such insight will contribute to the understanding and treatment of disease and its spread.

Organizer: Laura Ritter Southern Polytechnic State University, USA

Organizer: Akif Ibragimov Texas Tech University, USA

Organizer: Jay R. Walton Texas A&M University, USA

3:00-3:20 Using a Mathematical Model to Analyze the Treatment of a Mathematical Model of a Wound Infection with Oxygen Therapy *Richard Schugart*, Western Kentucky

University, USA

## 3:25-3:45 Modeling the Effects of Systemic Cortisol on the Wound Healing Process

Angela M. Reynolds, Virginia Commonwealth University, USA

continued on next page

# **MS50**

## Applications of Differential Equations and Dynamical Systems in Immunology and Medicine - Part II of III

3:00 PM-4:40 PM

continued

## 3:50-4:10 Dynamics of Hepatitis B Virus Infection: What Causes Viral Clearance?

Anne Catlla, Wofford College, USA; Stanca Ciupe, University of Louisiana, USA; Jonathan Forde, Hobart and William Smith Colleges, USA; David G. Schaeffer, Duke University, USA

## 4:15-4:35 Moving the Head: The Donderian Way

Bijoy K. Ghosh, Texas Tech University, USA

# Monday, May 23

# **MS51**

Dynamical System Methods for Design and Operation of Sustainable Buildings - Part II of II

## 3:00 PM-4:40 PM

Room: Wasatch B

## For Part 1 see MS40

Energy consumption is a global concern for scientists and engineers as building operation accounts for approximately 40% of this consumption in developed economies. Efficient design and operation is essential to reduce this consumption. This twopart minisymposia will investigate the dynamics of high performance buildings and how current design and analysis tools are being used to make buildings more efficient. We report on efforts to quantify how uncertainty or component failures propagate through wholebuilding models, zoning concerns when defining models, model reduction for capturing relevant dynamics, Lagrangian coherent structures and multiple steady state analysis of airflows, and some of the current challenges to future design tools.

Organizer: Bryan Eisenhower University of California, Santa Barbara, USA

Organizer: Amit Surana United Technologies Research Center, USA

#### 3:00-3:20 Reduced-order Models for Control of Building Indoor Environment

Sunil Ahuja and Amit Surana, United Technologies Research Center, USA; Eugene Cliff, Virginia Polytechnic Institute & State University, USA

continued in next column

## 3:25-3:45 Design Specific Computational Tools for Control of Energy Efficient Buildings

John A. Burns, Eugene Cliff, and Lizette Zietsman, Virginia Polytechnic Institute & State University, USA

## 3:50-4:10 Optimal Zoning in Building Energy Models

Michael Georgescu, University of California, Santa Barbara, USA

## 4:15-4:35 Nonlinear Behaviors in Building Ventilation Systems

Jinchao Yuan and Leon Glicksman, Massachusetts Institute of Technology, USA

## MS52 Dynamics in Systems Biology - Part II of II

3:00 PM-4:40 PM

## Room:Maybird

## For Part 1 see MS41

Dynamical system theory has proven to be a fundamental tool to describe fundamental processes in cell biology. In this minisymposium, we address how the theories of dynamical systems and stochastic processes provide key insight into two questions of utmost biological importance, robustness and coordination. In Part I, we will discuss how dynamics can ensure robustness to fluctuations and how to characterize robustness of a biological model to parameter changes. In Part II, we will consider how spatial coordination can be achieved in intra-cell and cell-tocell communication, and development. Special emphasis will be put on integrating theoretical predictions with experimental results.

Organizer: Marc Lefranc Universite de Lille 1, France

Organizer: Marco Thiel University of Aberdeen, United Kingdom

### 3:00-3:20 Genetic Oscillations: From Time to Space

Mogens Jensen, Sandeep Krishna, and Simone Pigolotti, Niels Bohr Institute, Denmark

## 3:25-3:45 Synchronized Genetic Clocks in E. Coli

*Tal Danino*, Octavio Mondragon-Palomino, Lev S. Tsimring, and Jeff Hasty, University of California, San Diego, USA

## 3:50-4:10 How Do Cells Behave as a Collective During Embryogenesis? The Role of Cell-cell Interaction

*Yasushi Saka*, University of Aberdeen, United Kingdom; Cedric Lhoussaine and Celine Kuttler, Universite de Lille 1, France; Ekkehard Ullner and Marco Thiel, University of Aberdeen, United Kingdom

## 4:15-4:35 Bifurcation Theory for Evodevo

Paul François, McGill University, Canada

## Monday, May 23

## MS53 Discrete and Continuous Waves - Part I of II

3:00 PM-4:40 PM

## Room:Superior A

## For Part 2 see MS64

Nonlinear waves are a fundamental mechanism by which energy or activity can be transported from one spatial region to another in a spatially extended systems. This mini-symposium highlights recent work on the existence, stability, and interaction properties of waves for both partial differential equations and lattice differential equations. Of particular interest are differences in the dynamics between continuous and discrete systems and between one and higher space dimension.

Organizer: Aaron Hoffman Franklin W. Olin College of Engineering, USA

Organizer: Erik Van Vleck University of Kansas, USA

Organizer: Atanas Stefanov University of Kansas, USA

## 3:00-3:20 Nonlinear Stability of Semidiscrete Shocks

Björn Sandstede, Brown University, USA

3:25-3:45 Fast and Slow Pulses for the Discrete FitzHugh-Nagumo Equation *Hermen Jan Hupkes*, Brown University, USA

# 3:50-4:10 Propagation Failure in the Discrete Nagumo Equation

Dmitry Pelinovsky, McMaster University, Canada

## 4:15-4:35 Neutral Mixed Type Functional Differential Equations

Charles Lamb, University of Kansas, USA

## Monday, May 23

## MS54 Dynamical implications of network structures

3:00 PM-4:40 PM

## Room:Superior B

The study of complex networks of dynamical systems has become an area of wide interest, following an explosion of our knowledge of the detailed structure of connectivity in many real networks. Given this everexpanding body of knowledge, a natural and fundamental problem for the dynamical systems community is to study how the time evolution of the node dynamics is influenced by the properties of the network structure. The speakers of this minisymposium will address various aspects of this problem using synchronization, as well as other dynamical processes taking place on the network.

Organizer: Takashi Nishikawa Clarkson University, USA

# 3:00-3:20 Synchronization and Network Directionality

Takashi Nishikawa, Clarkson University, USA

# 3:25-3:45 Synchronization in Networks with Disconnected Components

Igor Belykh, Georgia State University, USA

#### 3:50-4:10 Controlling Nonlinear Dynamics in Complex Networks

Adilson E. Motter, Northwestern University, USA

## 4:15-4:35 Building a Cancer-type Specific Metabolic Network Model

Joo Sang Lee, John Marko, and Adilson E. Motter, Northwestern University, USA

## MS55 Neuronal and Network Dynamics in Basal Ganglia

3:00 PM-4:40 PM

## Room: White Pine

Abnormalities in oscillatory activity and synchronization in the basal ganglia (BG) neurons and networks are believed to contribute to many BG-associated disorders, including Parkinson's disease (PD). Recent experimental studies of PD and BG physiology opened a way for application of dynamical systems to a variety of important phenomena, from the oscillations in the dopaminergic cells to the beta-band synchronization in PD. We will discuss dynamical systems applications to the neurons and networks in BG to get insights into their role in the mechanisms of Parkinson's disease and other BG disorders as well as in healthy brain function.

Organizer: Choongseok Park Indiana University - Purdue University Indianapolis, USA

Organizer: Leonid Rubchinsky Indiana University-Purdue University Indianapolis (IUPUI), USA

3:00-3:20 Intermittent Synchronization of Basal Ganglia Activity

Leonid Rubchinsky, and Choongseok Park, Indiana University - Purdue University Indianapolis, USA; Robert Worth, Indiana University School of Medicine, USA

## 3:25-3:45 A Novel Phase Model of Subthalamic Neurons Capturing the Interaction Between Synaptic Excitation and Spike Threshold

Michael Farries and Charles Wilson, University of Texas, San Antonio, USA

continued in next column

## 3:50-4:10 Firing Pattern of Mid-brain Dopaminergic Neurons

Joon Ha, National Institutes of Health, USA; Alexey Kuznetsov, Indiana University - Purdue University Indianapolis, USA

## 4:15-4:35 Entrainment of a Thalamocortical Neuron to Periodic Sensorimotor Signals

Dennis Guang Yang and Yixin Guo, Drexel University, USA

## **Coffee Break**

4:40 PM-5:10 PM Room:Golden Cliff



Monday, May 23

# **MS56**

Mathematical Neuroendocrinology -Part I of II

5:10 PM-6:50 PM

Room:Ballroom I

## For Part 2 see MS67

The regulation of hormone release from glands in the body is crucial to good health. Much of this regulation is through hormone-secreting cells in the pituitary gland. Secretion from these cells is in turn controlled largely by a region of the brain called the hypothalamus. Neuroendocrinology refers to the study of interactions between the pituitary and the hypothalamus. In this minisymposium, speakers describe mathematical models for these interactions. In addition, some of the cellular behavior is quite complex, often involving bursting electrical oscillations. This complex, multiscale behavior is also a focus area of the minisymposium.

Organizer: Richard Bertram Florida State University, USA

Organizer: Krasimira Tsaneva-Atanasova

University of Bristol, United Kingdom

Organizer: Joel Tabak Florida State University, USA

5:10-5:30 Mathematical Modeling of P2X7 Receptor/channel Gating

Anmar Khadra, Arthur Sherman, Yan Zonghe, and Stanko Stojilkovic, National Institutes of Health, USA

5:35-5:55 Model Calibration and Testing on the Same Cell

Maurizio Tomaiuolo, Richard Bertram, Arturo Gonzalez-Iglesias, and Joel Tabak, Florida State University, USA

#### 6:00-6:20 Mathematical Modelling of Adult GnRH Neurons in the Mouse Brain

Wen Duan, University of Auckland, New Zealand; Kiho Lee and Allan Herbison, University of Otago, New Zealand; James Sneyd, University of Auckland, New Zealand

6:25-6:45 Searching for the Glucocorticoid Pulse Generator Jamie Walker, University of Bristol, United Kingdom

# **MS57**

## Dynamics of Spatially Extended Structures in Higher Order Systems -Part II of II

5:10 PM-6:50 PM

## Room:Ballroom II

## For Part 1 see MS46

Many physical applications including reaction-diffusion systems, phase separation in charged polymer-solvent interactions, and ion channels are modeled by higher order systems of equations which display a range of dynamics beyond that of lower order counterparts. In higher space dimension the interaction of spots, curvature driven evolution of bilayers and pore-like solutions leads to complex bifurcations and challenging stability problems. This minisymposium will present that latest developments in this emerging field.

Organizer: Keith Promislow Michigan State University, USA

Organizer: Gurgen Hayrapetyan Michigan State University, USA

#### 5:10-5:30 Pattern Selection Through Invasion in Cahn-Hilliard and Phase-Field Models

Arnd Scheel, University of Minnesota, Minneapolis, USA

#### 5:35-5:55 Existence of Homoclinic Solutions of the Functionalized Cahn-Hilliard Equation

*Li Yang*, Michigan State University, USA; Keith Promislow, Michigan State University, USA

#### 6:00-6:20 Accelerating and Oscillating Fronts in a Threecomponent System

Martina Chirilus-Bruckner, Boston University, USA; Jens Rademacher, CWI, Amsterdam, Netherlands; Arjen Doelman, Leiden University, Netherlands

### 6:25-6:45 Towards Traveling Spots in a Three-component FitzHugh-Nagumo System

Peter van Heijster and Bjorn Sandstede, Brown University, USA Monday, May 23

## MS58 Piecewise Affine Maps: Theory

5:10 PM-6:50 PM

## Room:Ballroom III

Piecewise affine (linear plus constant) maps arise in models of hybrid systems and mechanics. They are also interesting in their own right. A theory is emerging for the general case, addressing invariant measures, topological entropy and periodic orbits. At the same time special cases continue to fascinate: piecewise isometries have structures reminiscent of Hamiltonian dynamics, and there has been a resurgence of work on the continuous case (border-collisions, Lozi maps) showing resonant tongues (see the conference logo!) and proofs of the existence of simple geometric attractors. We will address recent developments and look at how the different cases interact.

Organizer: Paul Glendinning University of Manchester, United Kingdom

# **5:10-5:30 Piecewise Isometries** *Arek Goetz*, San Francisco State

University, USA

**5:35-5:55 Entropy of the Lozi Maps** *Yutaka Ishii*, Kyushu University, Japan

## 6:00-6:20 Resonance in Piecewisesmooth Continuous Maps

David J. Simpson, University of British Columbia, Canada

6:25-6:45 Two-dimensional Attractors of the Border Collision Normal Form Paul Glendinning, University of

Manchester, United Kingdom

## Monday, May 23

## MS59 A Glimpse of Stochastic Dynamics - Part II of II

5:10 PM-6:50 PM

Room:Magpie A

## For Part 1 see MS48

Nonlinear systems are often under random influences. The uncertainties may be due to external fluctuations or unresolved scales. These random influences may affect system evolution at various spatial and temporal scales, sutbly or profundly. Taking uncertainty into account is essential in modeling various complex phenomena in biological, physical and chemical systems. The objective of this minisymposium is to bring together experts from multiple disciplines with complementary views and approaches to stochastic dynamics in the context of applications.

Organizer: Jinqiao Duan Illinois Institute of Technology, USA

5:10-5:30 Molecular Motors and Pattern Formation with Microtubules Peter Bates, Michigan State University, USA

## 5:35-5:55 Dynamical Systems Driven by Levy Motions

*Zhihui Yang*, University of Phoenix, USA; Jinqiao Duan, Illinois Institute of Technology, USA; Peter Imkeller, Humboldt University at Berlin, Germany; Ilya Pavlyukevich, Friedrich Schiller Universität Jena, Germany

#### 6:00-6:20 A Backward-forward Method for Simulating Stochastic Inertial Manifolds

Xingye Kan and Jinqiao Duan, Illinois Institute of Technology, USA; Yannis Kevrekidis, Princeton University, USA; Anthony J. Roberts, University of Adelaide, Australia

## 6:25-6:45 Multiscale Modeling for Stochastic Forest Dynamics

Maud Comboul, University of Southern California, USA; Roger Ghanem, University of Southern California, USA

# **MS60**

## Time Averages of Observables: Theory, Numerics, and Applications - Part II of II

5:10 PM-6:50 PM

## Room:Magpie B

## For Part 1 see MS49

Recently, averaging-based methods for analyzing dynamical systems have been gaining attention as indicated in the plenary talks of Igor Mezic (DS09) and Christopher Jones (DS11). In this minisymposium, we connect to these plenaries and explore diverse and novel methods for obtaining a range of beneficial information that one can extract from averaging purposefully chosen observables. Specifically, we will (1) discuss the theory behind several time-averaging methods for identifying coherent structures and building models, (2) consider numerical analysis issues that arise with these methods, and (3)present applications of the methods in the analysis of systems such as ocean flows and power systems.

Organizer: Marko Budisic University of California, Santa Barbara, USA

## 5:10-5:30 Koopman Operator, Time Averages and the Big Oil Spill

*Igor Mezic*, University of California, Santa Barbara, USA

### 5:35-5:55 A Theory of Ergodic Partition in Continuous-time Dynamical Systems with Applications to Power System Analysis

Yoshihiko Susuki, Kyoto University, Japan

## 6:00-6:20 Understanding the Interplay Between Lagrangian Coherent Structures, Trajectory Complexities, and Transport in the Ocean

Irina Rypina, Woods Hole Oceanographic Institute, USA; Sherry Scott, Marquette University, USA; Lawrence Pratt, Woods Hole Oceanographic Institute, USA

### 6:25-6:45 Probabilistic Averages of Jacobi Operators

Helge Krueger, California Institute of Technology, USA

# Monday, May 23

## Applications of Differential Equations and Dynamical Systems in Immunology and Medicine - Part III of III

5:10 PM-6:50 PM

## Room: Wasatch A

## For Part 2 see MS50

Many biomedical processes including tumor growth, cardio-vascular disease, infection, and healing are mediated by immunologic mechanisms. The study of nonlinear differential equations arises in the endeavor to characterize many complex processes observed in immunology and medical applications. This minisymposium is dedicated to research and analysis of mathematical models of such phenomena. It is believed that the features of solutions such as instabilities, bifurcations, symmetries, and blow-up can provide insight into the nature of the underlying bio-physical mechanisms. Such insight will contribute to the understanding and treatment of disease and its spread.

Organizer: Laura Ritter Southern Polytechnic State University, USA

Organizer: Akif Ibragimov Texas Tech University, USA

Organizer: Jay R. Walton Texas A&M University, USA

### 5:10-5:30 Stability Analysis of a Reaction-Diffusion System Modeling Atherogenesis

Laura Ritter, Southern Polytechnic State University, USA; Jay R. Walton, Texas A&M University, USA; Akif Ibragimov, Texas Tech University, USA; Catherine McNeal, Scott & White Hospital, USA

continued in next column

## 5:35-5:55 Bone Remodeling Dynamics in Myeloma Bone Disease

Bruce P. Ayati, University of Iowa, USA; Claire Edwards, Vanderbilt University Medical Center, USA; Glenn F. Webb and John P. Wikswo, Vanderbilt University, USA

### 6:00-6:20 Traveling Waves of Bacterial Population Chemotaxis

*Zhi-An Wang*, Hong Kong Polytechnic University, China

### 6:25-6:45 Spatial Dynamics in a Dengue Epidemic Model

Andrew Nevai, University of Central Florida, USA; Edy Soewono, Institut Teknologi Bandung, Indonesia

## MS62 Traffic Dynamics 5:10 PM-6:50 PM

## Room: Wasatch B

The introduction of the assembly line in the automotive industry about a century ago allowed the mass production of automobiles. This revolutionized land transportation but also generated a problem that has not yet been resolved: traffic congestion. This session will represent how state-of-the-art dynamical systems theory can be used to analyze the complex dynamics of vehicular traffic on highways as well as on urban networks. Linear and nonlinear flow stability and the effects of bottlenecks and reaction-time delays will be addressed. Understanding such dynamical phenomena is crucial for the development of future traffic control systems.

Organizer: Gabor Orosz University of Michigan, Ann Arbor, USA

# 5:10-5:30 Traffic Jams: Dynamics and Control

Gabor Orosz, University of Michigan, Ann Arbor, USA

## 5:35-5:55 Absolute and Convective Instability in Traffic Flow Models

Jonathan A. Ward, University of Limerick, Ireland; R. Eddie Wilson, University of Southampton, United Kingdom

## 6:00-6:20 Dynamics Induced by Bottleneck

Ingenuin Gasser and Bodo Werner, University of Hamburg, Germany

#### 6:25-6:45 Macroscopic Relations of Urban Traffic Variables: Instability, Bifurcations, and Hysteresis

Vikash Gayah and Carlos Daganzo, University of California, Berkeley, USA Monday, May 23

## MS63 Adaptive Network Dynamics

5:10 PM-6:50 PM

## Room:Maybird

The field of complex networks has recently seen the emergence of a new type of model, adaptive networks. Adaptive networks incorporate a feedback loop between dynamics of the network and dynamics on the network. The network structure changes adaptively in response to the state of the nodes, and the nodes' subsequent dynamics is affected by the network structure. Many physical systems are thought to be adaptive, including neural networks, social networks, and certain man-made communications networks. This session brings together researchers in adaptive network dynamics from a variety of fields and applications.

Organizer: Leah Shaw College of William & Mary, USA

Organizer: Thilo Gross Max Planck Institute for Physics of Complex Systems, Germany

### 5:10-5:30 Self-organized Criticality on Adaptive Networks

Stefan Bornholdt, University of Bremen, Germany

## 5:35-5:55 Computational Approaches to Adaptive Network Modeling

Hiroki Sayama, Binghamton University, USA

## 6:00-6:20 Adaptive-network Models for Collective Motion

Cristian Huepe, USA; *Gerd Zschaler*, Max Planck Institute for Physics of Complex Systems, Germany; Anne-Ly Do, Max Planck Institute for Complex Systems, Germany; Thilo Gross, Max Planck Institute for Physics of Complex Systems, Germany

#### 6:25-6:45 Dynamics of Epidemic Extinction in Adaptive Social Networks

*Leah Shaw*, College of William & Mary, USA; Ira Schwartz, Naval Research Laboratory, USA

## Monday, May 23

## MS64 Discrete and Continuous Waves - Part II of II

5:10 PM-6:50 PM

Room:Superior A

## For Part 1 see MS53

Nonlinear waves are a fundamental mechanism by which energy or activity can be transported from one spatial region to another in a spatially extended systems. This minisymposium highlights recent work on the existence, stability, and interaction properties of waves for both partial differential equations and lattice differential equations. Of particular interest are differences in the dynamics between continuous and discrete systems and between one and higher space dimension.

Organizer: Aaron Hoffman Franklin W. Olin College of Engineering, USA

Organizer: Erik Van Vleck University of Kansas, USA

Organizer: Atanas Stefanov University of Kansas, USA

# 5:10-5:30 Phase Transition Waves in a Diatomic Chain

Anna Vainchtein, University of Pittsburgh, USA; Panayotis Kevrekidis, University of Massachusetts, Amherst, USA

## 5:35-5:55 Multidimensional Stability of Planar Fronts in the Discrete Allen-Cahn Equation

Aaron Hoffman, Franklin W. Olin College of Engineering, USA; Erik Van Vleck, University of Kansas, USA

## 6:00-6:20 The Transverse Instability of Periodic Traveling Waves in the Generalized Kadomtsev-Petviashvili (KP) Equation

Mat Johnson, Indiana University, USA

## 6:25-6:45 Asymptotic Stability of Small Gap Solitons in the Nonlinear Dirac Equations

Atanas Stefanov, University of Kansas, USA

# **MS65**

## Linking Neuronal Network Architecture and Collective Dynamics - Part I of II

5:10 PM-6:50 PM

## Room:Superior B

## For Part 2 see MS76

Networks of neurons in the brain can exhibit complex connectivity structure that is not captured by simplified or homogeneous models. Such structure may arise, for example, from spatial dependencies in connection probabilities, clustering, or non-trivial distributions of divergent and convergent connections. This added structure can yield collective dynamics that are not exhibited by simpler network models. This symposium will feature studies that relate the structure of connectivity in neuronal networks to collective dynamics such as synchrony, oscillations, or persistent activity.

## Organizer: Robert Rosenbaum University of Houston, USA

Organizer: Ashok L. Kumar Carnegie Mellon University, USA

## 5:10-5:30 Non-synchronous Behavior of Oscillators on Graphs

Bard Ermentrout, University of Pittsburgh, USA

## 5:35-5:55 Collective Phase Diffusion in Networks of Noisy Oscillators

Naoki Masuda, University of Tokyo, Japan; Yoji Kawamura, Japan Agency for Marine-Earth Science and Technology, Japan; Hiroshi Kori, Ochanomizu University, Japan

## 6:00-6:20 The Interaction of Intrinsic Dynamics and Network Topology in Determining Network Burst Synchrony

Jonathan E. Rubin, University of Pittsburgh, USA

## 6:25-6:45 The Impact of Cellular Dynamics, Synaptic Noise, and Synaptic Convergence on Correlations and Synchrony

Robert Rosenbaum, University of Houston, USA

## Monday, May 23

## MS66 Hydrodynamics of Filaments and Particles

5:10 PM-6:50 PM

## Room: White Pine

Nonlinear systems comprising hydrodynamically coupled filaments and particles arise in both natural and engineered settings, particularly on small physical scales. Microorganisms employ oscillating cilia to capture food particles suspended in their surroundings, for instance, while analogous manmade actuators promise novel applications ranging from the contact-free manipulation of delicate living cells for medical research to the precision polishing of brittle surfaces. This minisymposium convenes scholars engaged in complementary theoretical, computational, and experimental research into the modeling, design, and control of such systems.

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

#### 5:10-5:30 Manipulation of Suspended Micro-Particles via Localized Fluid Boundary Dynamics

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

#### 5:35-5:55 Inertial Focusing, Ordering, and Separation of Particles in Confined Flows

Dino Di Carlo, University of California, Los Angeles, USA

6:00-6:20 Modeling Particle Suspensions Near Ciliated Surfaces Alexander Alexeev, Georgia Institute of Technology, USA

## 6:25-6:45 Interaction Between an Elastic Filament and the Vesicle Membrane

Yuan-Nan Young, New Jersey Institute of Technology, USA

Monday, May 23 Dinner Break 6:50 PM-8:15 PM Attendees on their own

## SIAG/DS Business Meeting

8:15 PM-9:00 PM

Room:Ballroom II

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Complimentary beer and wine will be served.

## Registration

8:00 AM-5:30 PM Room:Ballroom Foyer

# **MS67**

## Mathematical Neuroendocrinology -Part II of II

8:30 AM-10:10 AM

Room:Ballroom I

## For Part 1 see MS56

The regulation of hormone release from glands in the body is crucial to good health. Much of this regulation is through hormone-secreting cells in the pituitary gland. Secretion from these cells is in turn controlled largely by a region of the brain called the hypothalamus. Neuroendocrinology refers to the study of interactions between the pituitary and the hypothalamus. In this minisymposium, speakers describe mathematical models for these interactions. In addition, some of the cellular behavior is quite complex, often involving bursting electrical oscillations. This complex, multiscale behavior is also a focus area of the minisymposium.

Organizer: Richard Bertram Florida State University, USA

Organizer: Krasimira Tsaneva-Atanasova *University of Bristol, United Kingdom* Organizer: Joel Tabak

Florida State University, USA

continued in next column

## 8:30-8:50 Model-based Study of the Back-and-forth Transitions Between the Pulsatile and Surge Phase in GnRH Secretion

Alexandre Vidal, University of Evry-Val-d'Essonne, France; Martin Krupa, INRIA Paris-Rocquencourt Research Centre, France; Frédérique Clément, INRIA Rocquencourt, France; Mathieu Desroches, University of Bristol, United Kingdom

#### 8:55-9:15 From Plateau to Pseudo-Plateau Bursting: Making the Transition

Wondimu W. Teka, Florida State University, USA; Krasimira Tsaneva-Atanasova, University of Bristol, United Kingdom; Richard Bertram and Joel Tabak, Florida State University, USA

## 9:20-9:40 Decoding Pulsatile GnRH Signals

*Krasimira Tsaneva-Atanasova* and Craig McArdle, University of Bristol, United Kingdom

## 9:45-10:05 Dynamics of Plateau Bursting in Dependence on the Location of its Equilibrium

Hinke M. Osinga and Krasimira Tsaneva-Atanasova, University of

## Tuesday, May 24

## MS68 Stochastic Transitions and Bifurcation Analysis

8:30 AM-9:45 AM

## Room:Ballroom II

This minisymposium aims at presenting recent advances on numerical techniques for stochastic systems, with a special focus on numerical continuation and stability computations. Numerical methods for the bifurcation analysis of multiscale complex stochastic systems have recently been proposed (equationfree methods); practical implementations are inherently problem specific, and there are still open questions concerning how to identify systematically adequate macroscopic variables, and how to choose appropriate moment maps in order to select initial data. The talks will present applications related to fluid dynamics (Samaey, Barkley) and biology (Hoyle, Laing). Samaey's talk will also serve as a brief introduction to equation-free methods.

Organizer: Daniele Avitabile University of Surrey, United Kingdom

## 8:30-8:50 A Micro/macro Acceleration Technique for Monte Carlo Simulation of Polymeric Fluids *Giovanni Samaey*, Katholieke

Universiteit Leuven, Belgium

### 8:55-9:15 Simplifying the Complexity of Pipe Flow

Dwight Barkley, University of Warwick, United Kingdom

## 9:20-9:40 A Reduced Model for Binocular Rivalry

Carlo R. Laing, Massey University, New Zealand

2011 SIAM Conference on Dynamical Systems

Tuesday, May 24

# MS69 Recent Applications of

## Dynamical Systems in Ecology - Part I of III

8:30 AM-10:10 AM

## Room:Ballroom III

## For Part 2 see MS80

Difference and differential equations are mathematical modeling tools which contribute to improved understanding of complex ecological and epidemiological systems. In this mini-symposium, we bring together distinguished researchers with expertise in applying these models to study problems arising from life sciences. Three sessions will focus on spatio-temporal trends, models of mutualism, and control and optimization. Speakers will address recent advances in dynamical systems related to plant and insect ecology, evolution, climate change, oceanography, immunology and disease spread.

Organizer: Andrea Bruder Colorado College, USA

Organizer: Yun Kang Arizona State University, USA

Organizer: Rachael Miller Neilan Louisiana State University, USA

## 8:30-8:50 The Timing of Insect Developmental and Trajectory of Bark Beetle Outbreaks

James Powell, Utah State University, USA

## 8:55-9:15 A Chemostat Model for Bacteria-phage Interaction with Infinite Distributed Delay

Zhun Han and Hal L. Smith, Arizona State University, USA

#### 9:20-9:40 Modeling Bee Pollination of Almond Orchards with Cross- and Self-diffusion: An Application of the Shigesada-Kawasaki-Teramoto Model

*Kamuela E. Yong*, Yi Li, and Stephen Hendrix, University of Iowa, USA

## 9:45-10:05 Modeling an Obligate Mutualism: Leaf-cutter Ants and its Fungus Garden

*Yun Kang*, Rebecca Clark, Michael Makiyama, and Jennifer Fewell, Arizona State University, USA

## Tuesday, May 24

# **MS70**

## The Role of Invariant Manifolds in Global Bifurcations - Part I of II

8:30 AM-10:10 AM

## Room:Magpie A

## For Part 2 see MS81

Global bifurcations of maps and vector fields are characterized by the re-arrangement of stable and unstable manifolds of invariant objects under parameter variation. This may result in drastic changes of the dynamics, including transitions to chaotic dynamics. The key question is how higher-dimensional manifolds change in global bifurcations to reorganize the phase space, transforming or creating basins of attractions and chaotic sets. The objective of this minisymposium is to discuss how the study of global invariant manifolds by analytical and computational methods allows one to obtain deeper insight into the nature of global bifurcations.

Organizer: Stefanie Hittmeyer University of Bristol, United Kingdom

Organizer: Pablo Aguirre University of Bristol, United Kingdom

8:30-8:50 Global Invariant Manifolds Organizing Shilnikov Chaos

Pablo Aguirre, Bernd Krauskopf, and Hinke M. Osinga, University of Bristol, United Kingdom

### 8:55-9:15 A Lin's Method Approach to Finding and Continuing Heteroclinic Connections Between Periodic Orbits of Saddle Type

Wenjun Zhang, University of Auckland, New Zealand; Bernd Krauskopf, University of Bristol, United Kingdom; Vivien Kirk, University of Auckland, New Zealand

continued in next column

## 9:20-9:40 Unfoldings of Singular Hopf Bifurcation

Philipp Meerkamp and John Guckenheimer, Cornell University, USA

## 9:45-10:05 Two-dimensional Global Manifolds in the Transition to Chaos in the Lorenz System

Bernd Krauskopf and Hinke M. Osinga, University of Bristol, United Kingdom; Eusebius J. Doedel, Concordia University, Canada

## MS71 Pattern Formation in Biological Systems

8:30 AM-10:10 AM

## Room:Magpie B

Spatial pattern formation is an important phenomenon in many biological domains, ranging from ecology to neuroscience to developmental biology, and the application of dynamical systems methods to study biological pattern formation dates back at least to Turing's seminal work in the midtwentieth century. This minisymposium focuses on the formulation and analysis of PDE models of growth, development, and pattern formation in multicellular systems, viz. microbial communities and embryonic development. The models presented address two areas of current biological interest, namely the spatial patterning of gene expression in development and the growth of antibiotic tolerant bacteria, and largely consider reaction-diffusion patterns.

Organizer: John Burke Boston University, USA

8:30-8:50 Spatial Modeling of Bacterial Antibiotic Tolerence John Burke, Boston University, USA

#### 8:55-9:15 Dynamics of Persister Formation: Dosing and Fluid Interactions

Nick Cogan, Florida State University, USA

## 9:20-9:40 Pattern Formation in Reaction-diffusion Systems with an External Morphogen Gradient

*Tilmann Glimm*, Western Washington University, USA

### 9:45-10:05 Dorsal-ventral Patterning in Sea Urchin and Drosophila Embryos Heather D. Hardway, Boston University, USA

## Tuesday, May 24

# **MS72**

## Flows Structured by Multiple Fixed Points: from Glass Networks to Stable Heteroclinic Channels

8:30 AM-10:10 AM

## Room:Wasatch A

Stable heteroclinic channels (SHCs) arise generically from perturbations of heteroclinic cycles with saddle values exceeding unity. Such perturbed flows often contain stable limit cycles, the structure of which is influenced by the saddle points comprising the heteroclinic cycle. SHCs have attracted recent attention as models of neural dynamics. Glass networks are piecewise linear dynamical systems (PLDS) representing flows in genetic regulatory networks. Their trajectories are structured by a sequence of stable nodes, and much work has been done characterizing the conditions under which they lead to limit cycle dynamics. This session will showcase recent work in which SHCs, PLDS, and other systems structured by multiple fixed points can contribute to understanding biological rhythmicity, control and decision making.

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

Organizer: Roderick Edwards University of Victoria, Canada

# 8:30-8:50 Glass Networks: Overview and Recent Results

Roderick Edwards, University of Victoria, Canada

## 8:55-9:15 Nonlinear Dynamics of Gene Regulatory Networks: An Automated Analyzer

Liliana Ironi, CNR, Italy; Luigi Panzeri, IMATI-CNR, Italy; Erik Plahte, Norwegian University of Life Sciences, Norway; Valeria Simoncini, Universita' di Bologna, Italy

continued in next column

## 9:20-9:40 Transient Vector Field Effects on Oscillations in a Neuromechanical Model of Limbed Locomotion

Lucy Spardy, University of Pittsburgh, USA; Sergey Markin and Natalia Shevtsova, Drexel University College of Medicine, USA; Boris Prilutsky, Georgia Institute of Technology, USA; Ilya A. Rybak, Drexel University, USA; Jonathan Rubin, University of Pittsburgh, USA

## 9:45-10:05 Phase Resetting in Phaseless Systems

Peter J. Thomas and Kendrick Shaw, Case Western Reserve University, USA; Klaus Stiefel, Okinawa Institute of Science and Technology, Japan; Hillel Chiel, Case Western Reserve University, USA

## MS73 Collective Behavior -Part I of II

8:30 AM-10:10 AM

## Room: Wasatch B

## For Part 2 see MS84

Collective behavior is a wide-ranging notion in that encompasses coupled oscillators, clustering in networks, herding and flocking in animals, and more. Oscillators can synchronize by phase-locking or other means; groups of nodes in a network can belong to the same or related communities; in the context of cattle, a herd might try to eat or lie down at the same time. In this minisymposium, several speakers will provide a survey of numerous aspect of collective behavior. This set of talks also serves a second purpose, as many of the speakers are young scientists who are making important contributions to these areas.

## Organizer: Mason A. Porter University of Oxford, United Kingdom

Organizer: Erik Bollt Clarkson University, USA

## 8:30-8:50 Collective Chaotic Incoherence Stabilizes Synchronization Chimera

*Erik Bollt*, Clarkson University, USA; Sun Jie, Northwestern University, USA; Takashi Nishikawa, Clarkson University, USA

## 8:55-9:15 Social Influence and the Spread of Facebook Applications

Jukka-Pekka Onnela, Harvard University, USA

## 9:20-9:40 Gang Dynamics in Los Angeles

Alethea Barbaro, University of California, Los Angeles, USA

## 9:45-10:05 Robustness of Overlapping Modular Networks

James Bagrow and Yong-Yeol Ahn, Northeastern University, USA; Sune Lehmann, Technical University of Denmark, Denmark

## Tuesday, May 24

## MS74 Modelling the Dynamics of the Atomic Force Microscope

8:30 AM-10:10 AM

## Room:Maybird

The atomic force microscope celebrates its 25th birthday in 2011. Its use stretches over many disciplines from DNA analysis to microchip manufacturing. In this minisymposium we will show, using contributions by experimentalists and theoreticians, how a greater understanding of the dynamics between the microscope and the sample surface is leading to a wealth of new quantitative measuring techniques. Analysis of the highly nonlinear system is shining light on the origin of artefacts and noise in the images produced, while mathematical modelling of the interactions between the microscope, sample and surface fluid is helping to explain newly discovered operating regimes.

Organizer: Oliver D. Payton University of Bristol, United Kingdom

## 8:30-8:50 High Speed Atomic Force Microscopy

*Oliver D. Payton*, University of Bristol, United Kingdom

8:55-9:15 Good Vibrations: Bimodal Atomic Force Microscopy *Ricardo Garcia*, Instituto de Microelectronica de Madrid, Spain

9:20-9:40 The Dynamics of Tapping Mode Atomic Force Microscopy Arvind Raman, Purdue University, USA

## 9:45-10:05 Hysteretic Capillary Interactions in Models of Atomic-Force Microscopy: a Bifurcation Paradigm for Nonsmooth Systems

Harry Dankowicz and Michael Katzenbach, University of Illinois at Urbana-Champaign, USA

## Tuesday, May 24

# MS75

## Low-dimensional Reduction Methods and Their Applications - Part I of II

8:30 AM-10:10 AM

Room:Superior A

## For Part 2 see MS86

Dimensionality reduction techniques are of growing importance due to their ability to render highly complex systems to a more manageable and insightful system of equations. In this minisymposium, a wide range of applications will be considered, from neuroscience to laser physics to turbulence control, where dimensionality reduction techniques such as those arising from principle component analysis, orthogonal decompositions or structural construction of the set of equations play a critical role in understanding the governing dynamical system of interest.

Organizer: J. Nathan Kutz University of Washington, USA

#### 8:30-8:50 Parabolic Resonance Instability in Near-integrable PDEs Eli Shlizerman, University of

Washington, Seattle, USA; *Vered Rom-Kedar*, Weizmann Institute of Science, Israel

## 8:55-9:15 Variational Approximations in Discrete Nonlinear Schrödinger Equations

*Christopher Chong*, University of Stuttgart, Germany

### 9:20-9:40 Dynamics and Pattern Formation in Large Systems of Spatially-Coupled Oscillators with Finite Response Times

Wai S. Lee, University of Maryland, USA; Juan G. Restrepo, University of Colorado at Boulder, USA; Edward Ott and Thomas Antonsen, University of Maryland, USA

## 9:45-10:05 Principal Component Analysis of the Ginzburg-Landau Equation

*Edwin Ding*, University of Washington, USA; Eli Shlizerman, University of Washington, Seattle, USA; J. Nathan Kutz, University of Washington, USA

# **MS76**

## Linking Neuronal Network Architecture and Collective Dynamics - Part II of II

8:30 AM-10:10 AM

## Room:Superior B

## For Part 1 see MS65

Networks of neurons in the brain can exhibit complex connectivity structure that is not captured by simplified or homogeneous models. Such structure may arise, for example, from spatial dependencies in connection probabilities, clustering, or non-trivial distributions of divergent and convergent connections. This added structure can yield collective dynamics that are not exhibited by simpler network models. This symposium will feature studies that relate the structure of connectivity in neuronal networks to collective dynamics such as synchrony, oscillations, or persistent activity.

Organizer: Ashok L. Kumar Carnegie Mellon University, USA

Organizer: Robert Rosenbaum University of Houston, USA

### 8:30-8:50 The Case Against Common Input: Why Convergence and Chains are Network Structures that Influence Synchrony in Recurrent Neuronal Networks

Duane Nykamp, University of Minnesota, USA

## 8:55-9:15 Slow Dynamics in Balanced Networks with Distance-dependent Connections

Ashok L. Kumar, Carnegie Mellon University, USA; Brent Doiron, University of Pittsburgh, USA

## 9:20-9:40 Effective Langevin Equations for Heterogeneous Coupled Neural Networks

Michael Buice, National Institutes of Health, USA; Carson C. Chow, National Institutes of Health and University of Pittsburgh, USA

## Tuesday, May 24

# MS77 Interface Motion in a Hele-Shaw Cell

8:30 AM-10:10 AM

## Room: White Pine

Interface dynamics in a Hele-Shaw cell as well as many other physical processes are governed by the Laplacian growth model. Despite significant efforts, the model still lacks a complete mathematical description. The minisymposium addresses to both theoretical understanding and applications. The problem of the avoidance of singularity formation in Hele-Shaw problem, achievable by a proper way of suction or through a physically motivated regularization of the model, is tackled. The talks present also an exponential transform appropriate for the description of planar shapes, and the modification of the Hele-Shaw model in the problem of a thin film evaporation.

#### Organizer: Alexander Nepomnyashchy Technion Israel Institute of Tec

Technion Israel Institute of Technology, Israel

Organizer: Tatiana Savin Ohio University, USA

#### 8:30-8:50 Interface Motion in a Hele-Shaw Cell and a Dynamical Mother Body

*Tatiana Savin*, Ohio University, USA; Alexander Nepomnyashchy, Technion, Israel

#### 8:55-9:15 Reconstruction of Planar Domains Using Orthogonal Polynomials

*Razvan Teodorescu*, University of South Florida, Tampa, USA

## 9:20-9:40 Interface Motion of Evaporating Thin Films

*Oded Agam*, Hebrew University of Jerusalem, Israel

## 9:45-10:05 Stokes Regularization of the Laplacian Growth in Hele-Shaw Cell Artem G. Abanov, Texas A&M

University, USA

## Intermission

10:10 AM-10:15 AM

## Tuesday, May 24

# CP23 Biological Applications I

10:15 AM-11:15 AM

Room:Ballroom I

Chair: Richard Buckalew, Ohio University, USA

## 10:15-10:30 A Dynamical Model of the Innate Immune Response in the Lungs

Richard Buckalew and Todd Young, Ohio University, USA; Erik M. Boczko, Vanderbilt University, USA

## 10:35-10:50 Gradient Flow Model for Osmotic Cell Swelling

Martijn Zaal, Vrije Universiteit Amsterdam, The Netherlands

## 10:55-11:10 Development of a Model of Human Cardiovascular System and Heart Rate Variability

Vladimir Fonoberov, AIMdyn, Inc., USA; Igor Mezic, University of California, Santa Barbara, USA; Marsha Bates, Rutgers University, USA

## **CP24 CANCELLED** 10:15 AM-11:15 AM

## CP25 Networks and Transport

10:15 AM-11:15 AM

## Room: Wasatch A

Chair: Rosa M. Benito, Universidad Politécnica de Madrid, Spain

## 10:15-10:30 Mesoscale Analysis of Porous Soil Networks

Rosa M. Benito, Universidad Politécnica de Madrid, Spain; Juan Pablo Cardenas, Antonio Santiago, Ana Tarquis, and Juan Carlos Losada, Universidad Politécnica de Madrid, Spain; Florentino Borondo, Universidad Autonoma de Madrid, Spain

#### 10:35-10:50 A Neutral Theory of Speciation Matching Empirical Diversity

Marcus A. Aguiar, Universidade Estadual de Campinas, Brazil; Yaneer Bar-Yam, New England Complex Systems Institute, USA; Michel Baranger, Massachusetts Institute of Technology, USA; Les Kaufman, Boston University, USA; Elizabeth Baptestini, UNICAMP, Brazil; Ayana Martins, Universidade de Sao Paulo, Brazil

#### 10:55-11:10 Analysis of the Pattern Formation in Various Models of Hormone Transport

Delphine Draelants, Universiteit Antwerpen, Belgium Tuesday, May 24

# **CP26**

Stochastics II

10:15 AM-11:15 AM

Room:Maybird

Chair: Robert Bryce, Defence R&D Canada, Canada

### 10:15-10:30 Nonlinearities in Stocks As a Consequence of Socio-Political Events: Classification of Events Triggering Nonlinearity in Stock Exchange

Syed Nasir Danial and Rosheena Siddiqi, Bahria University, Pakistan

### 10:35-10:50 Chaotic Fluctuations in Stocks in a Market : Approximating with the Duffing-Oscillator Model

Varsha S. Kulkarni, Indiana University, USA; Raghav Gaiha, University of Delhi, India

# 10:55-11:10 Fluctuation Analysis Via Synthetic Diffusion

*Robert Bryce*, Defence R&D Canada, Canada

## CP27 Partial Differential Equations III

10:15 AM-11:15 AM

Room:Magpie B

Chair: Kazuyuki Yagasaki, Niigata University, Japan

## 10:15-10:30 Bifurcation and Stability Properties for Asymptotically Asymmetric Slowly Non-Dissipative Equations

Nitsan Ben-Gal, Weizmann Institute of Science, Israel; Kristen Moore, University of Michigan, USA; Juliette Hell, Freie Universitat Berlin, Germany

## 10:35-10:50 Some Applications of Differential Galois Theory in Dynamical Systems

Kazuyuki Yagasaki, Niigata University, Japan

10:55-11:10 Existence and Regularity Result for Functional Integrodifferential Equations with Finite Delay Via Fractional Operators: An Application to Bacterial Growth And Multilication .

Hechmi Hattab, ENIT-LAMSIN, Tunisia Tuesday, May 24

**CP28** Fluids III 10:15 AM-11:15 AM

Room:Ballroom III

Chair: John R. Mahoney, University of California, Merced, USA

## 10:15-10:30 Lagrangian Coherent Structures in Aerobiological Transport

Amir E. Bozorgmagham, Shane D. Ross, and David Schmale, Virginia Polytechnic Institute & State University, USA; Phanindra Tallapragada, University of North Carolina, USA

### 10:35-10:50 Fast Computations of Lagrangian Coherent Structures in 2 and 3 Dimensions

*Douglas M. Lipinski*, University of Colorado at Boulder, USA; Kamran Mohseni, University of Florida, Gainesville, USA

## 10:55-11:10 Invariant Manifolds in Chaotic Advection-Reaction-Diffusion Systems

John R. Mahoney and Kevin A. Mitchell, University of California, Merced, USA; Tom Solomon, Bucknell University, USA Tuesday, May 24

# CP29

## Non-smooth Dynamical Systems I

10:15 AM-11:15 AM

Room:Superior B

Chair: Mario Di Bernardo, University of Bristol, United Kingdom

## 10:15-10:30 Multistability Analysis Via a Lyapunov-Based Approach

Qing Hui, Texas Tech University, USA

### 10:35-10:50 Discontinuity Geometry - An Alternative Way to Analyse Impacting Systems

*Neil Humphries* and Petri Piiroinen, National University of Ireland, Galway, Ireland

# 10:55-11:10 Non-Smooth Bifurcations in a Sustainable Development Model

*Gerard Olivar*, Jorge Amador, David Angulo, and Hector Granada, Universidad Nacional de Colombia, Colombia

# CP30 Systems Biology

10:15 AM-11:15 AM

Room:Ballroom II

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

10:15-10:30 The Nonlinear Dynamics of Transcription Regulation in Mammalian Timekeeping *Richard Yamada*, University of

Michigan, USA

10:35-10:50 A Systems-Biology Investigation of Heat-Shock Protein Regulated Gene Networks: Mathematical Models, Predictions and Laboratory Experiments

Mainul Haque, John King, and David dePomarai, University of Nottingham, United Kingdom

10:55-11:10 Analysis and Design of a Versatile Synthetic Network for Inducible Gene Expression in Mammalian Systems

John Hogan, Bristol Centre for Applied Nonlinear Mathematics and University of Bristol, United Kingdom Tuesday, May 24

**CP31 CANCELLED** 10:15 AM-11:15 AM

Room:Superior A

Tuesday, May 24

CP32 Network Dynamics I 10:15 AM-11:15 AM

Room:Magpie A

Chair: Dane Taylor, University of Colorado at Boulder, USA

10:15-10:30 A General Theory of Percolation Thresholds for Networks

Dane Taylor and Juan G. Restrepo, University of Colorado at Boulder, USA

10:35-10:50 Noise Bridges Dynamical Correlation and Topology in Coupled Oscillator Networks

Wenxu Wang and Ying-Cheng Lai, Arizona State University, USA; Jie Ren and Baowen Li, National University of Singapore, Singapore

10:55-11:10 Investigating Global Brain States Using Empirical Mode Decomposition Based Weighting Function Analysis and Permutation Based Entropic Measures

John L. Aven, National Institutes of Health, USA; Arnold Mandell, Cielo Institute, USA; Tom Holroyd and Richard Coppola, National Institutes of Health, USA

## CP33 Dynamical Systems II

10:15 AM-11:15 AM

Room: Wasatch B

Chair: Bruce B. Peckham, University of Minnesota, Duluth, USA

## 10:15-10:30 New Computational Methods for Open Dynamics

*Rua Murray*, University of Canterbury, New Zealand; Christopher Bose, University of Victoria, Canada

## 10:35-10:50 Recent Advances in Mostly Conjugacy

Rana D. Parshad, Erik Bollt, Joe Skufca, and Jiongxuan Zheng, Clarkson University, USA

### 10:55-11:10 A Conjecture of Lorenz: Transitive Plus Noninvertible Implies Sensitive

Bruce B. Peckham, University of Minnesota, Duluth, USA; Garrett Taft, Indiana University - Purdue University Indianapolis, USA

## Coffee Break

11:15 AM-11:45 AM Room:Golden Cliff



## Tuesday, May 24

## IP5

## Robust and Generic Dynamics: A Phenomenon/mechanism Correspondence

11:45 AM-12:30 PM

## Room:Ballroom

Chair: Tim Sauer, George Mason University, USA

If we consider that the mathematical formulation of natural phenomena always involves simplifications of the physical laws, real significance of a model may be accorded only to those properties that are robust under perturbations. In loose terms, robustness means that some main features of a dynamical system are shared by all nearby systems. In the talk, we will explain the structures related to the presence of robust phenomena and the universal mechanisms that lead to lack of robustness. Providing a conceptual framework, the goal is also to show how to provide a generic correspondence phenomenon/mechanism for all dynamical systems.

Enrique Pujals Instituto Nacional de Matematica Pura e Aplicada, Brazil

# Lunch Break

12:30 PM-2:00 PM

Attendees on their own

## Tuesday, May 24

# PD1 Funding Agency Panel

12:45 PM-1:45 PM

Room:Ballroom

Co-Chair: Steven Shaw, Michigan State University, USA

Co-Chair: Hans G. Kaper, Argonne National Laboratory, USA

The purpose of this session is to allow Program Managers from various funding agencies to present brief overviews of their programs and be available for questions and discussions. There will be short presentations from three speakers.

Jeff Rogers is the Program Manager in the Microsystems Technology Office within the US Defense Advanced Research Projects Agency (DARPA).

Karin Remington is the Director of the Center for Bioinformatics and Computational Biology, part of the National Institute of General Medical Sciences which is one of the US National Institutes of Health.

Eduardo Misawa is the Program Director for the Dynamical Systems Program in the Division of Civil, Mechanical, and Manufacturing Innovation in the Directorate of Engineering at the US National Science Foundation (NSF). He is also Co-Chair of the Cyber-enabled Discovery and Innovation Initiative which is an NSF-wide activity, and Chair of the Complex Systems Working Group.

## Jeff Rogers

Defense Advanced Research Projects Agency, USA

Karin Remington National Institutes of Health, USA

Eduardo Misawa National Science Foundation, USA

# IP6

## Models and Control of Collective Spatio-Temporal Phenomena in Power Grids

2:00 PM-2:45 PM

## Room:Ballroom

# Chair: Vivien Kirk, University of Auckland, New Zealand

We are asking modern power grids to serve under conditions it was not originally designed for. We also expect the grids to be smart, in how they function, how they withstand contingencies, respond to fluctuations in generation and load, and how the grids are controlled. To meet these ever increasing expectations requires extending power grid models beyond the scope of traditional power engineering. In this talk aimed at applied mathematicians and physicists I first review basics of power flows, and then outline a number of new problems in modeling, optimization and control theory for smart grids. In particular, I describe new approaches to control of voltage and reactive flow in distribution networks, algorithms to study distance to failure, and statistical analysis of cascading blackouts in transmission networks.

Michael Chertkov Los Alamos National Laboratory, USA

## Intermission

2:45 PM-3:00 PM

## Tuesday, May 24

## **MS78**

## Dynamical Systems Approaches in Smart (Power) Grids - Part I of II

3:00 PM-4:40 PM

## Room:Ballroom I

## For Part 2 see MS89

This minisymposium will bring together power engineers, control theorists, applied mathematicians and statisticians to discuss dynamical systems approaches and techniques used (or to be used in the future) to study new challenging problems related to design, optimization, control and stability of power grids of the future.

Organizer: Konstantin Turitsyn Massachusetts Institute of Technology, USA

Organizer: Michael Chertkov Los Alamos National Laboratory, USA

## 3:00-3:20 Critical Slowing Down As An Indicator of Dynamic Instability in Power Systems

*Paul Hines* and Eduardo Cotilla-Sanchez, University of Vermont, USA

## 3:25-3:45 Inverse Problems in Power System Dynamics

Ian Hiskens, University of Michigan, USA

### 3:50-4:10 Cascading Dynamics of Power Grid Networks

Konstantin Turitsyn, Massachusetts Institute of Technology, USA

4:15-4:35 Algebraic Methods for Robust Power Grid Analysis and Design Marian Anghel, Los Alamos National Laboratory, USA

## Tuesday, May 24

## **MS79**

## Modeling Dynamics of Sleep-Wake Regulation -Part I of II

3:00 PM-4:40 PM

Room:Ballroom II

## For Part 2 see MS90

Sleep and wake states are regulated by the interactions among brainstem and hypothalamic neuronal populations and the expression of their neurotransmitters. This sleep-wake regulatory network receives inputs from the circadian pacemaker and from cortical regions that modulate sleepwake dynamics. Significant advances have been made in translating the physiological understanding of these interactions into dynamical mathematical models. In this mini-symposium, we present different models of the sleep-wake regulatory network, its interaction with the circadian pacemaker, and the integration of models with experimental data.

Organizer: Bruce J. Gluckman Pennsylvania State University, USA

Organizer: Victoria Booth University of Michigan, USA

Organizer: Cecilia Diniz Behn University of Michigan, USA

Organizer: Amitaba Bose New Jersey Institute of Technology, USA

## 3:00-3:20 Overview of Sleep-Wake Regulation and Dynamics

Victoria Booth, University of Michigan, USA

# 3:25-3:45 Ultradian Dynamics in a Potential Formulation of Human Sleep

Andrew Phillips, Brigham and Women's Hospital and Harvard Medical School, USA; Peter Robinson, University of Sydney, Australia; Elizabeth Klerman, Brigham and Women's Hospital and Massachusetts General Hospital, USA

## 3:50-4:10 Mechanisms for Controlling REM Sleep Patterns

Amitabha Bose, New Jersey Institute of Technology, USA

### 4:15-4:35 Modeling the Human Sleep-Wake Cycle

*Michael Rempe*, Whitworth University, USA; Janet Best and David H. Terman, Ohio State University, USA

# **MS80**

## Recent Applications of Dynamical Systems in Ecology - Part II of III

3:00 PM-4:40 PM

## Room:Ballroom III

### For Part 1 see MS69 For Part 3 see MS91

Difference and differential equations are mathematical modeling tools which contribute to improved understanding of complex ecological and epidemiological systems. In this mini-symposium, we bring together distinguished researchers with expertise in applying these models to study problems arising from life sciences. Three sessions will focus on spatio-temporal trends, models of mutualism, and control and optimization.

Organizer: Andrea Bruder Colorado College, USA

Organizer: Yun Kang Arizona State University, USA

Organizer: Rachael Miller Neilan Louisiana State University, USA

## 3:00-3:20 Competitive Outcomes Changed by Evolution

Jim M. Cushing, University of Arizona, USA; Rosalyn Rael, and Thomas Vincent, University of Arizona, USA

### 3:25-3:45 Measuring the Response of Species Interactions to Climate Change: The Use of Models and Experiments to Study Seed Dispersal by Ants

Judith Canner, California State University, Monterey Bay, USA

## 3:50-4:10 Niche Construction and Sustainability in Resource-dependent Competition Models

Irina Kareva, Arizona State University, USA

## 4:15-4:35 Management and Dynamics in a Predator-Prey Metapopulation

*Kehinde Salau*, Arizona State University, USA

## Tuesday, May 24

# MS81

## The Role of Invariant Manifolds in Global Bifurcations - Part II of II

3:00 PM-4:40 PM

## Room:Magpie A

## For Part 1 see MS70

Global bifurcations of maps and vector fields are characterized by the re-arrangement of stable and unstable manifolds of invariant objects under parameter variation. This may result in drastic changes of the dynamics, including transitions to chaotic dynamics. The key question is how higher-dimensional manifolds change in global bifurcations to reorganize the phase space, transforming or creating basins of attractions and chaotic sets. The objective of this mini-symposium is to discuss how the study of global invariant manifolds by analytical and computational methods allows one to obtain deeper insight into the nature of global bifurcations.

Organizer: Stefanie Hittmeyer University of Bristol, United Kingdom

Organizer: Pablo Aguirre University of Bristol, United Kingdom

3:00-3:20 Interacting Global Manifolds in a Planar Map Model of Wild Chaos *Stefanie Hittmeyer*, Bernd Krauskopf, and Hinke M. Osinga, University of Bristol, United Kingdom

## 3:25-3:45 Contact Bifurcations of Invariant Absorbing Sets and Basins in Noninvertible Maps

*Gian Italo Bischi* and Laura Gardini, University of Urbino, Italy

## 3:50-4:10 Connecting Period-doubling Cascades to Chaos via Manifolds in Phase Cross Parameter Space

*Evelyn Sander*, George Mason University, USA; James A. Yorke, University of Maryland, USA; Madhura Joglekar, University of Maryland, USA

## 4:15-4:35 Global Dynamics Using Parameter-sweeping Techniques

Sergio Serrano, Roberto Barrio, and Fernando Blesa, University of Zaragoza, Spain

## Tuesday, May 24

## MS82 New Directions in Onedimensional Localized

# Structures

## 3:00 PM-4:40 PM

## Room:Magpie B

Recent years have seen a lot of work on localized structures in continuous systems in one spatial dimension and as a result, the basic theory for their emergence in a bifurcation scenario known as homoclinic snaking is now well understood. This minisymposium will provide an overview of current research on extensions and generalizations of the basic scenario, as well as discussions of novel applications. Addressed topics include the interaction of snaking curves with local bifurcations, the behaviour of multi-pulses and finite domain effects.

Organizer: Thomas Wagenknecht University of Leeds, United Kingdom

Organizer: Steve Houghton University of Leeds, United Kingdom

3:00-3:20 Homoclinic Snaking: Overview, Recent Progress and Open Questions

Alan R. Champneys, University of Bristol, United Kingdom

## 3:25-3:45 Defect-mediated Snaking: Spatial and Temporal Dynamics

*Yiping Ma* and Edgar Knobloch, University of California, Berkeley, USA

#### 3:50-4:10 1D Localized Structures in Bounded Domains in the Lugiato-Lefever Model

*Lendert Gelens*, Vrije Universiteit Brussels, Belgium; Gregory Kozyreff, Université Libre de Bruxelles, Belgium

## 4:15-4:35 Multi-pulse Solutions in the Swift-Hohenberg Equation

Steve Houghton and Thomas Wagenknecht, University of Leeds, United Kingdom

## MS83 Dynamics of Microswimmers - Part I of II

3:00 PM-4:40 PM

Room: Wasatch A

## For Part 2 see MS94

Recent experiments have been achieving increasingly accurate measurements for how the swimming motions of microorganisms such as bacteria affect the dynamics of the surrounding fluid as well as of nearby microorganisms. This has stimulated the development of hydrodynamic and statistical theories to explain the complex flow structure and enhanced mixing induced by the swimming dynamics as well as the collective behavior of a suspension of swimming microorganisms. Of particular interest is determining to what extent the physical aspects of the swimming motion facilitate biologically beneficial coordination and transport. Speakers in this minisymposium will address recent mathematical, computational, and experimental developments.

Organizer: Peter R. Kramer Rensselaer Polytechnic Institute, USA

## 3:00-3:20 An Overview of the Simulation-based Dynamics of Microswimmer Suspensions

Patrick Underhill, Rensselaer Polytechnic Institute, USA

#### 3:25-3:45 Simulations Versus Experiments on the Rheology of Active Suspensions

*Philippe Peyla*, Levan Jibuti, and Salima Rafai, Universite Joseph Fourier, France

continued in next column

## 3:50-4:10 Alignment Dynamics and Its Effects on Effective Viscosity of Bacterial Suspensions

Dmitry Karpeev, Argonne National Laboratory, USA; Leonid Berlyand, Pennsylvania State University, USA; Igor Aronson, Argonne National Laboratory, USA; Brian Haines, Pennsylvania State University, USA; Shawn Ryan, Pennsylvania State University, USA

## 4:15-4:35 Oxygen Transport and Mixing Dynamics in Thin Films of Oxytactic Microorganisms

David Saintillan, Amir Alizadeh Pahlavan, and Barath Ezhilan, University of Illinois at Urbana-Champaign, USA

## Tuesday, May 24

## MS84 Collective Behavior -Part II of II

3:00 PM-4:40 PM

Room:Wasatch B

# For Part 1 see MS73

Collective behavior is a wide-ranging notion in that encompasses coupled oscillators, clustering in networks, herding and flocking in animals, and more. Oscillators can synchronize by phaselocking or other means; groups of nodes in a network can belong to the same or related communities; in the context of cattle, a herd might try to eat or lie down at the same time. In this minisymposium, several speakers will provide a survey of numerous aspect of collective behavior.

Organizer: Mason A. Porter

University of Oxford, United Kingdom

Organizer: Erik Bollt Clarkson University, USA

**3:00-3:20 Synchronization of Cows** *Mason A. Porter*, University of Oxford,

United Kingdom

# 3:25-3:45 Compensatory Perturbations for Network Dynamics

Jie Sun, Sagar Sahasrabudhe, and Adilson E. Motter, Northwestern University, USA

## 3:50-4:10 A Dynamical Systems Analysis of Territorial Behavior

*Jeff Moehlis*, University of California, Santa Barbara, USA; Ronald Votel, Stanford University, USA; David A. Barton, University of Bristol, United Kingdom; Takahide Gotou, Takeshi Hatanaka, and Masayuki Fujita, Tokyo Institute of Technology, Japan

## 4:15-4:35 Role of the Interaction Graph Topology in the Evolution of Collective Migration

Darren Pais and Naomi E. Leonard, Princeton University, USA

## MS85 Computation and Topology in Dynamics

## 3:00 PM-4:40 PM

## Room:Maybird

The modern approach to dynamical systems is based on combining local and global information. The localglobal dichotomy is reflected by Conley's decomposition theorem: "local" recurrent dynamics and "global" connecting orbits. Topological approaches are robust and global, but lack quantitive information. On the other hand, simulations and computational methods give quantitative data, but this is local in nature (both in phase- and parameter space) and sensitive to the details of the system. The theme of this minisymposium is the major challenge to get the best of both worlds: to blend topology and computation to investigate and prove properties of dynamical systems.

Organizer: Jan Bouwe Van Den Berg

VU University, Amsterdam, Netherlands

Organizer: Robert Vandervorst VU University, Amsterdam, Netherlands

## 3:00-3:20 Dynamics at Infinity

Juliette Hell, Freie Universitat Berlin, Germany

**3:25-3:45 Flow Categories** *Thomas Rot*, VU University, Amsterdam, Netherlands

## 3:50-4:10 Rigorous Numerics for Connecting Orbits for Flows

Jason Mireles James, Rutgers University, USA

### 4:15-4:35 The Euler-Floer Characteristic and Forcing of Periodic Points in Two-dimensional Diffeomorphisms

Simone Munao, Vrije Universiteit Amsterdam, The Netherlands

## Tuesday, May 24

# **MS86**

## Low-dimensional Reduction Methods and Their Applications - Part II of II

3:00 PM-4:40 PM

## Room:Superior A

## For Part 1 see MS75

Dimensionality reduction techniques are of growing importance due to their ability to render highly complex systems to a more manageable and insightful system of equations. In this minisymposium, a wide range of applications will be considered, from neuroscience to laser physics to turbulence control, where dimensionality reduction techniques such as those arising from principle component analysis, orthogonal decompositions or structural construction of the set of equations play a critical role in understanding the governing dynamical system of interest.

Organizer: J. Nathan Kutz University of Washington, USA

#### **3:00-3:20 Principal Component Analysis of the Water Wave Problem** *J. Nathan Kutz*, University of

Washington, USA

3:25-3:45 Discovery of Cellular Mechanisms and Prognosis of Cancers from Mathematical Modeling of DNA Microarray Data *Orly Alter*, University of Utah, USA

#### 3:50-4:10 Master Stability Function Approach for Designing Synchronous Networks

Adam B. Cohen and Bhargava Ravoori, University of Maryland, College Park, USA; Francesco Sorrentino, Universita degli Studi di Napoli Parthenope, Italy; Thomas E. Murphy, University of Maryland, College Park, USA; Edward Ott and Rajarshi Roy, University of Maryland, USA

#### 4:15-4:35 Proper Orthogonal Modes for the Muti-Pulsing Instability in a Mode-Locked Laser Cavity

Matthew O. Williams, Eli Shlizerman, and J. Nathan Kutz, University of Washington, USA

## Tuesday, May 24

# **MS87**

## Dynamics and Statistics of Neural Networks and Fields - Part I of II

3:00 PM-4:40 PM

Room:Superior B

## For Part 2 see MS98

In the nervous system, thousands or millions of neurons interact to produce even simple functionality. A variety of methods for deriving and analyzing the properties of neural networks will be presented. The approaches include mean-field and evolution models of spiking behavior and activity measures such as correlation functions, touching on a wide variety of mathematical techniques from renormalization to graph theory. These models give insight to the impact of individual neural dynamics and connectivity statistics on global behavior. Unifying these studies is the recognition that nontrivial, surprising global behavior can arise from the interactions of individual units.

Organizer: Eli Shlizerman University of Washington, Seattle, USA

Organizer: Andrea K. Barreiro University of Washington, USA

## 3:00-3:20 Piecewise-smooth Neural Fields with Nonlinear Adaptation

Paul C. Bressloff, University of Utah, USA and University of Oxford, United Kingdom; Zachary Kilpatrick, University of Pittsburgh, USA

## 3:25-3:45 Neural Activity Measures and Their Dynamics

*Eli Shlizerman* and Konrad Schroder, University of Washington, Seattle, USA; J. Nathan Kutz, University of Washington, USA

### 3:50-4:10 A Network of Sparsely Active Interneurons Initiates Retinal Waves

*Kevin Ford* and Marla Feller, University of California, Berkeley, USA

## 4:15-4:35 Finite Size Effects in Spiking Neural Networks

*Carson C. Chow*, National Institutes of Health and University of Pittsburgh, USA; Michael Buice, National Institutes of Health, USA

Organizer: Cecilia Diniz Behn

New Jersey Institute of Technology, USA

Cecilia Diniz Behn, Michelle Fleshner, Daniel Forger, and Victoria Booth, University of Michigan, USA

# 5:35-5:55 High-resolution Sleep **Onto a Cortical State Model**

Beth A. Lopour, University of California, Los Angeles, USA; Savas Tasoglu, University of California, Berkeley, USA; Heidi E. Kirsch, University of California, San Francisco, USA; James W. Sleigh, University of Auckland, New Zealand; Andrew J. Szeri, University of California, Berkeley, USA

## **MS88** Fluctuation and Noise in Living Organisms - Part I of II

3:00 PM-4:40 PM

## Room: White Pine

## For Part 2 see MS99

Recently, nonlinear dynamical systems with presence of noise appear to be important in the various fields in biological sciences, neurosciences and computer sciences. Recent developments have indicated that subtle and interesting noise-induced phenomena including synchronous and chaotic transition occur. These are observed even in systems that are rather simple nonlinear dynamical systems such as one-dimensional maps, oscillators, and gradient dynamics and spatially extended systems of them. In this minisymposium, we will outline recent results for each of these, address possible theoretical framework, and relate the dynamical behaviour to implications for real-world phenomena.

## Organizer: Yuzuru Sato Hokkaido University, Japan

Organizer: Keiichi Kitajo **RIKEN Brain Science Institute, Japan** 

Organizer: Jun-nosuke Teramae **RIKEN Brain Science Institute, Japan** 

## 3:00-3:20 Noise-induced Phenomena in One-dimensional Maps

Yuzuru Sato, Hokkaido University, Japan

## 3:25-3:45 Amoeba-based Neurocomputing and Resource-**Competing Oscillator Networks**

Masashi Aono, RIKEN Institute of Physical and Chemical Research, Japan

## 3:50-4:10 EHR Dynamics: An Introduction

George Hripcsak, Columbia University, USA

4:15-4:35 Macroscopic Physiology David Albers, Columbia University, USA

## **Coffee Break**

4:40 PM-5:10 PM

# LR

Room:Golden Cliff

## Tuesday, May 24

# **MS89**

## **Dynamical Systems Approaches in Smart** (Power) Grids - Part II of II

5:10 PM-6:50 PM

## Room:Ballroom I

## For Part 1 see MS78

This minisymposium will bring together power engineers, control theorists, applied mathematicians and statisticians to discuss dynamical systems approaches and techniques used (or to be used in the future) to study new challenging problems related to design, optimization, control and stability of power grids of the future.

Organizer: Konstantin Turitsyn Massachusetts Institute of Technology, USA

Oraanizer: Michael Chertkov Los Alamos National Laboratory, USA

## 5:10-5:30 Modeling and Control of Aggregated Heterogeneous Thermostatically Controlled Loads for **Ancillary Services**

Duncan Callaway, University of California, Berkeley, USA; Stephan Koch, ETH Zürich, Switzerland; Johanna Mathieu, University of California, Berkeley, USA

## 5:35-5:55 Modeling and Simulation of a Renewable and Resilient Electric **Power Grid**

Thomas Overbye, University of Illinois at Urbana-Champaign, USA

## 6:00-6:20 Rules Versus Optimization for Enabling Adaptive Network **Topologies**

Seth Blumsack, and Clayton Barrows, Pennsylvania State University, USA

## 6:25-6:45 Demand Response to **Uncertainty in Renewable Energy** Steven Low and Libin Jiang, California

Institute of Technology, USA

Tuesday, May 24

# **MS90**

## Modeling Dynamics of Sleep-Wake Regulation -Part II of II

5:10 PM-6:25 PM

Room:Ballroom II

## For Part 1 see MS79

Sleep and wake states are regulated by the interactions among brainstem and hypothalamic neuronal populations and the expression of their neurotransmitters. This sleep-wake regulatory network receives inputs from the circadian pacemaker and from cortical regions that modulate sleep-wake dynamics. Significant advances have been made in translating the physiological understanding of these interactions into dynamical mathematical models. In this minisymposium, we present different models of the sleep-wake regulatory network, its interaction with the circadian pacemaker, and the integration of models with experimental data.

Organizer: Bruce J. Gluckman Pennsylvania State University, USA

Organizer: Victoria Booth University of Michigan, USA

University of Michigan, USA

Organizer: Amitaba Bose

## 5:10-5:30 Modeling Circadian Modulation of Sleep-wake **Regulatory Dynamics**

# Scoring Through the Mapping of EEG



#### 6:00-6:20 Data Assimilation in Sleep Models - a Nonlinear Ensemble Kalman Approach To Tracking and Predicting State

Madineh Sedigh-Sarvestani, Steven Schiff, and *Bruce J. Gluckman*, Pennsylvania State University, USA

## Tuesday, May 24

# **MS9**1

## Recent Applications of Dynamical Systems in Ecology - Part III of III

5:10 PM-6:25 PM

Room:Ballroom III

#### For Part 2 see MS80

Difference and differential equations are mathematical modeling tools which contribute to improved understanding of complex ecological and epidemiological systems. In this mini-symposium, we bring together distinguished researchers with expertise in applying these models to study problems arising from life sciences. Three sessions will focus on spatio-temporal trends, models of mutualism, and control and optimization. Speakers will address recent advances in dynamical systems related to plant and insect ecology, evolution, climate change, oceanography, immunology and disease spread. Speakers with diverse backgrounds are chosen to promote collaboration among mathematicians and other scientists. The speakers include five women and others from underrepresented groups.

Organizer: Andrea Bruder Colorado College, USA

Organizer: Yun Kang Arizona State University, USA

Organizer: Rachael Miller Neilan Louisiana State University, USA

5:10-5:30 Optimal Management Controls for Maximizing the Recovery of an Endangered Fish Species

Rachael Miller Neilan, Louisiana State University, USA; Kenneth Rose, University of Louisiana, USA; Wim Kimmerer, San Francisco State University, USA; William Bennett, University of California, Davis, USA; Karen Edwards, San Francisco State University, USA

continued in next column

### 5:35-5:55 A Model for the Spread of Animal Diseases with Mitigation Strategies and a Case Study on Rinderpest

*Carrie A. Manore*, Oregon State University, USA; Benjamin McMahon and Jeanne Fair, Los Alamos National Laboratory, USA; James Hyman, Tulane University, USA; Mac Brown, Los Alamos National Laboratory, USA; Montiago LaBute, Lawrence Livermore National Laboratory, USA

#### 6:00-6:20 Analyzing Endogenous Thresholds in Coupled Socioeconomic-ecological Systems

Rick Horan, Michigan State University, USA; *Eli Fenichel*, Arizona State University, USA; Kevin Drury, Bethel College, USA; David Lodge, Notre Dame University, USA

# MS92

## Weakly and Strongly Nonlinear Dynamics in Lattice Differential Equations

5:10 PM-6:25 PM

## Room:Magpie A

Nonlinear lattice differential equations are used to model a wide variety of physical phenomena with examples ranging from light propagation in waveguide arrays (weakly nonlinear) to earthquake response (highly nonlinear). The analysis and properties of the structures that these equations emit, such as a solitary waves, can differ greatly depending on the nonlinearity strength. It is the goal of this minisymposium to bring together young and senior researchers who work on the analysis, computation, and experimental study of such problems in order to explore the most recent advances and to underline differences and commonality between these two types of models.

Organizer: Christopher Chong University of Stuttgart, Germany

#### 5:10-5:30 Intrinsic Energy Localization Through Discrete Breathers in Onedimensional Diatomic Granular Crystals

*Georgios Theocharis*, California Institute of Technology, USA

## 5:35-5:55 Breathers and Kinks in FPU Lattices

Jonathan Wattis, University of Nottingham, United Kingdom; Andrew Pickering and Pilar R. Gordoa, Universidad Rey Juan Carlos, Spain

### 6:00-6:20 Internal Modes and Instabilities of Solitons in the Discrete NLS Equation

Anton Sakovich and Dmitry Pelinovsky, McMaster University, Canada Tuesday, May 24

## MS93 Multi-dimensional Localized Patterns

5:10 PM-6:50 PM

## Room:Magpie B

Localized structures in greater than one dimension are seen in diverse settings ranging from oscillons in vertically vibrated media to vegetation rings in the Negev desert. Most analytical progress has been made in one dimension. In this minisymposium, we will explore the experimental, computational, and analytic methods used to understand the existence and dynamics of these patterns in higher dimensions.

Organizer: Scott McCalla Brown University, USA

Organizer: David Lloyd University of Surrey, United Kingdom

5:10-5:30 Localized Patterns in the Swift-Hohenberg Equation Scott McCalla, Brown University, USA

#### 5:35-5:55 Continuation of Oscillons in an Autonomous System of Reactiondiffusion Equations

Daniele Avitabile, University of Surrey, United Kingdom

## 6:00-6:20 Localised Patterns in a Crime Hotspot Model

David Lloyd, University of Surrey, United Kingdom

## 6:25-6:45 Stability of Planar Layers in Reaction Diffusion Equations Coupled with a Conservation Law

Alin Pogan, University of Minnesota, USA

Tuesday, May 24

## MS94 Dynamics of Microswimmers - Part II of II

5:10 PM-6:50 PM

Room: Wasatch A

## For Part 1 see MS83

Recent experiments have been achieving increasingly accurate measurements for how the swimming motions of microorganisms such as bacteria affect the dynamics of the surrounding fluid as well as of nearby microorganisms. This has stimulated the development of hydrodynamic and statistical theories to explain the complex flow structure and enhanced mixing induced by the swimming dynamics as well as the collective behavior of a suspension of swimming microorganisms. Of particular interest is determining to what extent the physical aspects of the swimming motion facilitate biologically beneficial coordination and transport. Speakers in this minisymposium will address recent mathematical, computational, and experimental developments.

Organizer: Peter R. Kramer Rensselaer Polytechnic Institute, USA

## 5:10-5:30 Boundary Effects on Continuum Models for Active Suspensions

*Christel Hohenegger*, University of Utah, USA; Michael J. Shelley, Courant Institute of Mathematical Sciences, New York University, USA

## 5:35-5:55 Collective Dynamics of Flagella and Multiflagellar Organisms

Michael D. Graham and Pieter Janssen, University of Wisconsin, Madison, USA

# 6:00-6:20 Random Flow in Suspensions of Swimming Algae

Vasily Kantsler, Cambridge University, United Kingdom

## 6:25-6:45 Constructive and Destructive Correlation Dynamics in Simple Stochastic Swimmer Models

Kajetan Sikorski, Peter R. Kramer, and Patrick Underhill, Rensselaer Polytechnic Institute, USA

## MS95 Network Analysis Based on Data

## 5:10 PM-6:50 PM

## Room: Wasatch B

In this minisymposium we present different but complementary ways of how to infer and analyse networks based on measured data. Two possible scenarios will be discussed: (i) multivariate data are given and the topology of the network has to be inferred, and (ii) a model for a network is given, and it has to be validated based on its predictions and further comparison to experimental data. The talks presented in this minisymposium will show how these two approaches can be combined in a single iterative scheme. Examples of application will cover neuroscience, electrochemical oscillators and cell biology.

Organizer: Celso Grebogi King's College, University of Aberdeen, United Kingdom

Organizer: Jens Timmer University of Freiburg, Germany

## 5:10-5:30 Inferring Properties of Networks from Spike Trains

*Tim Sauer*, George Mason University, USA

#### 5:35-5:55 Frequency Domain Based Estimations of Interactions Between Nonlinear Oscillators

*Bjoern Schelter*, University of Freiburg, Germany; Marco Thiel and M. Carmen Romano, University of Aberdeen, United Kingdom; Linda Sommerlade and Jens Timmer, University of Freiburg, Germany

## 6:00-6:20 Synchronization of Small Networks of Electrochemical Oscillators

*Istvan Kiss* and Mahesh Wickramasinghe, Saint Louis University, USA

### 6:25-6:45 Reactions of the Cell Cycle Network to Multiple Stresses

*Elahe Radmaneshfar*, University of Aberdeen, United Kingdom; Celso Grebogi, King's College, University of Aberdeen, United Kingdom; M. Carmen Romano and Marco Thiel, University of Aberdeen, United Kingdom

## Tuesday, May 24

# MS96

## Jumps, Switches, Impacts, and Breaks: Discontinuities in Dynamical Systems

5:10 PM-6:50 PM

## Room:Maybird

The study of nonsmooth dynamical systems continues to challenge the way that we study and interpret discontinuities in modern modeling applications. This session will give a broad view of recent advances, covering problems from the general way that we describe switching and impact in terms of maps, flows and bifurcations, to some novel consequences such as nondeterminism, forward-time ambiguities, and robust chaos. We present work that provides both a deeper theoretical understanding of discontinuities in dynamics, and new techniques to study systems wherever they suffer jumps, switches, impacts, and breaks.

Organizer: Stewart D. Johnson *Williams College, USA* 

Organizer: Alan R. Champneys University of Bristol, United Kingdom

### 5:10-5:30 Discontinuous Maps and Their Applications

*Chris Budd* and *Karin Mora*, University of Bath, United Kingdom

## 5:35-5:55 Piecewise Smooth Systems, Set Valued Fields, and Nondeterministic Chaos

Alessandro Colombo, Massachusetts Institute of Technology, USA

#### 6:00-6:20 Stasis Sets and Approximating Cycles

Stewart D. Johnson, Williams College, USA

# 6:25-6:45 Title Not Available at Time fo Publication

Arne Nordmark, Royal Institute of Technology, Sweden

## Tuesday, May 24

# **MS97**

## Numerical Approximations of Invariant Objects Including Lagrangian Systems

## 5:10 PM-6:25 PM

## Room:Superior A

This minisymposium considers two recent trends for efficient computation of dynamically invariant objects: a) methods based on the parameterization of stable and unstable manifolds and b) numerical approximation of invariant objects for Lagrangian systems which do not admit a dynamical systems interpretation. Techniques to be explored include local approximation of multidimensional manifolds and their intersections by power series and their globalization using splines. Lagrangian systems studied include implicitly defined systems such as billiards, and spatially extended systems such as long-range, Frenkel-Kontorova models and Heisenberg spin chains. The presentations will discuss the implementation and limitations of these methods.

Organizer: Hector E. Lomeli Instituto Tecnológico Autónomo de México, Mexico

## 5:10-5:30 Parameterization of Invariant Manifolds for Lagrangian Systems with Long-range Interactions

*Hector E. Lomeli*, Instituto Tecnológico Autónomo de México, Mexico; Rafael de La Llave, University of Texas, USA

#### 5:35-5:55 On the Lengths of Periodic Billiard Trajectories Inside Axisymmetric Analytic Convex Tables Rafael Ramírez-Ros, Universitat

Politecnica de Catalunya, Spain

## 6:00-6:20 Higher-order Adaptive Methods For Computing Invariant Manifolds of Maps

Jacek K. Wrobel and Roy Goodman, New Jersey Institute of Technology, USA

# MS98

## Dynamics and Statistics of Neural Networks and Fields - Part II of II

5:10 PM-6:50 PM

## Room:Superior B

## For Part 1 see MS87

In the nervous system, thousands or millions of neurons interact to produce even simple functionality. A variety of methods for deriving and analyzing the properties of neural networks will be presented. The approaches include mean-field and evolution models of spiking behavior and activity measures such as correlation functions, touching on a wide variety of mathematical techniques from renormalization to graph theory. These models give insight to the impact of individual neural dynamics and connectivity statistics on global behavior. Unifying these studies is the recognition that nontrivial, surprising global behavior can arise from the interactions of individual units.

Organizer: Eli Shlizerman University of Washington, Seattle, USA

Organizer: Andrea K. Barreiro University of Washington, USA

## 5:10-5:30 Dynamical regimes of integrate-and-fire neuronal network models

Katherine Newhall, Rensselaer Polytechnic Institute, USA

## 5:35-5:55 A Kinetic Theory Model of Second Order Feedforward Neuronal Networks

*Chin-Yueh Liu*, National University of Kaohsiung, Taiwan; Duane Nykamp, University of Minnesota, USA

6:00-6:20 When are Pairwise continued in next column

# Maximum Entropy Methods Good Enough?

Andrea K. Barreiro, University of Washington, USA; Julijana Gjorgjieva, University of Cambridge, United Kingdom; Fred Rieke and Eric Shea-Brown, University of Washington, USA

## 6:25-6:45 Characterization of Network Connectivity from Neural Activity in Behaving Animals

Sara A. Solla and James M. Rebesco, Northwestern University, USA; Lee E. Miller, Northeastern University, USA Tuesday, May 24

# **MS99**

## Fluctuation and Noise in Living Organisms -Part II of II

5:10 PM-6:50 PM

Room: White Pine

## For Part 1 see MS88

Recently, nonlinear dynamical systems with presence of noise appear to be important in the various fields in biological sciences, neurosciences and computer sciences. Recent developments have indicated that subtle and interesting noise-induced phenomena including synchronous and chaotic transition occur. These are observed even in systems that are rather simple nonlinear dynamical systems such as one-dimensional maps, oscillators, and gradient dynamics and spatially extended systems of them. In this minisymposium, we will outline recent results for each of these, address possible theoretical framework, and relate the dynamical behaviour to implications for real-world phenomena.

Organizer: Yuzuru Sato Hokkaido University, Japan

Organizer: Keiichi Kitajo

RIKEN Brain Science Institute, Japan

Organizer: Jun-nosuke Teramae RIKEN Brain Science Institute, Japan

5:10-5:30 Stochastic Resonance and Noise-enhanced Phenomena in the Human Brain

Keiichi Kitajo, RIKEN Brain Science Institute, Japan

5:35-5:55 Fluctuation of Brain Dynamics Related to Perception

Masanori Shimono, Indiana University, USA

6:00-6:20 Encoding of Slow Signals in High-pass Phasic Neurons with Background Fluctuations

Cheng Ly, University of Pittsburgh, USA

6:25-6:45 Long-tailed EPSP Distribution Reveals Origin and Computational Role of Cortical Noisy Activity Jun-nosuke Teramae, RIKEN Brain

Science Institute, Japan

## **Dinner Break**

6:50 PM-8:30 PM Attendees on their own

# Poster Session and Dessert Reception

8:30 PM-10:30 PM

Room:Ballroom

## Desynchronization Bifurcation of Coupled Nonlinear Dynamical Systems

*Suman Acharyya* and R. E. Amritkar, Physical Research Laboratory, India

## Learning from the Past: Empirical Correction of Models of Natural Chaotic Phenomena

Nicholas A. Allgaier, Kameron D. Harris, and Chris Danforth, University of Vermont, USA

## Streamline Topology of Helical Fluid Flow

Morten Andersen, Technical University of Denmark, Denmark

## Study of the Connectome of a Simple Spinal Cord Locomotor Network

Abul K. Azad and Roman Borisyuk, University of Plymouth, United Kingdom

## Mixed Mode Oscillations in a Gnrh Neuron Model

Sayanti Banerjee and Janet Best, Ohio State University, USA; Kelly Suter, University of Texas, San Antonio, USA

## Mixed-Pattern Solutions of An Eighth Order Swift-Hohenberg Equation

David Bentley, University of Leeds, United Kingdom; Alastair M. Rucklidge, University of Leeds, United Kingdom; Thomas Wagenknecht and Rainer Hollerbach, University of Leeds, United Kingdom

## Migration Effects on Disease Outbreaks

Jackson Burton and Lora Billings, Montclair State University, USA; Ira B. Schwartz, Naval Research Laboratory, USA; Derek Cummings, Johns Hopkins Bloomberg School of Public Health, USA

## Effects of Variability and Noise on Synchrony Between Reciprocally Pulse Coupled Oscillators with Delays

Lakshmi Chandrasekaran and Shuoguo Wang, Louisiana State University Health Sciences Center, USA; Fernando Fernandez and John White, University of Utah, USA; Carmen Canavier, Louisiana State University, USA

#### Exploring the Dynamics of CRISPR Length: How Much Can a Bacterium Remember About Viruses That Infected It?

*Lauren M. Childs*, Cornell University, USA; Joshua Weitz, Georgia Institute of Technology, USA

#### Dynamic Switch in a Model of Unfolded Protein Response To Endoplasmic Reticulum Stress

Danilo Diedrichs, University of Iowa, USA; Rodica Curtu, University of Iowa, USA

# Correction of Periodic Orbits in High Precision

Angeles Dena, Alberto Abad, and Roberto Barrio, University of Zaragoza, Spain

## Existence and Stability of Traveling Wave Solutions in a Simplified Model of Cardiac Tissue

*Lisa D. Driskell*, Mesa State College, USA; Gregery Buzzard, Purdue University, USA

# Dimension Reduction of Mechanical Systems

Michael Elmegaard, Jens Starke, Frank Schilder, and Jon J. Thomsen, Technical University of Denmark, Denmark

### Frequency Response of Gonadotropin-Releasing Hormone (GnRH) Induced Gonadotropin Subunit Transcription in Pituitary Gonadotrophs

Patrick A. Fletcher, Florida State University, USA

## **Decay and Destruction of Invariant Tori in Volume Preserving Maps** *Adam M. Fox* and James Meiss,

University of Colorado, Boulder, USA

## Stochastic Network Models of Disease Outbreaks

Jonathan Hayes and Lora Billings, Montclair State University, USA

#### Comparison of Different Mean-Field Equations: Finite-Size Effects and Synchronization

*Geoffroy Hermann*, Jonathan D. Touboul, and Olivier Faugeras, INRIA, France

# Analyzing Point Process Data by Distances and Recurrence Plots

Yoshito Hirata, University of Tokyo, Japan; Satoshi Suzuki, University of California, Berkeley, USA; Kazuyuki Aihara, JST/University of Tokyo, Japan

## An Agent-Based Framework for Designing Water Efficient Residential Landscapes

Rhonda Hoenigman, University of Colorado, Boulder, USA; *Elizabeth Bradley*, University of Colorado at Boulder, USA; Nichole Barger, University of Colorado, Boulder, USA

## Analysis of the Shimmy Phenomenon in Aircraft Main Landing Gears

*Chris Howcroft*, University of Bristol, United Kingdom

### Adaptive Mathematical Model of Heat and Mass Transfer for Automatic Control of Solidification in Continuous Casting

*Ganna Ivanova*, National Academy of Science, Ukraine

# Fronts and Pulses Locked to Stimuli in Continuum Neuronal Networks

*Jozsi Z. Jalics*, Youngstown State University, USA; Bard Ermentrout and Jonathan E. Rubin, University of Pittsburgh, USA

#### Delay Coupled Limit Cycle Oscillators with Non-Linear Frequency Shift Effects

*George L. Johnston*, EduTron Corp., USA; Abhay Ram, Massachusetts Institute of Technology, USA; Abhijit Sen, Institute for Plasma Research, India

## Linear Conjugacy of Chemical Reaction Networks

Matthew D. Johnston and David Siegel, University of Waterloo, Canada

## Linearization of Hyperbolic Finite-Time Processes

Daniel Karrasch, TU Dresden, Germany

## Transferring Time Series Analysis Methods to Point Processes

Malenka Killmann, Linda Sommerlade, Wolfgang Mader, Jens Timmer, and Björn Schelter, University of Freiburg, Germany

#### Clustering Generates Gamma Rhythms in a Recurrent Neuronal Network with Spike Frequency Adaptation

Zachary Kilpatrick and Bard Ermentrout, University of Pittsburgh, USA

### Mixed Mode Oscillations and Graded Persistent Activity Contribute to Memory Formation

Jung Eun Kim and Janet Best, Ohio State University, USA

### Intrinsic Localized Modes in Mechanically Coupled Cantilever Array with Tunable On-Site Potential

Masayuki Kimura, University of Shiga Prefecture, Japan; Takashi Hikihara, Kyoto University, Japan

#### Linear Response Prediction for Fluctuation-Dissipation With Adaptive Time Stepping

*Marc Kjerland*, University of Ilinois at Chicago, USA; Rafail Abramov, University of Illinois, Chicago, USA

#### Amplitude Equations for SPDEs with Cubic Nonlinearities on Unbounded Domains

*Konrad Klepel*, Universitaet Augsburg, Germany

## Numerical Continuation Applied to Landing Gear Mechanism Analysis

James Knowles, University of Bristol, United Kingdom; Bernd Krauskopf and Mark Lowenberg, University of Bristol, United Kingdom

## Spatiotemporal Ecology by Remote Sensing from Satellite Imagery

Sean Kramer, Ranil Basnayake, Erik Bollt, and Aaron B. Luttman, Clarkson University, USA

## Sliding Mode Control Applied to Suppress Grazing-Induced Chaos in An Impact Oscillator

Soumya Kundu, University of Michigan, Ann Arbor, USA

## Stochastic Synchronization of Neuronal Populations with Intrinsic and Extrinsic Noise

*Yi Ming Lai*, University of Oxford, United Kingdom; Paul C. Bressloff, University of Utah, USA and University of Oxford, United Kingdom

## Mathematical Modeling of Hydrodynamic Contributions to Amoeboid Cell Motility

*Owen Lewis* and Robert D. Guy, University of California, Davis, USA

### From Synchronous Oscillations to Oscillation-arrested for Segmentation Clock Gene of Zebrafish

*Kang-Ling Liao* and Chih-Wen Shih, National Chiao Tung University, Taiwan

#### Interaction of Epidemic and Information Spreading in Adaptive Networks

Yunhan Long, College of William & Mary, USA; Thilo Gross, Max Planck Institute for Physics of Complex Systems, Germany; Leah Shaw, College of William & Mary, USA

## From Bivariate Analysis to the Small World Property

Wolfgang Mader, Malenka Killmann, Linda Sommerlade, Jens Timmer, and Björn Schelter, University of Freiburg, Germany

#### Reducing the Dimension of Mathematical Models of Physiological Systems

*Pingyu Nan*, University of Auckland, New Zealand

## Hybrid Deterministic/stochastic Processes and Optimal Search Strategies

Jay M. Newby, Oxford University, United Kingdom; Paul C. Bressloff, University of Utah, USA and University of Oxford, United Kingdom

### Discovering Novel Treatment Strategies for Type 1 Diabetes Through Mathematical Modeling

Kenneth Hagde M. Nielsen and Johnny T. Ottesen, Roskilde University, Denmark

# Reconstructing Neuronal Inputs from Voltage Recordings

*Stephen E. Odom* and Alla Borisyuk, University of Utah, USA

### Phase Reduction for Analyzing Collective Rhythms of Delay-Induced Oscillations

Yutaro Ogawa and Ikuhiro Yamaguchi, University of Tokyo, Japan; Hiroya Nakao, Kyoto University, Japan; Yashuhiko Jimbo and Kiyoshi Kotani, University of Tokyo, Japan

### One Possible Mechanism Underlying Intermittently Synchronous Activity Patterns.

Choongseok Park, Indiana University -Purdue University Indianapolis, USA; Leonid Rubchinsky, Indiana University-Purdue University Indianapolis (IUPUI), USA

# Symmetry Breaking Bifurcations in a $D_4$ Symmetric Hamiltonian System

*Slawomir Piasecki*, Roberto Barrio, and Fernando Blesa, University of Zaragoza, Spain

## Optimal Trajectories, Front Tracking, and Lagrangian Structures in Coastal Ocean Flows

*Blane Rhoads* and Igor Mezic, University of California, Santa Barbara, USA; Andrew Poje, City University of New York, Staten Island, USA

## Mode Interactions Between Superlattice Patterns

Pakwan Riyapan, University of Leeds, United Kingdom; Alastair M. Rucklidge, University of Leeds, United Kingdom

## Numerical Study of Existence, Stability and Collision Properties of Dark-Bright Discrete Solitons

*Azucena Alvarez* and Francisco Romero, Universidad de Sevilla, Spain

#### Riemann Problems for Multiphase Flow with Several Thermodynamic Equilibria

Julio Daniel M. Silva and Dan Marchesin, Instituto Nacional de Matematica Pura e Aplicada, Brazil

#### Modelling Gang Membership in Trinidad and Tobago As An Epidemic

Joanna Sooknanan, Balswaroop Bhatt, and Donna Comissiong, University of The West Indies, Trinidad & Tobago

## The Effect of Network Structure on the Path to Synchronization in Large Systems of Coupled Oscillators

John E. Stout, North Carolina State University, USA; Matthew Whiteway, University of Oklahoma, USA; Edward Ott, Michelle Girvan, and Thomas Antonsen, University of Maryland, USA

# Dynamics of Actuators and Actuator Arrays

Randall Tagg, University of Colorado, Denver, USA; Vinnie Basile, Westminster High School, USA; Rod Cruz, Kearney Middle School, USA

## Real-Valued Complex Chaotic Spreading Sequences with Constant Power in Complex CDMA

Ryo Takahashi, Kyoto University, Japan

# Blowup Solutions of the Korteweg-De Vries Equation

*Vincent Timperio*, University of Leiden, The Netherlands; Vivi Rottschäfer, Leiden University, Netherlands

# Synchronization of Stochastic Oscillators

Ralf Toenjes, Ochanomizu University, Japan

## Pulses in Singularly Perturbed Two Component Reaction-Diffusion Equations

Arjen Doelman and *Frits Veerman*, Leiden University, Netherlands

#### An Analytical Method to Compute Bifurcation Curves for Neural Networks with Space Dependent Delays

*Romain Veltz*, INRIA Sophia Antipolis, France

#### Mathematical Modelling of Membrane Separation

Frank Vinther, Technical University of Denmark, Denmark

## Pattern Formation on Small World Networks

*Thomas Wagenknecht* and Nick McCullen, University of Leeds, United Kingdom

#### Rigid Phase Shifts in Periodic Solutions of Network Systems and Network Symmetry

Yunjiao Wang, Ohio State University, USA

#### Slow Variable Dominance in Beta-Cell Models

*Margaret A. Watts*, Joel Tabak, and Richard Bertram, Florida State University, USA

### Traveling Waves in a Neural Field Model of Binocular Rivalry

Matthew Webber, University of Oxford, United Kingdom; Paul C. Bressloff, University of Utah, USA and University of Oxford, United Kingdom

## Spiral Defect Chaos and Skew-Varicose Instability of 2D Generalized Swift-Hohenberg Model Equations

Jinendrika A. Weliwita, University of Leeds, United Kingdom; Alastair M. Rucklidge, University of Leeds, United Kingdom; Steve Tobias, University of Leeds, United Kingdom

### An Equationless Approach to Studying the Organizing Principles of a Multifunctional Central Pattern Generator

*Jeremy Wojcik*, Andrey Shilnikov, and Robert Clewley, Georgia State University, USA

## Phase-Locking in Chains of Half-Center Oscillators: Mechanisms Underlying Phase Constancy in the Crayfish Swimmeret System

*Jiawei Zhang* and Timothy Lewis, University of California, Davis, USA

#### Augmented Graph Method for Synchronization in Directed Networks *Ken Zhao* and Igor Belykh, Georgia State University, USA

### Cardiac Disease Detection by Mostly Conjugacy

Jiongxuan Zheng, Clarkson University, USA

### Time-dependent Solutions of a Convection Problem with Temperature Dependent Viscosity

*Jezabel Curbelo* and Ana María Mancho, Instituto de Ciencias Matematicas, Spain

### Ergodic and Non-ergodic Clustering of Inertial Particles

Kristian Gustafsson, University of Gothenburg, Sweden

#### Persistence of Normally Hyperbolic Invariant Manifolds: The Noncompact Case

Jaap Eldering, Utrecht University, The Netherlands

## Registration

8:00 AM-5:30 PM Room:Ballroom Foyer

## MS100 Graph Theoretical Analysis in Systems Biology

8:30 AM-10:10 AM

## Room:Ballroom I

Recent developments in systems biology made it crucial to get better insight into the structure and dynamics of networks that are made up of thousands of interacting molecules of DNA, proteins, metabolites, and other components. The goal of this minisymposium is to explore how graph theory methods can be applied to gain better perception of this yet little understood subject. The topics that will be discussed include reconstruction and reverse engineering of biological networks, decomposition of networks into modules and identification of cell signaling regulatory mechanisms. We will explore applications of dynamical modeling and coarse-graining the dynamics of biological networks.

Organizer: Alice Hubenko University of California, Santa Barbara, USA

#### 8:30-8:50 Synthesizing and Simplifying Biological Networks from Pathway Level Information

Bhaskar DasGupta, University of Illinois, Chicago, USA

#### 8:55-9:15 Protein Kinase Target Discovery from Genome-wide mRNA Expression Profiling

Avi Ma'ayan, Mount Sinai School of Medicine, USA

continued in next column

## 9:20-9:40 Decomposition of Biological Networks

*Alice Hubenko* and Igor Mezic, University of California, Santa Barbara, USA

## 9:45-10:05 Coarse-Graining Dynamics of (and On) Networks

Yannis Kevrekidis, Princeton University, USA; *Karthikeyan Rajendran* and Andreas Tsoumanis, Princeton University, USA; Constantinos Siettos, National Technical University of Athens, Greece Wednesday, May 25

## MS101 Nonlinear Dynamics for Radar and Sonar

8:30 AM-10:10 AM

## Room:Ballroom II

Radar has been thought of as linear, but nonlinear dynamics allows many new techniques. Chaotic sources can produce complex patterns in space, and can extend applications such as location. The interaction of chaotic signals with complex targets may be analyzed in phase space, allowing for identification of the targets. Matched filters for broad band chaotic radar signals may be built as hardware, greatly speeding signal processing. The structure of chaotic signals makes us think very differently about radar.

Organizer: Thomas L. Carroll Naval Research Laboratory, USA 8:30-8:50 Matched Filter for Chaos Radar

*Ned J. Corron*, Jonathan N. Blakely, and Mark Stahl, US Army RDECOM, USA

## 8:55-9:15 De-Synchronized Chaos Angle Selective Radiation Systems Jay Wilson and Bryan James, Comtech

AeroAstro, Inc., USA 9:20-9:40 Acoustic Experiments with

Multiple Chaotic Signal Sources Frederic Rachford, Naval Research Laboratory, USA

9:45-10:05 Phase Space Method for Target Identification

*Thomas L. Carroll*, Naval Research Laboratory, USA

## MS102 Noise in Neural Systems 8:30 AM-10:10 AM

## Room:Ballroom III

Noise is prevalent in neural systems on all scales, ranging from fluctuating ion channels to the noise-like activity of large ensembles of spiking neurons. The different roles played by noise necessitate the use of a variety of mathematical approaches. The minisymposium will discuss detailed models of synapses and the effect of synaptic noise on the amplification of weak signals, elucidate the connections between Markov chain descriptions of ion channels and their treatment via stochastic differential equations, show how macroscopic oscillations can arise in recurrent networks by stochastic synchronization, and derive and analyse a nonlinear Fokker-Planck equation describing basic human motor behavior.

## Organizer: Hermann Riecke Northwestern University, USA

## Organizer: Jens Starke Technical University of Denmark, Denmark

### 8:30-8:50 Network Effects of Noisy Synaptic Release

*Herbert Levine*, University of California, San Diego, USA

## 8:55-9:15 Stochastic Synchrony in Networks With and Without Feedback, Elucidation of the Rate of Convergence to Steady State in Type I and Type II Oscillators

Sashi Marella and Bard Ermentrout, University of Pittsburgh, USA

## 9:20-9:40 Spike-time Dependent Coding and Noisy Kuramoto Networks

Andreas Daffertshofer, Vrije Universiteit Amsterdam, The Netherlands

#### 9:45-10:05 Revisiting Stochastic Differential Equation Models for Ion Channel Noise in Hodgkin-Huxley Neurons

Joshua Goldwyn, University of Washington, USA; Nikita Imennov, Michael Famulare, and Eric Shea-Brown, University of Washington, USA

## Wednesday, May 25

## MS103 Computational Topology and the Dynamics of Computation

8:30 AM-10:10 AM

## Room:Magpie A

Computational topology can be used to show rigorously that a dynamical system is chaotic by obtaining lower bounds on entropy. Advantages of these methods include their applicability to time series and high (even infinite) dimensional systems, as well as their relative insensitivity to noise. Talks in this minisymposium will address recent results in this area as well as applications to granular materials, the study of computers as dynamical systems, and the development of new metrics for computer performance.

Organizer: Elizabeth Bradley University of Colorado at Boulder, USA

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

8:30-8:50 The Dynamics of Computer Behavior

*Todd D. Mytkowicz*, Microsoft Research, USA

## 8:55-9:15 Geometry and Topology of Computer Dynamics

Zachary Alexander, University of Colorado, USA; Amer Diwan, James D. Meiss, and Elizabeth Bradley, University of Colorado at Boulder, USA

# 9:20-9:40 The Dynamics of Granular Materials

*Miroslav Kramar*, Rutgers University, USA; Lou Kondic, New Jersey Institute of Technology, USA; Konstantin Mischaikow, Rutgers University, USA

## 9:45-10:05 Experimental Determination of the Homology of Invariant Manifolds

Mark Muldoon, Jeremy Huke, and David Broomhead, University of Manchester, United Kingdom

## Wednesday, May 25

## MS104 Localised Solutions in Turbulent Flows

8:30 AM-10:10 AM

## Room:Magpie B

Over the last couple of years great progress has been made in the study of turbulence through equilibrium, periodic and traveling wave solutions. The study of such special solutions on the boundary of the basin of attraction of laminar flow in shear turbulence has shed new light subcritical transition. However, these studies have been restricted to small, periodic domains and solutions extending globally in space and time. In experiments we see localised structures such as puffs and spots. The latest work on compution and analysis of solutions localised in space or time in pipes, channels and ducts are presented here.

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

## 8:30-8:50 On the Edge of Turbulent Pipe Flow

Ashley Willis, University of Sheffield, United Kingdom; Yohann Duguet, LIMSI-CNRS, France; Rich Kerswell, University of Bristol, United Kingdom; Chris Pringle, University of Reading, United Kingdom

## 8:55-9:15 Spatially Localized Turbulence Structures in Transitional Rectangular-duct Flow

Genta Kawahara and Hiroki Wakabayashi, Osaka University, Japan; Markus Uhlmann, Karlsruhe Institute of Technology, Germany; Alfredo Pinelli, CIEMAT, Madrid, Spain

## 9:20-9:40 From Swift-Hohenberg to Navier-Stokes: Homoclinic Snaking in Plane Couette Flow

*Tobias Schneider*, Harvard University, USA; John Gibson, University of New Hampshire, USA; John Burke, Boston University, USA

## 9:45-10:05 A Homoclinic Tangle on the Edge of Couette Turbulence

*Lennaert van Veen*, University of Ontario Institute of Technology, Canada; Genta Kawahara, Osaka University, Japan

# MS105 Waves in Stratified Flows

8:30 AM-9:45 AM

## Room: Wasatch A

The idea of this minisymposium is to bring together people who study waves in stratified flows from slightly different angles, and we hope to have a dynamical exchange of ideas and synergy of the group combining people at different stages of their careers. Talks will look at waves stratified flows from theoretical numerical and experimental prospective, and will include flows in the ocean, atmosphere and laboratory. More specifically, we will consider internal waves in the ocean, reduced highly nonlinear models of stratified flows and two layer fluids, as well as stability results.

Organizer: Yuri V. Lvov Rensselaer Polytechnic Institute, USA

Organizer: Roberto Camassa University of North Carolina at Chapel Hill, USA

#### 8:30-8:50 Generation of Shear Flows by Three-wave Interactions in Stratified Flows

Leslie Smith, University of Wisconsin, USA

### 8:55-9:15 Reduced Nonlinear Models of Internal Waves

*Roberto Camassa*, University of North Carolina at Chapel Hill, USA

#### 9:20-9:40 Internal Waves in the Ocean - Observations, Theory and DNS

*Yuri V. Lvov*, Rensselaer Polytechnic Institute, USA

## Wednesday, May 25

## MS106 Dynamics of Hearing 8:30 AM-10:10 AM

## Room: Wasatch B

The auditory organs of mammals form a complex system that processes sound with great frequency and amplitude resolution and with sensitivity at the physical limits. The most intriguing organ is the inner ear that transforms sound into neural signals to be interpreted by the brain. Among the many features of the inner ear the talks will focus on amplification, sharp tuning, compressive nonlinearity and otoacoustic emmissions that are signatures of the active process. Naturally, our aim is to demonstrate that techniques of dynamical systems theory play a significant role in understanding the dynamics of hearing.

Organizer: Robert Szalai University of Bristol, United Kingdom

#### 8:30-8:50 Dynamic Properties of Human Cochlear Processing Investigated with Otoacoustic Emissions

Sarah Verhulst, James Harte, and Torsten Dau, Technical University of Denmark, Denmark

#### 8:55-9:15 The Effect of Tectorial Membrane and Basilar Membrane Longitudinal Coupling in Cochlear Mechanics

Julien Meaud and Karl Grosh, University of Michigan, USA

### 9:20-9:40 Effects of Coupling on Sensory Hair Bundles

Kai Dierkes, Max Planck Institute for the Physics of Complex Systems, Germany; Jérémie Barral, Institut Curie, France; Benjamin Lindner, Max Planck Institute for the Physics of Complex Systems, Germany; Pascal Martin, Institut Curie, France; Frank Jülicher, Max Planck Institute for the Physics of Complex Systems, Germany

#### 9:45-10:05 A Cochlear Model Using the Time-averaged Lagrangian and the Push-pull Mechanism in the Organ of Corti

*Charles Steele*, Sunil Puria, and John Oghalai, Stanford University, USA

## Wednesday, May 25

## MS107 Aubry-Mather Theory 8:30 AM-10:10 AM

## Room:Maybird

Aubry-Mather Theory started in the study of Hamiltonian twist maps as a variational counterpart of KAM theory. Since then, it has brought forward many powerful techniques for finding quasi-periodic solutions of ODEs and PDEs. This minisymposium aims to give a broad impression of the field by bringing together scientists with different modern perspectives on the topic: 1. The use of gradient flows in lattice Aubry-Mather theory and PDEs. 2. Numerical techniques for computing Aubry-Mather sets and invariant curves 3. Weak KAM theory for the Hamilton-Jacobi equation 4. Applications of Aubry-Mather theory and examples of Arnol'd diffusion

Organizer: Bob Rink Free University Amsterdam, Netherlands

Organizer: Blaz Mramor Vrije Universiteit Amsterdam, The Netherlands

# 8:30-8:50 Arnold Diffusion Along a Chain of Oscillators

Mark Levi, Pennsylvania State University, USA

## 8:55-9:15 Aubry-Mather Theory and Ghost Circles

*Blaz Mramor*, Vrije Universiteit Amsterdam, The Netherlands; Bob Rink, Free University Amsterdam, Netherlands

#### 9:20-9:40 Weak KAM Theory and Viscosity Solutions of Hamilton-Jacobi Equations

*Yifeng Yu*, University of California, Irvine, USA

## 9:45-10:05 Computing the Boundary of Analyticity of Families of Quasiperiodic Solutions

*Renato Calleja*, McGill University, Canada; Rafael de La Llave, University of Texas, USA

## MS108 Stochastic Dynamics in Population Biology

8:30 AM-10:10 AM

## Room:Superior A

Major advances have recently been made in population biology through the analysis of stochastic dynamical systems. Some examples of applications include the evolution and spread of infectious disease, vaccine effectiveness, population extinction, dynamics of random mutation and selection, and modeling the evolution of drug-resistant cell populations in tumors. The purpose of this minisymposium is to expose the audience to recent progress in the field of population biology as well as to bring together researchers developing new mathematical methods for the analysis of stochastic problems in population biology.

Organizer: Eric Forgoston Montclair State University, USA

## 8:30-8:50 Predicting Infectious Disease Extinction

Simone Bianco, University of California, San Francisco, USA; Eric Forgoston, Montclair State University, USA; Leah Shaw, College of William & Mary, USA; Ira B. Schwartz, Naval Research Laboratory, USA

## 8:55-9:15 The Effects of Stochasticity in the Dynamics of Multi-Strain Diseases

Luis Mier-y-Teran and Derek Cummings, Johns Hopkins Bloomberg School of Public Health, USA

## 9:20-9:40 Stochastic Dynamics of Tumorigenesis

Jasmine Foo, Harvard University, USA; Rick Durrett, Duke University, USA; Kevin Leder, Harvard University, USA; John Mayberry, University of the Pacific, USA; Franziska Michor, Harvard University, USA

continued in next column

## 9:45-10:05 Stochastic Extinction in Non-Gaussian Environments with Differential Delay

*Ira B. Schwartz*, Naval Research Laboratory, USA; Lora Billings, Montclair State University, USA; Thomas W. Carr, Southern Methodist University, USA; Mark I. Dykman, Michigan State University, USA

## Wednesday, May 25

## MS109 Predictability and Prediction of Social Network Dynamics

8:30 AM-10:10 AM

## Room:Superior B

Enormous resources are devoted to the task of predicting the outcomes of social network dynamics, in domains such as economics, public policy, popular culture, and national security, but the quality of such predictions is often quite poor. Recently, important advances in network theory and dramatic increases in availability of social dynamics data are being combined to yield significant progress in exploring and exploiting the predictability of social processes. The four presentations which make up this minisymposium will characterize the predictability of social dynamics and leverage this understanding to develop mathematically-sound, empiricallygrounded methods for formulating useful predictions in real world settings.

Organizer: Richard Colbaugh Sandia National Laboratories, USA

8:30-8:50 Predictability of Social Network Dynamics: An Appraisal *Richard Colbaugh*, Sandia National Laboratories, USA; Kristin Glass, New Mexico Tech, USA

8:55-9:15 Ex-ante Prediction of Cascade Sizes on Networks of Agents Facing Binary Outcomes

Paul Ormerod and Ellie Cooper, Volterra Consulting, LLC, United Kingdom

9:20-9:40 Reachability Analysis of Idea Propagation on Networks with Community Structure

Michael Bencomo, New Mexico Tech, USA

## 9:45-10:05 Sentiment-Over-Time Analysis of Tweets

Alexander D. George, New Mexico Institute of Mining and Technology, USA

# MS110

## Dynamics of Cytoplasm in Amoeboid Cells: Experiments and Mathematical Models

8:30 AM-10:10 AM

## Room: White Pine

The true slime mold Physarum polycephalum is a single cell organism reaching up to meters in size. The cell exhibits regular, periodic cytoplasmic streaming through a complex, highly adaptable network formed by the cytoskeleton. Cytoplasmic streaming is essential for locomotion of the cell as well as intracellular communication of chemical and physical signals across the large distances spanned by the cell. This minisymposium will include talks on recent experimental and theoretical advances including whole-cell measurements of cytoplasmic streaming and cytoskeletal rearrangement and mathematical models of cell behavior controlled by the modulation of cytoplasmic rheology, cell shape, and cytoskeletal dynamics.

Organizer: Robert D. Guy University of California, Davis, USA

Organizer: Toshiyuki Nakagaki Hokkaido University, Japan

8:30-8:50 Mechanics of Amoeboid Locomotion Driven by Contraction Waves and Friction Control

Toshiyuki Nakagaki and Yoshimi Tanaka, Hokkaido University, Japan

8:55-9:15 Spontaneous Formation and Evolution of the Channel Network Inside Physarum Polycephalum Sheet-like Structures: Direct Experimental Observations

Serge Bielawski, PhLAM/Université Lille I, France; Paul Dely, Universite de Lille 1, France; Christophe Szwaj, PhLAM/Université Lille I, France; Eric Lacot, Lab. Spectro, France; Olivier Hugon, Universite Joseph Fourier, France; Toshiyuki Nakagaki, Hokkaido University, Japan

continued in next column

### 9:20-9:40 Channeling Instabilities in the Cytoplasm of Amoeboid Cells

Robert D. Guy, University of California, Davis, USA; Toshiyuki Nakagaki, Hokkaido University, Japan; Grady B. Wright, Boise State University, USA

## 9:45-10:05 Transport and Mixing of Cytosol Through the Whole Body of Physarum Plasmodium

Makoto Iima and Toshiyuki Nakagaki, Hokkaido University, Japan

## Intermission

10:10 AM-10:15 AM

## Wednesday, May 25

# **CP34**

Control Theory

10:15 AM-11:15 AM

Room: Wasatch A

Chair: Genevieve Brown, Northwestern University, USA

10:15-10:30 Feedback Control of Traveling and Standing Waves in the O(2) Equivariant Hopf Bifurcation Problem

Genevieve Brown, Northwestern University, USA; Claire M. Postlethwaite, University of Auckland, New Zealand; Mary C. Silber, Northwestern University, USA

### 10:35-10:50 Stabilizing Traveling Waves in the One-Dimensional CGLE Using Spatio-Temporal Feedback Control

*Tiffany M. Psemeneki* and Mary C. Silber, Northwestern University, USA

## 10:55-11:10 Partial Control of Chaotic Transients and Escape Times

Miguel Sanjuan, Universidad Rey Juan Carlos, Spain

# CP35 Pattern Formation I

10:15 AM-11:15 AM

## Room: Wasatch B

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

## 10:15-10:30 Nonlinear Three-Wave Interactions and Spatio-Temporal Chaos

*Alastair M. Rucklidge*, University of Leeds, United Kingdom; Anne Skeldon, University of Surrey, United Kingdom

## 10:35-10:50 Interaction of Faraday Waves and Cross-Waves

*Jeff Porter*, Ignacio Tinao, and Ana Laveron-Simavilla, Universidad Politécnica de Madrid, Spain

### 10:55-11:10 Pinning of Rotating Waves in Systems with Imperfect So(2) Symmetry

*Francisco Marques*, and Alvaro Meseguer, Universitat Politecnica de Catalunya, Spain; Juan M. Lopez and Rafael Pacheco, Arizona State University, USA Wednesday, May 25

## CP36 Neuroscience II 10:15 AM-11:15 AM

Room:Ballroom II

Chair: Rhonda Dzakpasu, Georgetown University, USA

## 10:15-10:30 Effect of Nodal Scale on the Analysis of Whole-Brain Anatomical Networks

Adam S. Landsberg, Claremont McKenna, Pitzer and Scripps Colleges, USA; Eric Friedman, Cornell University, USA

## 10:35-10:50 Manipulating the Excitatory/inhibitory Balance Alters *in Vitro* Dynamical Patterns in Neuronal Networks

Rhonda Dzakpasu and Xin Chen, Georgetown University, USA; Mark Niedringhaus, Georgetown University Medical Center, USA

## 10:55-11:10 Multi-bump Standing Pulses in a Firing Rate Model

*Yixin Guo*, and Dennis Guang Yang, Drexel University, USA

## Wednesday, May 25

# **CP37**

## Stochastics III

10:15 AM-11:15 AM

Room:Magpie A

Chair: Sophie Loire, University of California, Santa Barbara, USA

## 10:15-10:30 Amplitude Equations for the Stochastic Ginzburg-Landau Equation

Wael W. Mohammed, University of Augsburg, Germany; Dirk Blömker, Universitaet Augsburg, Germany

### 10:35-10:50 Spatial Filter and Backward Time Approach of Probabilistic Method to Advection Diffusion Equation

Sophie Loire and Igor Mezic, University of California, Santa Barbara, USA

## 10:55-11:10 A Stochastic Boundary Forcing Model for Simulating Wave Turbulence Systems

*Warren Towne*, Peter R. Kramer, and Yuri V. Lvov, Rensselaer Polytechnic Institute, USA

## CP38 Chaotic Dynamics I

10:15 AM-11:15 AM

## Room:Magpie B

Chair: Jesús Seoane, Universidad Rey Juan Carlos, Spain

### 10:15-10:30 Transient Chaos in a Damped, Undriven System: The Magnetic Pendulum

*György Károlyi*, Budapest University of Technology and Economics, Hungary; Tamas Tel, Etovos University, Hungary; Adilson E. Motter, Northwestern University, USA; Marton Gruiz, Eötvös University, Hungary

## 10:35-10:50 Phase Control of Escapes and Basin Boundary Metamorphoses

Jesus M. Seoane, Universidad Rey Juan Carlos, Spain

# 10:55-11:10 Permutation Complexity of Spatiotemporal Dynamics

Samuel Zambrano, Universidad Rey Juan Carlos, Spain; José M. Amigó, Universidad Miguel Hernandez, Spain; Miguel Sanjuán, Universidad Rey Juan Carlos, Spain

## Wednesday, May 25

# CP39

## Non-smooth Dynamical Systems II

10:15 AM-11:15 AM

## Room:Superior B

Chair: James L. Hook, University of Manchester, United Kingdom

#### 10:15-10:30 Analysis of the Dynamics Near a Degenerate Grazing Point for Rigid Impact Oscillators

*Gheorghe Tigan*, Jeroen Lamb, and Oleg Makarenkov, Imperial College London, United Kingdom

#### 10:35-10:50 The Moving Average Transformation

James L. Hook, University of Manchester, United Kingdom

### 10:55-11:10 Border Collision Bifurcations, Organizing Centers, and Continuity Breaking

Viktor Avrutin, University of Stuttgart, Germany; Laura Gardini, University of Urbino, Italy; Albert Granados and Michael Schanz, University of Stuttgart, Germany; Iryna Sushko, National Academy of Science, Ukraine

## Wednesday, May 25

# **CP40**

## Waves in Stratified Flows

10:15 AM-10:55 AM

## Room:Maybird

Chair: Claudio Viotti, University of North Carolina, USA

## 10:15-10:30 Shear Instability in Strongly Non-linear Solitary Waves: Non-parallel Effects

*Claudio Viotti*, University of North Carolina, USA

# 10:35-10:50 Title Not Available at Time of Publication

*Roxana Tiron*, University of North Carolina at Chapel Hill, USA
# **CP41 CANCELLED** 10:15 AM-11:15 AM

Wednesday, May 25

## CP42 Network Dynamics II 10:15 AM-11:15 AM

Room:Ballroom III

Chair: Siu Fai Chow, Northwestern University, USA

### 10:15-10:30 Dynamically Reorganizing Neural Networks for Stimulus Decorrelation

Siu Fai Chow and Hermann Riecke, Northwestern University, USA

#### 10:35-10:50 Synchronizing Distant Nodes: A Universal Classification of Time-Delayed Networks

Valentin Flunkert, TU Berlin, Germany; Serhiy Yanchuk, Humboldt University at Berlin, Germany; Thomas Dahms, TU Berlin, Germany; Eckehard Schöll, Technische Universität Berlin, Germany

### 10:55-11:10 Robustness of the Master Stability Function Approach to Network Synhronization

*Francesco Sorrentino*, Universita degli Studi di Napoli Parthenope, Italy; Maurizio Porfiri, Polytechnic Institute of New York University, USA Wednesday, May 25

## CP43 Global Structures in Stochastic Systems

10:15 AM-11:15 AM

Room:Superior A

Chair: Thomas W. Carr, Southern Methodist University, USA

### 10:15-10:30 Non-Gaussian Noise and its Effects on Scaling Laws Near Bifurcation Points

Lora Billings, Montclair State University, USA; Ira B. Schwartz, Naval Research Laboratory, USA; Mark I. Dykman, Michigan State University, USA

## 10:35-10:50 Set-based Corral Control in Stochastic Dynamical Systems

*Eric Forgoston*, Lora Billings, and Philip Yecko, Montclair State University, USA; Ira B. Schwartz, Naval Research Laboratory, USA

# 10:55-11:10 Stochastic Extinction in the Presence of Delayed Feedback

*Thomas W. Carr*, Southern Methodist University, USA; Mark I. Dykman, Michigan State University, USA; Lora Billings, Montclair State University, USA; Ira B. Schwartz, Naval Research Laboratory, USA

# CP44

## Engineering Applications I 10:15 AM-11:15 AM

Room:Ballroom I

Chair: Daniel A. Brake, Colorado State University, USA

### 10:15-10:30 Equations with Advanced Arguments in a Segway Model

*Tamas Insperger* and Richard Wohlfart, Budapest University of Technology and Economics, Hungary; Janos Turi, University of Texas at Dallas, USA; Gabor Stepan, Budapest University of Technology and Economics, Hungary

#### 10:35-10:50 Identification of Nonlinear Characteristics Based on Bistability in Delayed Model of Cutting

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

## 10:55-11:10 Workspace Estimation of Cooperating Robots after Joint Failure

Daniel A. Brake, Vakhtang Putkaradze, Daniel J. Bates, and Anthony Maciejewski, Colorado State University, USA

## **Coffee Break**

11:15 AM-11:45 AM



Wednesday, May 25

## IP7 Pattern Formation and Partial Differential Equations

11:45 AM-12:30 PM

Room:Ballroom

Chair: Jens Rademacher, CWI, Amsterdam, Netherlands

The research I present is motivated by specific, but ubiquitous pattern in models from physics: Domain and wall patterns the magnetization forms in ferromagnets, the coarsening of the phase distribution in demixing of polymer blends, the roughening of a crystal surface under deposition. Dynamically speaking, the type of models ranges from variational formulations, over (driven) gradient flows to non-gradient systems. The challenge for a rigorous analysis lies in the fact that we are interested in generic behavior of solutions, as expressed by (experimentally and numerically observed) scaling laws, that hold in the limit of large system sizes. We argue that methods from the theory of partial differential equations can be used to provide at least one-sided, optimal bounds on these scaling laws.

Felix Otto Max Planck Institute for Mathematics in the Sciences, Germany

Lunch Break 12:30 PM-2:00 PM Attendees on their own Wednesday, May 25

# IP8

## Mathematical Models for Tissue Engineering Applications

2:00 PM-2:45 PM

Room:Ballroom

## Chair: Vered Rom-Kedar, Weizmann Institute of Science, Israel

The broad goal of tissue engineers is to grow functional tissues and organs in the laboratory to replace those which have become defective through age, trauma, and disease and which can be used in drug screening applications. To achieve this goal, tissue engineers aim to control accurately the biomechanical and biochemical environment of the growing tissue construct, in order to engineer tissues with the desired composition, biomechanical and biochemical properties (in the sense that they mimic the in vivo tissue). The growth of biological tissue is a complex process, resulting from the interaction of numerous processes on disparate spatio-temporal scales. Advances in the understanding of tissue growth processes promise to improve the viability and suitability of the resulting tissue constructs. In this talk, I highlight some of our recent mathematical modelling work that aims to provide insights into tissue engineering applications.

Sarah Waters University of Oxford, United Kingdom

Intermission 2:45 PM-3:00 PM

# MS111

## Prediction of Noisy Slow-fast Critical Transitions -Part I of II

3:00 PM-4:40 PM

## Room:Ballroom I

## For Part 2 see MS122

Abrupt transitions to distant attractors have been studied in dynamical systems from the viewpoint of bifurcation theory and singular perturbation theory. One of the most challenging problems in this area is to predict these transitions from data before they occur in the presence of noise. Examples of important applications are climate change, ecological systems, medical applications and financial markets. This minisymposium is going to bring together theory and applications. Open problems and new techniques are going to be highlighted.

Organizer: Christian Kuehn Max Planck Institute for Physics of Complex Systems, Germany

## Organizer: Jan Sieber University of Portsmouth, United Kingdom

#### 3:00-3:20 Potential Analysis of Geophysical Time Series

Valerie Livina, University of East Anglia, United Kingdom

### 3:25-3:45 Transition to Instability in Financial Markets with Many Heterogeneous Agents

*Florian Wagener*, University of Amsterdam, Netherlands

# 3:50-4:10 Extreme Events: The Larger, the Better Predictable

Sarah Hallerberg, TU Chemnitz, Germany

#### 4:15-4:35 A Mathematical Framework for Critical Transitions

*Christian Kuehn*, Max Planck Institute for Physics of Complex Systems, Germany

## Wednesday, May 25

## MS112

Transport in Time-Dependent Flows: Theory, Computation, and Experiment

## 3:00 PM-4:40 PM

## Room:Ballroom II

Aperiodically time-dependent flows are the norm for models of geophysical and industrial dynamical systems. Many standard methods of analysis for dynamical systems fail in the timedependent setting, and classical notions of equilibria, invariant manifolds, and invariant measures must be suitably generalised. Research on the theory and numerics of time-dependent systems continues apace, creating new mathematical techniques using tools from geometry and ergodic theory. Lagrangian descriptions of flows enable the quantification of fluid transport and a better understanding of time-dependent dynamics. This minisymposium discusses the very latest quantitative methods of analysis for time-dependent flows and the application of these methods to industrial systems and ocean models.

Organizer: Gary Froyland University of New South Wales, Australia

## 3:00-3:20 Transport in Time-Dependent Flows -- An Overview

James D. Meiss, University of Colorado at Boulder, USA

#### 3:25-3:45 The Lagrangian Description of Aperiodic Flows: New Concepts and Tools

Ana M. Mancho, Consejo Superior Investigaciones Cientificas, Spain

## 3:50-4:10 Set-oriented Numerical Analysis of Time-dependent Transport

Kathrin Padberg-Gehle, Dresden University of Technology, Germany; Gary Froyland, University of New South Wales, Australia

#### 4:15-4:35 Lagrangian Transport Phenomena in 3D Laminar Mixing Flows

*Michel Speetjens*, Eindhoven University of Technology, Netherlands

## Wednesday, May 25

## MS113 Inertial Particles - Part I of II 3:00 PM-4:40 PM

Room:Ballroom III

## For Part 2 see MS124

The motion of inertial particles in a given flow is among the most important one in nature and technology - examples of open scientific and technological issues include rain formation in clouds, pollution dispersion in the atmosphere, optimization and emission reduction in combustion, plankton population dynamics - and constitute a major scientific challenge with immediate practical implications and applications. In this minisymposium we discuss the effect of inertia, collisions, and advection in complex flow geometries.

Organizer: Markus Abel University of Potsdam, Germany

Organizer: Bernhard Mehlig University of Gothenburg, Sweden

Organizer: Ulrike Feudel University of Oldenburg, Germany

### 3:00-3:20 Aggregation and Fragmentation of Inertial Particles in Random Flows

*Ulrike Feudel*, University of Oldenburg, Germany

#### 3:25-3:45 Droplet Distributions in Binary Mixtures

*Tobias Lapp* and Martin Rohloff, Max Planck Institute for Dynamics and Self-Organization, Germany; Juergen Vollmer, Max Planck Institute for Polymer Research, Germany; Bjoern Hof, Max Planck Institute for Dynamics and Self-Organization, Germany

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## MS113 Inertial Particles - Part I of II

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3:00 PM-4:40 PM

continued

#### 3:50-4:10 A Reactive-flow Model of Phase Separation in Fluid Binary Mixtures with Continuously Ramped Temperature

Juergen Vollmer, Max Planck Institute for Polymer Research, Germany; Izabella Benczik, and Jan-Hendrik Trösemeier, Max Planck Institute for Dynamics and Self-Organization, Germany

## 4:15-4:35 Chaotic Motion of Inertial Particles in Finite Domains

Tamas Tel, Etovos University, Hungary

# Wednesday, May 25

# MS114

## Physical Random Number Generation by Dynamical and Stochastic Systems

3:00 PM-4:40 PM

## Room:Magpie A

Random number generators find application in fields ranging from cryptography to Monte Carlo simulations. Although computer-based pseudo-random number generation remains popular, there is an increasing interest using physical dynamical or stochastic systems to produce nonperiodic and unpredictable sequences of random numbers. The session will focus on the different approaches (both experimental and numerical) that have been pursued for physical random number generation, and the methods by which the generated numbers have been tested, evaluated or "certified."

Organizer: Thomas E. Murphy University of Maryland, College Park, USA

Organizer: Rajarshi Roy University of Maryland, USA

### 3:00-3:20 Synchronization of Random Bit Generators Based on Coupled Chaotic Lasers and Application to Cryptography

*Ido Kanter*, Yitzhak Peleg, Meital Zigzag, and Michael Rosenbluh, Bar-Ilan University, Israel; Wolfgang Kinzel, University of Würzburg, Germany

#### 3:25-3:45 Ultra-fast Physical Random Number Generation based on Chaotic Photonic Integrated Circuits

Apostolos Argyris and Dimitris Syvridis, National & Kapodistrian University of Athens, Greece

continued in next column

## 3:50-4:10 Physical Random Bit Generator with Chaotic Lasers

Atsushi Uchida, Taiki Yamazaki, and Yasuhiro Akizawa, Saitama University, Japan; Takahisa Harayama, Satoshi Sunada, Kazuyuki Yoshimura, and Peter Davis, NTT Communication Science Laboratories, Japan

## 4:15-4:35 12.5 Gb/s Random Number Generation Using Amplified Spontaneous Emission

Thomas E. Murphy, University of Maryland, College Park, USA; Xiaowen Li, Beijing Normal University, China; Caitlin R. S. Williams, Julia Salevan, and Rajarshi Roy, University of Maryland, USA

# MS115

## Using Phase Response Curves to Understand Neurodynamics - Part I of II

3:00 PM-4:40 PM

## Room:Magpie B

## For Part 2 see MS126

Phase response curves (PRCs) quantify the response of oscillators to brief external stimuli. Theoreticians have used PRCs extensively to identify mechanisms underlying phase-locking in externally-driven neurons and in networks of coupled neurons. Recently, the use of PRCs to understand neuronal synchronization has received considerable attention from experimental neuroscientists.

This minisymposium brings together theoreticians and experimentalists to discuss recent advances in our understanding of neuronal dynamics by using PRCs. Part I of the minisymposium probes the biophysical and dynamical mechanisms that shape PRCs and therefore determine phase-locking properties. Part II examines how PRCS can be used to understand the influence of noise and heterogeneity on neuronal dynamics.

Organizer: LieJune Shiau University of Houston, Clear Lake, USA

Organizer: Tim Lewis University of California, Davis, USA

3:00-3:20 Effects of the Frequency Dependence of Phase Response Curves on Network Synchronization

Christian G. Fink, Victoria Booth, and Michal Zochowski, University of Michigan, USA

3:25-3:45 Using PRC's to Understand How Antiepileptic Drugs and Deep Brain Stimulation Prevent Seizures

*Theoden I. Netoff*, Bryce Beverlin II and Brendan Murphy, University of Minnesota, USA; Charles Wilson, University of Texas, San Antonio, USA

### 3:50-4:10 The Role of Transient Potassium Channels in Phase Resetting and Stochastic Synchrony in the Olfactory Bulb

Aushra Abouzeid, University of Pittsburgh, USA; Anne-Marie M. Oswald, Carnegie Mellon University, USA; Roberto F. Galan, Case Western Reserve University, USA; Nathan Urban, Carnegie Mellon University, USA; Bard Ermentrout, University of Pittsburgh, USA

## 4:15-4:35 Isochrons and Phase Response in Multiple Time-Scale Systems

Eric Sherwood, Boston University, USA

## Wednesday, May 25

## MS116 Existence and Stability of Nonlinear Waves in Coupled Systems -Part I of III

3:00 PM-4:40 PM

Room:Wasatch A

## For Part 2 see MS127

Nonlinear Wave Phenomena is of broad scientific interest. It pertains to the understanding of real water waves, the interaction of light with matter, optical fiber transmission, traffic flow, earthquakes and galaxy formation. At the heart of studying the phenomena of nonlinear waves is the question of existence and stability of solutions of nonlinear equations. The existence study aims at exhibiting the possible behavior of a given system. The goal of stability analysis is to see if a given solution can be realized experimentally. Our mini-symposium aims at bringing speakers who address these issues using numerical or analytical methods.

Organizer: Stephane Lafortune College of Charleston, USA

Organizer: Anna Ghazaryan Miami University and University of Kansas, USA

Organizer: Vahagn Manukian *Miami University, USA* 

## 3:00-3:20 Bifurcations of Travelling Waves in the Oregonator Model for the BZ Reaction

Peter L. Simon, Eötvös Loránd University, Hungary

#### 3:25-3:45 Spectral Stability of Shock Layers for Dissipative Hyperbolicparabolic Systems

Jeffrey Humpherys, Brigham Young University, USA

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# MS116

## Existence and Stability of Nonlinear Waves in Coupled Systems -Part I of III 3:00 PM-4:40 PM

continued

## 3:50-4:10 Localized Standing Waves in Inhomgeneous Schrodinger Equations

Robert Marangell and Christopher Jones, University of North Carolina at Chapel Hill, USA & University of Warwick, United Kingdom; Hadi Susanto, University of Nottingham, United Kingdom

#### 4:15-4:35 Existence, Stability and Dynamics of Some Single- and Multi-Component Solitary Waves: From Theory to Experiments

Panayotis Kevrekidis, University of Massachusetts, Amherst, USA

Wednesday, May 25

# MS117

Mutistability and Rhythmogenesis: Basic Motifs and Network Dynamics

3:00 PM-4:40 PM

## Room:Wasatch B

Elementary excitatory and inhibitory circuits control dynamics of specialized neuronal systems such as central pattern generators (CPG) and also serve as building blocks of more complex networks found in thalamic, cortical and other brain systems. This mini is focused on the dynamics of such elementary motifs of neuronal networks. We will discuss how different attractor states emerge as a result of intrinsic dynamics of such neuronal motifs and how they interact to lead to more complex emerging behavior. Its goal is to bring together experimental and computational neuroscientists to discuss universal mechanisms of neuronal dynamics.

Organizer: Andrey Shilnikov Georgia State University, USA

Organizer: Maxim Bazhenov University of California, Riverside, USA

## 3:00-3:20 Maintaining Novel Inputs in a Working Memory Model

David H. Terman, Robert McDougal, Kyle Lyman, Brian Myers, and Mustafa Zeki, Ohio State University, USA; Chris Fall, University of Illinois, Chicago, USA

### 3:25-3:45 Using the Structure of Inhibitory Networks to Unravel Mechanisms of Spatiotemporal Patterning

Collins Assisi and *Maxim Bazhenov*, University of California, Riverside, USA

continued in next column

### 3:50-4:10 Duty Cycle as Order Parameter for Polyrhythms in Multifunctional Center Pattern Generator Motifs

Andrey Shilnikov, Jeremy Wojcik, Matt Brooks, and Robert Clewley, Georgia State University, USA

#### 4:15-4:35 Modeling and Experiment on the Control of Reafference During Locomotion

Donald Edwards, Giselle Linan-Velez, and Eric Randall, Georgia State University, USA; Daniel Cattaert, Université Bordeaux I, France

# MS118 Synchronization of Chaos and its Applications

3:00 PM-4:40 PM

## Room:Maybird

Many fundamental processes in nature are based on synchronization of chaos. This phenomenon is also used as building block for the development of applications in technology and for construction of models based on data series. In this minisimposium theoretical and application issues related to this phenomenon will be considered. In special, it will address the role of noise in inducing synchronization in neuronal models, methodologies that can be applied to convey high speed communication through optical channels, and procedures that lead to model parameter estimation according to the synchronization achieved between data series and a mathematical model.

Organizer: Elbert E. Macau Laboratory for Computing and Applied Mathematics and Brazilian Institute for Space Research, Brazil

Organizer: Epaminondas Rosa Illinois State University, USA

3:00-3:20 Competing Chaotic Synchrony: Theory and Experiment Epaminondas Rosa, Illinois State University, USA

#### 3:25-3:45 Nonlinear Delayed Optical Phase Oscillator for High Performance Chaos Synchronization: Dynamics and Chaos Communication at 10Gb/s

Laurent Larger, Universite de Franche-Comte, France; Lavrov Roman and Maxime Jacquot, FEMTO-ST Institute, France; Vladimir Udaltsov, Vavilov Optical State Institute, Russia

continued in next column

## 3:50-4:10 Synchronization of Uncoupled Dynamical Systems Induced by White and Colored Noise

*Ines P. Mariño*, Universidad Rey Juan Carlos, Spain

#### 4:15-4:35 Estimating Model Parameters from Time Series by Using Chaotic Synchronization and Speed-gradient Methodology

*Elbert E. Macau*, Laboratory for Computing and Applied Mathematics and Brazilian Institute for Space Research, Brazil; Ubiratan S. Freitas, Universite de Rouen, France

## Wednesday, May 25

# MS119 Oscillatory Dynamics in Delay Differential Equations

3:00 PM-4:40 PM

## Room:Superior A

Delay differential equations (DDEs) arise in many applications areas, and non-equilibrium invariant sets such as periodic orbits and tori play a central role in understanding the dynamics of these equations. But, the study of these invariant sets is in general non-trivial due to the fact that DDEs are infinite dimensional systems. The local theory of invariant manifolds is reasonably well-developed for DDEs with constant delays, but extending the theory, for example to state dependent delays, is difficult. In this session we will present the latest results and ongoing work in oscillatory dynamics and related stability and bifurcation theory in DDEs with multiple delays and/or state dependent delays.

Organizer: Tony R. Humphries *McGill University, Canada* 

Organizer: Renato Calleja McGill University, Canada

## 3:00-3:20 Invariant Tori in Scalar State-dependent DDEs

*Tony R. Humphries* and Renato Calleja, McGill University, Canada

#### 3:25-3:45 Invariant Tori and Resonances for Time Periodic Delay Differential Equations

*Gergely Röst*, University of Szeged, Hungary

### 3:50-4:10 Floquet Multipliers for Periodic Solutions of Delay Equations with Several Delays

Benjamin Kennedy, Gettysburg College, USA

### 4:15-4:35 Oscillatory Dynamics of a Structured Consumer Resource Model

David A. Barton, University of Bristol, United Kingdom

# MS120 Immunity and Infection -Part I of II

3:00 PM-4:40 PM

## Room:Superior B

## For Part 2 see MS131

In second half of the twentieth century, the biological and medical communities came to understand that the mammalian immune system is an extremely complex system with thousands of components and tens of thousands of interactions. It recent years they have also been discovering many ways in which the immune system is inherently dynamical. We will highlight examples in which practitioners of applied dynamical systems have been rising to the challenge of modeling and analyzing various components and functions of the system. We begin with a talk about the basic assumptions of the dynamics associated with the immune response.

## Organizer: Erik M. Boczko Vanderbilt University, USA

Organizer: Vered Rom-Kedar Weizmann Institute of Science, Israel

Organizer: Todd Young Ohio University, USA

#### **3:00-3:20 Bacterial Infection: From theory to Experiments and Back** *Roy Malka* and Vered Rom-Kedar,

Weizmann Institute of Science, Israel

## 3:25-3:45 Non-Invasive Pathogen Profiling and New Prospects for In-Host Monitoring of Infection and Immune Response

*Erik M. Boczko*, Vanderbilt University, USA; Todd Young, Ohio University, USA; Patrick Norris and Addison May, Vanderbilt University Medical Center, USA

## 3:50-4:10 Investigating Bacteriaimmune Dynamics in Premature Infants

*Julia Arciero*, Bard Ermentrout, Yoram Vodovotz, and Jonathan E. Rubin, University of Pittsburgh, USA

## 4:15-4:35 Delayed Immune Response to Plasmodium Infection

Jonathan Mitchell, Hardin-Simmons University, USA; Thomas W. Carr, Southern Methodist University, USA Wednesday, May 25

## MS121 Dynamics of Cardiac Contraction and Mechanical Deformation

3:00 PM-4:40 PM

## Room: White Pine

The heart's primary function is to pump oxygenated blood efficiently throughout the body. Pumping is effected by contraction, which occurs through a complex series of biochemical processes at the cellular level. Although contraction arises from the dynamics of proteins within the cell, the whole-organ behavior also can be modeled using approximations at the tissue level. In this minisymposium, we will examine how the different spatial and temporal scales involved in contraction can be represented mathematically and how they interact.

Organizer: Flavio H. Fenton Cornell University, USA

## 3:00-3:20 Overview of Multi-scale Modeling of Cardiac Contraction

*Flavio H. Fenton*, Cornell University, USA; Elizabeth M. Cherry, Rochester Institute of Technology, USA; Rupinder Singh and Niels F. Otani, Cornell University, USA

## 3:25-3:45 An Efficient Spatially-explicit Model of Cardiac Myofilament Dynamics

Stuart G. Campbell, University of Kentucky, USA; Andrew D. McCulloch, University of California, San Diego, USA; Kenneth Campbell, University of Kentucky, USA

### 3:50-4:10 Modeling Cardiac Electromechanics Using the Immersed Boundary Method

Boyce E. Griffith, New York University, USA

### 4:15-4:35 Visualizing Patterns of Cardiac Action Potential Propagation Using Ultrasound Images of Contraction

Niels F. Otani and Rupinder Singh, Cornell University, USA Wednesday, May 25

Coffee Break

4:40 PM-5:10 PM Room:Golden Cliff



# MS122

## Prediction of Noisy Slow-fast Critical Transitions - Part II of II

5:10 PM-6:50 PM

## Room:Ballroom I

## For Part 1 see MS111

Abrupt transitions to distant attractors have been studied in dynamical systems from the viewpoint of bifurcation theory and singular perturbation theory. One of the most challenging problems in this area is to predict these transitions from data before they occur in the presence of noise. Examples of important applications are climate change, ecological systems, medical applications and financial markets. This minisymposium is going to bring together theory and applications. Open problems and new techniques are going to be highlighted.

Organizer: Christian Kuehn Max Planck Institute for Physics of Complex Systems, Germany

Organizer: Jan Sieber University of Portsmouth, United Kingdom

## 5:10-5:30 Atmospheric Regimes, Predictability and Climate Change

Christian Franzke, British Antarctic Survey, United Kingdom

#### 5:35-5:55 Recurrent Episodes of Synchrony in a Spatial Neural Network Model

Alexander Rothkegel and Klaus Lehnertz, University of Bonn, Germany

#### 6:00-6:20 Identifying and Characterizing Change Points Using the Informational Approach

Claudie Beaulieu, Princeton University, USA

### 6:25-6:45 Dynamic Bifurcations with Loss of Local Stability in the Presence of Noise

Steve Shaw, Nicholas Miller, and Mark I. Dykman, Michigan State University, USA; Chris Burgner and Kimberly Turner, University of California, Santa Barbara, USA Wednesday, May 25

# MS123 Multi-level Modeling of Dynamical Systems

5:10 PM-6:50 PM

## Room:Ballroom II

Biological systems are often described by several mathematical models; each takes into account different features of the system and therefore has a very different level of description. This minisymposium will promote the ideas that: 1) mathematical modeling of biological systems in particular requires a computational framework that enables one to easily move between different levels of description of a system, and that 2) while each level of description provides a different level of understanding, the process of moving between the different levels IN ITSELF provides insights about the system. A range of methods and applications that illustrate these ideas will be presented.

Organizer: Alona Ben-Tal Massey University, New Zealand

Organizer: Robert Clewley Georgia State University, USA

# 5:10-5:30 Multi-level Modeling of the Respiratory System

Alona Ben-Tal, Massey University, New Zealand

#### 5:35-5:55 Opening and Closing the Loop in Small Networks: Simulation and Analysis of Multi-Level 'Hybrid' Dynamics

*Robert Clewley*, Georgia State University, USA

# 6:00-6:20 An Equation-Free Analysis of Evolution in Collective Migration

Yannis Kevrekidis and Yu Zou, Princeton University, USA; Iain Couzin and Vishwesha Guttal, Princeton University, USA

6:25-6:45 Structure Preserving Reduction of Quasi-Active Neurons *Steven Cox*, Rice University, USA

## Wednesday, May 25

## MS124 Inertial Particles - Part II of II 5:10 PM-6:50 PM

Room:Ballroom III

## For Part 1 see MS113

The motion of inertial particles in a given flow is among the most important one in nature and technology - examples of open scientific and technological issues include rain formation in clouds, pollution dispersion in the atmosphere, optimization and emission reduction in combustion, plankton population dynamics - and constitute a major scientific challenge with immediate practical implications and applications. In this minisymposium we discuss the effect of inertia, collisions, and advection in complex flow geometries.

Organizer: Markus Abel University of Potsdam, Germany

Organizer: Ulrike Feudel University of Oldenburg, Germany

Organizer: Bernhard Mehlig University of Gothenburg, Sweden

## 5:10-5:30 Caustics and Collisions in Turbulent Aerosols

Bernhard Mehlig and Kristian Gustavsson, University of Gothenburg, Sweden

#### 5:35-5:55 Pattern Formation in Colloidal Explosions: Theory and Experiments

Artur Straube, Humboldt University Berlin, Germany

## 6:00-6:20 PDF Approach for Particles in Turbulent Boundary Layers

*Mike Reeks*, University of New Castle, United Kingdom

## 6:25-6:45 Clustering of Particles in a Deterministic Intermittent Flow

Markus Abel, University of Potsdam, Germany

## MS125 Dynamics of Networks with Time-delayed Coupling

5:10 PM-6:50 PM

## Room:Magpie A

Networks of coupled systems are ubiquitous in nature. Time-delayed coupling is physically unavoidable in many such real-life systems and accounts for finite propagation time of signals like in optically coupled semiconductor lasers, reaction time in chemical reactions, synaptic transmission delays in neural networks etc. Recently there has been great interest in network dynamics with time delayed coupling. This minisymposium will focus on the rich variety of organized states of delaycoupled systems and their important applications. The speakers will cover a range of topics including theoretical modeling, numerical solutions and applications to actual physical systems.

Organizer: Eckehard Schöll Technical University of Berlin, Germany

Organizer: Gautam C. Sethia Institute for Plasma Research, India

### 5:10-5:30 On the Role of Delay for the Symmetry in the Dynamics of Networks

*Otti D'Huys*, Vrije Universiteit Brussels, Belgium

## 5:35-5:55 Synchronizing Coupled Optical Oscillators with Time Delay

Rajarshi Roy, University of Maryland, College Park, USA

## 6:00-6:20 Chaos Synchronization of Networks with Time-delayed Couplings

Wolfgang Kinzel, University of Würzburg, Germany

6:25-6:45 Stability and Resonance in Networks of Delay-Coupled Delay Oscillators

Johannes M. Hoefener, Max Planck Institute for Complex Systems, Germany

## Wednesday, May 25

## MS126 Using Phase Response Curves to Understand Neurodynamics - Part II of II

5:10 PM-6:50 PM

## Room:Magpie B

For Part 1 see MS115

Phase response curves (PRCs) quantify the response of oscillators to brief external stimuli. Theoreticians have used PRCs extensively to identify mechanisms underlying phase-locking in externally-driven neurons and in networks of coupled neurons. Recently, the use of PRCs to understand neuronal synchronization has received considerable attention from experimental neuroscientists. This minisymposium brings together theoreticians and experimentalists to discuss recent advances in our understanding of neuronal dynamics by using PRCs. Part I of the minisymposium probes the biophysical and dynamical mechanisms that shape PRCs and therefore determine phase-locking properties. Part II examines how PRCs can be used to understand the influence of noise and heterogeneity on neuronal dynamics.

Organizer: Tim Lewis University of California, Davis, USA

Organizer: LieJune Shiau University of Houston, Clear Lake, USA

5:10-5:30 Using Dynamic Clamp as a Tool to Study Neuronal Synchronization

John White, University of Utah, USA

#### 5:35-5:55 Effects of Variability on Hybrid Circuits of Two Pulse Coupled Neurons

*Carmen Canavier*, Louisiana State University, USA

6:00-6:20 A Stochastic Dynamics Approach to Understanding the Mean and Variance of Phase Response Curves

*Todd Troyer*, University of Texas, San Antonio, USA

## 6:25-6:45 Cellular Mechanisms Underlying Spike-Time Reliability

Roberto F. Galan, Case Western Reserve University, USA

## Wednesday, May 25

## MS127 Existence and Stability of Nonlinear Waves in Coupled Systems -Part II of III

5:10 PM-6:50 PM

Room:Wasatch A

## For Part 1 see MS116 For Part 3 see MS138

Nonlinear Wave Phenomena is of broad scientific interest. It pertains to the understanding of real water waves, the interaction of light with matter, optical fiber transmission, traffic flow, earthquakes and galaxy formation. At the heart of studying the phenomena of nonlinear waves is the question of existence and stability of solutions of nonlinear equations. The existence study aims at exhibiting the possible behavior of a given system. The goal of stability analysis is to see if a given solution can be realized experimentally. Our mini-symposium aims at bringing speakers who address these issues using numerical or analytical methods.

Organizer: Stephane Lafortune College of Charleston, USA

Organizer: Anna Ghazaryan Miami University and University of Kansas, USA

Organizer: Vahagn Manukian Miami University, USA

## 5:10-5:30 Surface Water Waves With Up an Downstream Boundary Conditions

*Carmen Chicone*, University of Missouri, Columbia, USA

## 5:35-5:55 Stability of Lax Shocks in Systems of Radiating Gas

Toan Nguyen, Brown University, USA

### 6:00-6:20 Dynamics of a Front Solution for a Bistable Reactiondiffusion Equation with a Degenerate Spatial Heterogeneity

Hiroshi Matsuzawa, Numazu National College of Technology, Japan

6:25-6:45 Dynamics near Turing patterns in Reaction-Diffusion Systems *Qiliang Wu* and Scheel Arnd, University of Minnesota, USA

# MS128

## Sprite Discharges – Towards a Quantitative Understanding of Lightning Dynamics

5:10 PM-6:50 PM

## Room: Wasatch B

Sprite discharges are enormous "lightning strokes" that develop at 40 to 90 km altitude high above active thunderclouds. Among lightning phenomena, they are the first whose nonlinear growth dynamics we now start to understand quantitatively. The minisymposium will proceed from an overview of observations and basic understanding through simulations to the nonlinear analysis of the observed phenomena. The nonlinear analysis concerns the (in)stability both of the propagating ionization front and of the current carrying state behind the front.

## Organizer: Ute Ebert Centrum voor Wiskunde en Informatica (CWI), Netherlands

#### 5:10-5:30 An Introduction to Sprites: Observations and Basic Phenomenology

Davis Sentman, University of Alaska, USA

## 5:35-5:55 Quantitative Simulations of Sprite Streamer Discharges

*Ningyu Liu*, Florida Institute of Technology, USA

### 6:00-6:20 Halo's and Sprites: A Sequence of Instabilities and Dynamic Attractors

*Ute Ebert*, Centrum voor Wiskunde en Informatica (CWI), Netherlands

#### 6:25-6:45 Stability of Simple Translating States in Laplacian Flows with Regularization

Saleh A. Tanveer, Ohio State University, USA

## Wednesday, May 25

## MS129 Recent Advances in Nonautonomous Dynamics

5:10 PM-6:50 PM

## Room:Maybird

Over the past few years, nonautonomous dynamics has developed into a highly active field related to, yet recognisably distinct from classical dynamical systems. This development has been motivated by problems of applied mathematics, as genuinely nonautonmous systems abound e.g. in meteorology (ocean dynamics), life science (dosing strategies), economics, and many other disciplines. The rise of nonutonomous dynamics has in turn influenced other areas of mathematics such as spectral, stability, and bifurcation theory. This minisymposium will provide a cross section of intriguing recent work on nonautonomous dynamics, including finite-time behavior, discretization theory, stability and bifurcation problems, as well as applications thereof.

Organizer: Christian Poetzsche Munich University of Technology, Germany

#### 5:10-5:30 General Theory for Monotone and Concave Skewproduct Semiflows

*Carmen Núñez*, and Rafael Obaya and Ana Sanz, University of Valladolid, Spain

# 5:35-5:55 An Alternative Approach to Sacker-Sell Spectral Theory

Martin Rasmussen, Imperial College London, United Kingdom; Fritz Colonius, University of Augsburg, Germany; Peter Kloeden, Johann Wolfgang Goethe University, Frankfurt am Main, Germany

#### 6:00-6:20 Dynamics in Finite Time -Concepts and Applications

Arno Berger, University of Alberta, Canada

# 6:25-6:45 Equivalence, Spectra and Nonautonomous Bifurcations

*Christian Poetzsche*, Munich University of Technology, Germany

## Wednesday, May 25

# MS130 Models and Applications of Network Dynamics

5:10 PM-6:50 PM

## Room:Superior A

Modeling of the structure and dynamics of complex systems has become one of the central topics in the study of dynamical systems. In recent years, mathematical development has led to many exciting applications for realworld problems in mathematical, biological, physical, and information sciences. In this minisymposium researchers from different application areas will give an overview of the stateof-the-art of several important problems in network dynamics and applications, including social competition, mobility dynamics, intracellular networks, and information propogation.

Organizer: Jie Sun

Northwestern University, USA

Organizer: Alexander Gutfraind Los Alamos National Laboratory, USA

## 5:10-5:30 Modeling the Dynamics of Social Competition

Daniel Abrams and Haley Yaple, Northwestern University, USA; Richard Wiener, University of Arizona, USA

## 5:35-5:55 Effect of Human Motion on Dynamic Contact Networks

Joseph Skufca and Daniel Ben-Avraham, Clarkson University, USA

## 6:00-6:20 Propagation of Epidemics on Dynamically-adapting Networks *Alexander Gutfraind*, Los Alamos

National Laboratory, USA

## 6:25-6:45 Network Analysis and Dynamical Modeling of Cancer Cells

Michael Schnabel, Max Planck Institute for Dynamics and Self-Organization, Germany; Nir Yungster, Dirk Brockmann, Adilson E. Motter, and William Kath, Northwestern University, USA

# MS131 Immunity and Infection -Part II of II

5:10 PM-6:50 PM

Room:Superior B

## For Part 1 see MS120

In second half of the twentieth century, the biological and medical communities came to understand that the mammalian immune system is an extremely complex system with thousands of components and tens of thousands of interactions. It recent years they have also been discovering many ways in which the immune system is inherently dynamical. We will highlight examples in which practitioners of applied dynamical systems have been rising to the challenge of modeling and analyzing various components and functions of the system. We begin with a talk about the basic assumptions of the dynamics associated with the immune response.

Organizer: Erik M. Boczko Vanderbilt University, USA

Organizer: Vered Rom-Kedar *Weizmann Institute of Science, Israel* 

Organizer: Todd Young Ohio University, USA

5:10-5:30 Inflammation, Immunity, and Age: Insights from An In-Host Model of Influenza

Ian Price, University of Pittsburgh, USA

### 5:35-5:55 Modeling Signaling Pathways in Macrophages

Hannah Callendar, University of Minnesota, USA; Mary Ann Horn, Vanderbilt University, USA, and National Science Foundation, USA

continued in next column

6:00-6:20 Tnf and II-10 Are Major Factors in Modulation of the Phagocytic Cell Environment in Lung and Lymph Node in Tuberculosis: a Next Generation Two Compartmental Model

Simeone Marino, University of Michigan, USA; Denise E. Kirschner, University of Michigan, Medical School, USA; Amy Myers and JoAnne Flynn, University of Pittsburgh School of Medicine, USA

## 6:25-6:45 Models of the Innate Immune Response in Inflammatory Diseases

Meagan C. Herald, Virginia Military Institute, USA Wednesday, May 25

## MS132 Control of Cardiac Arrhythmias

5:10 PM-6:50 PM

Room: White Pine

Understanding the dynamical mechanisms leading to the emergence and maintenance of cardiac arrhythmias (e.g., alternans, tachycardia, fibrillation) and using that understanding to devise treatment approaches is one of the frontline medical problems whose solution could save millions of lives every year. This minisymposium will bring together the leading researchers in cardiac dynamics and control whose combined expertise in mathematical modeling and electrophysiology of cardiac tissue is essential for development of a new generation of pacemakers and cardioverter-defibrillators capable of suppressing a range of arrhythmic behaviors using electrical feedback control.

Organizer: Roman Grigoriev Georgia Institute of Technology, USA

5:10-5:30 Model-based Control of Alternans in Purkinje Fibers

Alejandro Garzon, Georgia Institute of Technology, USA; *Roman Grigoriev*, Georgia Institute of Technology, USA

5:35-5:55 The Alternans Annihilation by Distributed Mechano-electric and Boundary Pacing Applied Perturbations

Stevan Dubljevic, University of Alberta, Canada

## 6:00-6:20 Control of Cardiac Cellular Alternans Induces Subcellular Turing Pattern in Calcium Dynamics

Stephen Gaeta, *Trine Krogh-Madsen*, and David Christini, Weill Cornell Medical College, Cornell University, USA

6:25-6:45 Reconstruction of Unmeasured Quantities in Models of Cardiac Action Potential Dynamics Laura Munoz and Niels F. Otani, Cornell University, USA

Dinner Break 6:50 PM-8:30 PM

Attendees on their own

## PD2 Forward Looking Panel Discussion

8:30 PM-9:30 PM

## Room:Ballroom II

Chair: Alan R. Champneys, University of Bristol, United Kingdom

The aim of this session is to discuss promising directions for future research in Dynamical Systems and its applications. Each panelist will be invited to answer provocative questions from the chair about the future of our community, and then to take follow-ups from the audience. It is hoped that the debate will be lively, stimulating and just possibly controversial.

## Carson Chow

National Institutes of Health and University of Pittsburgh, USA

Yannis Kevrekidis Princeton University, USA

## Mason Porter

University of Oxford, United Kingdom

Mary Silber Northwestern University, USA

## James Yorke University of Maryland, USA

# Thursday, May 26

Registration 8:00 AM-12:30 PM Room:Ballroom Foyer

## MS133 Inference in Dynamical Networks

## 8:20 AM-10:00 AM

## Room:Ballroom I

Dynamical processes interplay within complex networks. Understanding the behavior of such networks requires inference about their topology as well as their dynamics. Especially in the neurosciences this promises to gain deeper insights into the functioning or non-functioning of the prototypical example of a network, the human brain. This minisymposium aims at covering different aspects of network inference. Various topics ranging from first principle modeling towards the analysis in the inverse problem will be discussed.

Organizer: Björn Schelter University of Freiburg, Germany

#### 8:20-8:40 Multi-Layered Networks and Emergency of Spatio-temporal Order in Ecological Systems

*Celso Grebogi*, King's College, University of Aberdeen, United Kingdom

## 8:45-9:05 Direction of Information Flow in Networks

*Linda Sommerlade*, Jens Timmer, and Björn Schelter, University of Freiburg, Germany

### 9:10-9:30 Modelling Brain States by Adaptive Multiple-Time-Scale Networks

*Marco Thiel*, King's College, University of Aberdeen, United Kingdom; Bjoern Schelter, University of Freiburg, Germany

## 9:35-9:55 Dynamics of Large-Scale Epileptic Brain Networks

*Klaus Lehnertz*, Marie-Therese Kuhnert, and Stephan Bialonski, University of Bonn, Germany

## Thursday, May 26

## MS134 Approximation of Stability Spectra

8:20 AM-10:00 AM

## Room:Ballroom II

In this minisymposium we report on recent developements in numerical methods for the approximation of Lyapunov and other stability spectra for dynamical systems. Such stability spectra are important when determining stability properties of time dependent processes that occur in many areas of science and engineering. The types of models considered include ordinary and functional differential equations. Attention is focused on the development, error estimation and convergence analysis of different techniques. Connections are made to other fundamental aspects such us underlying theoretical issues and perturbation analysis.

Organizer: Dimitri Breda University of Udine, Italy

#### 8:20-8:40 Stability Spectra: Approximation and Perturbation Theory

Erik Van Vleck, University of Kansas, USA

#### 8:45-9:05 Perturbation Theory for the Approximation of Stability Spectra by QR Methods for Products of Linear Operators

Mohamed Badawy and Erik Van Vleck, University of Kansas, USA

## 9:10-9:30 Detecting Exponential Dichotomy on the Real Line

Cinzia Elia, University of Bari, Italy

### 9:35-9:55 Evolution Families and Lyapunov Exponents for Retarded Dynamical Systems

*Dimitri Breda*, University of Udine, Italy

# MS135

## Functional Roles of Neural Dynamics During Olfactory Sensory Processing

8:20 AM-10:00 AM

## Room:Ballroom III

Recent experimental research on the rodent olfactory bulb and the insect antennal lobe has provided critical insights into the functional role of these sensory-processing neural structures. These systems can robustly recognize vast arrays of complex odors despite the inherent nonlinearities of the sensory inputs and the continuous ongoing neural network remodeling induced by olfactory neurogenesis. Understanding the complex olfactory dynamics requires sophisticated computational models, reviewed or presented in the minisymposium, that examine the functional role of neural rhythms, the effect that connectivity and synaptic changes have on odor representations and other aspects of information processing within the olfactory neural networks.

Organizer: Remus Osan Boston University, USA

Organizer: Eric Sherwood Boston University, USA

8:20-8:40 Functional Aspects of Olfactory Processing: Neural Rhythms, Dynamics of Input/output Neural Activity and Overview of Related Olfactory Models

*Remus Osan* and Eric Sherwood, Boston University, USA

### 8:45-9:05 Network Adaptation Through Activity-dependent Restructuring: Neurogenesis Enhances Olfactory Pattern Separation

Hermann Riecke and Siu Fai Chow, Northwestern University, USA

continued in next column

## 9:10-9:30 Functional Roles for Synaptic Depression Within the Fly Antennal Lobe

*Aaditya Rangan*, Courant Institute of Mathematical Sciences, New York University, USA

## 9:35-9:55 A Model for Odor Discrimination in the Honeybee Antennal Lobe

Sungwoo Ahn, Indiana University-Purdue University Indianapolis (IUPUI), USA; David H. Terman, Ohio State University, USA Thursday, May 26

## MS136 Central Pattern Generators -Part II of II

8:20 AM-10:00 AM

Room:Magpie B

## For Part 1 see MS16

Neuronal circuits called central pattern generators (CPGs) underlie many rhythmic motor outputs in animals. CPGs incorporate many features that render them attractive for dynamical systems analysis. While their outputs are dynamically complex and emerge through interactions among network components. their structure makes CPG models amenable to mathematical analysis. In this session, speakers will discuss dynamics of neurons and networks in CPGs for locomotion, respiration, and digestion, including issues of multistability, feedback, and network topology effects.

Organizer: Justin Dunmyre University of Pittsburgh, USA

Organizer: Jonathan E. Rubin *University of Pittsburgh, USA* 

8:20-8:40 Instability of Twinned Orbits in a Coupled Respiratory Bursting Neuron Model

Casey O. Diekman, Ohio State University, USA; Peter Thomas and Chris Wilson, Case Western Reserve University, USA

8:45-9:05 Network Bursting: Interactions of the CAN and NaP Currents

Justin Dunmyre, University of Pittsburgh, USA; Christopher Del Negro, College of William & Mary, USA; Jonathan E. Rubin, University of Pittsburgh, USA

9:10-9:30 Multiple Bursting Mechanisms in Heterogeneous Neural Populations with Metabotropic Glutamate Receptors and NaP and CAN Currents

*Yaroslav Molkov*, Patrick Jasinski, and Natalia Shevtsova, Drexel University College of Medicine, USA; Ilya A. Rybak, Drexel University, USA

## 9:35-9:55 Interaction of the Two Distinct Bursting Mechanisms in the Model of Respiratory Neuron

Natalia Toporikova and Robert Butera, Georgia Institute of Technology, USA

# MS137 Change Detection in Biological Systems

8:20 AM-10:00 AM

## Room:Magpie A

Recent studies have shown that biological systems respond not only to the presence or magnitude of a stimulus, but also to perturbations in the level of that stimulus over time. Numerous biological systems function as change detectors; however, the underlying dynamics that generate this behavior are only beginning to be explored. Typically, change detection emerges as a result of specifically organized interactions, including positive and negative feedbacks and delayed responses among system agents. This minisymposium will gather researchers who are studying biological systems as change detectors that respond not only to magnitudes, but also to changes in stimulation.

Organizer: Peter S. Kim University of Utah, USA

Organizer: Sharon A. Bewick NIMBioS and University of Tennessee, Knoxville, USA

## 8:20-8:40 Biological Change Detection: Relating Information Acquired to Mechanism Employed

Sharon A. Bewick, NIMBioS and University of Tennessee, Knoxville, USA

#### 8:45-9:05 A Control-Oriented Model for Immune Regulatory Response: Pid Control with Switching

Matthew M. Peet, Illinois Institute of Technology, USA; Peter S. Kim, University of Utah, USA; Peter Lee, Stanford University, USA

continued in next column

### 9:10-9:30 Growth Detection: CD4+ T-cells Interaction Networks as an Interface for Immune System Decision-Making based on Changes in Antigen Load

Routing Yang, University of California, Santa Barbara, USA; Sharon A. Bewick, NIMBioS and University of Tennessee, Knoxville, USA; Mingjun Zhang, University of Tennessee, Knoxville, USA

## 9:35-9:55 T Cell State Transitions Produce an Emergent Change Detector

Peter Lee, Stanford University, USA; Peter S. Kim, University of Utah, USA

## Thursday, May 26

# MS138

Existence and Stability of Nonlinear Waves in Coupled Systems -Part III of III

8:20 AM-10:00 AM

Room: Wasatch A

## For Part 2 see MS127

Nonlinear Wave Phenomena is of broad scientific interest. It pertains to the understanding of real water waves, the interaction of light with matter, optical fiber transmission, traffic flow, earthquakes and galaxy formation. At the heart of studying the phenomena of nonlinear waves is the question of existence and stability of solutions of nonlinear equations. The existence study aims at exhibiting the possible behavior of a given system. The goal of stability analysis is to see if a given solution can be realized experimentally. Our minisymposium aims at bringing speakers who address these issues using numerical or analytical methods.

Organizer: Stephane Lafortune College of Charleston, USA

Organizer: Anna Ghazaryan Miami University and University of Kansas, USA

Organizer: Vahagn Manukian *Miami University, USA* 

8:20-8:40 Existence of Defects in Swift-Hohenberg Equations

*Mariana Haragus*, Universite de Franche-Comte, France; Arnd Scheel, University of Minnesota, Minneapolis, USA

# 8:45-9:05 On the Traveling Waves of Gray-Scott Model

Vahagn Manukian, Miami University, USA

#### 9:10-9:30 Stability Analysis for Closed Curve Solutions to the Vortex Filament Equation

Stephane Lafortune, College of Charleston, USA

9:35-9:55 On the Mechanisms for Instability of Standing Waves in Nonlinearly Coupled Schrodinger Equations

Russel Jackson, US Naval Academy, USA

## MS139 Nonlinear Dynamics of Laser Systems: Modelling and Applications

8:20 AM-10:00 AM

## Room: Wasatch B

This minisymposium addresses experimental and mathematical approaches to study the nonlinear dynamics of laser systems, such as networks of coupled lasers, and laser with time-delayed optoelectronic feedback. Lasers are oscillators with fundamental nonlinear properties that are also found in other systems in physics engineering and biology. They exhibit very complex dynamics and have a wide range of applications, including optical communication and signal processing, fast random number generation, or sensing. Many of these applications require a detailed understanding of the underlying nonlinear properties of lasers, which leads to interesting questions in dynamical systems theory.

Organizer: Hartmut Erzgraber University of Exeter, United Kingdom

### 8:20-8:40 Broadband Chaos Generated by an Optoelectronic Oscillator

*Lucas Illing*, Reed College, USA; Kristine Callan, Zheng Gao, and Daniel Gauthier, Duke University, USA

#### 8:45-9:05 Optimal Topologies for Synchronization in a Network of Chaotic Optoelectronic Oscillators

*Bhargava Ravoori*, University of Maryland, College Park, USA; Rajarshi Roy, University of Maryland, USA

## 9:10-9:30 Multiple Injection Dynamics in Two-mode Lasers

Andreas Amann, Simon Osborne, Patrycja Heinricht, Benjamin Wetzel, and Stephen O'Brien, University College Cork, Ireland

## 9:35-9:55 From Phase Locking to Optical Turbulence in Coupled Lasers

Nicholas Blackbeard, Hartmut Erzgraber, and Sebastian M. Wieczorek, University of Exeter, United Kingdom

## Thursday, May 26

# MS140 Applications of Stochastic Dynamical Systems

8:20 AM-10:00 AM

## Room:Maybird

Stochastically modeled processes are common in many areas of contemporary science, such as molecular dynamics, genetics, neuroscience, nonlinear optics, and geosciences, among others. Key topics of stochastic modeling for complex systems will be brought together in this interdisciplinary session. Two speakers will communicate their work in nonlinear optics, where stochastic framework is used to model spatial anisotropy of the medium, resulting in nondeterministic effects in light polarization and signal errors in optical fibers. Two other participants will use novel methods to quantify average behavior of stochastic geoscience-related applications to estimate vital dynamics parameters and predict statistical behavior under external perturbation.

Organizer: Rafail Abramov University of Illinois, Chicago, USA

### 8:20-8:40 Estimating Error Probabilities in Noise-Perturbed Nonlinear Optical Systems

*Gino Biondini*, State University of New York, Buffalo, USA

## 8:45-9:05 Stochastic Integrable Dynamics in Active Optical Media

*Gregor Kovacic*, Rensselaer Polytechnic Institute, USA; Ethan Atkins, Courant Institute of Mathematical Sciences, New York University, USA; Ildar R. Gabitov, University of Arizona and Los Alamos National Laboratory, USA; Peter R. Kramer, Rensselaer Polytechnic Institute, USA

#### 9:10-9:30 Sub-sampling in Parametric Estimation of Effective Stochastic Models from Discrete Data

Ilya Timofeyev, University of Houston, USA

9:35-9:55 Improved Linear Response for Stochastically Driven Systems *Rafail Abramov*, University of Illinois, Chicago, USA

## Thursday, May 26

# MS141 Vortex Dynamics: Analysis and Simulation

8:20 AM-10:00 AM

## Room:Superior A

This minisymposium will focus on cutting edge techniques being developed in the direct numerical simulation and the stability analysis of vortex dynamics in 2D, 3D, and spherical geometries and for both inviscid and viscous fluids. The topics presented here will include new higher order vortex methods which allow the vortex particles to deform under the flow, as well as rigorous stability analysis of relative equilibria. These talks will provide a unique opportunity for both mathematicians, applied mathematicians, and engineers to come together to discuss both the numerical and analytical approaches to understanding the complex behavior of vorticity.

Organizer: David T. Uminsky University of California, Los Angeles, USA

Organizer: Paul Newton University of Southern California, USA

## 8:20-8:40 Point Vortex Equilibria and Optimal Packings of Circles on a Sphere

Paul Newton, University of Southern California, USA

# 8:45-9:05 Relative Equilibria of the (1+N)-vortex Problem

Anna Barry, Glen R. Hall, and C. Eugene Wayne, Boston University, USA

## 9:10-9:30 Multi-moment Vortex Methods for 2D Viscous Fluids

David T. Uminsky, University of California, Los Angeles, USA; C. Eugene Wayne, Boston University, USA; Alethea Barbaro, University of California, Los Angeles, USA; Vitalii Ostrovskyi, University of Southern California, USA

## 9:35-9:55 High Order Three Dimensional Lagrangian Methods Based on Deforming Ellipsoids

Louis F. Rossi and Claudio Torres, University of Delaware, USA

## MS142 Stochastic Dynamics, Agentbased Models and Networks

8:20 AM-10:00 AM

## Room:Superior B

Network science at the intersection of applied math, computer science and statistical information theory is undergoing a profound revolution with the availability of social interaction data such as on Twitter and Facebook and the recent advance in experimental techniques. This MS will focus on the statistical equilibrium and nonequilibrium stochastic dynamics of agentbased models and other network models that arise in opinion dynamics, linguistics, protein folding and community detection.

Organizer: Chjan C. Lim Rensselaer Polytechnic Institute, USA

# 8:20-8:40 Isolated and Composite Networks

*H. Eugene Stanley*, Boston University, USA

## 8:45-9:05 Dynamic Centality in Real World Networks

Peter Csermely, Miklos Antal, Huba Kiss, Istvan Kovacs, Agoston Mihalik, Gabor Simko, and Kristof Szalay, Semmelweis University, Hungary

# 9:10-9:30 Network Synchronization in a Noisy Environment with Time Delays

*Gyorgy Korniss*, David Hunt, and Boleslaw Szymanski, Rensselaer Polytechnic Institute, USA

### 9:35-9:55 Center Manifolds, Bifurcations and Noise in Stochastic Network Dynamics

*Chjan C. Lim* and Weituo Zhang, Rensselaer Polytechnic Institute, USA

## Thursday, May 26

## MS143 Symbolic and Computational Algorithms for Chaos Explorations

8:20 AM-10:00 AM

## Room: White Pine

This minisymposium is focused on recent advances in computational methods for exploration of complex behaviors in universal systems including the exemplary Lorenz, Rossler, and Hindmarsh-Rose models. These methods, including but not limited to Lyapunov exponents, chaos indicators, spikecounting techniques, etc, combined with the generic bifurcation tools (like CONTENT, MATCONT, XPP and AUTO) and using state-of-theart numerical ODE solvers, reveal parametric patterns that give new insights into the origin of complexity in the deterministic systems including such phenomena as hereroclinic T-points, shrimps formation, and other nonlocal transformations that shape chaotic dynamics in various systems from neurodynamics, nonlinear optics, chemical physics etc.

Organizer: Roberto Barrio University of Zaragoza, Spain

## 8:20-8:40 Painting Chaos: Computational Methods for Exploration of Complex Behaviors

*Roberto Barrio*, University of Zaragoza, Spain; Andrey Shilnikov, Georgia State University, USA

#### 8:45-9:05 Parameter Space Classification of Stable Solutions of Flows

Jason Gallas, Instituto de Fisica da UFRGS, Brazil

### 9:10-9:30 Complex Spontaneous Oscillations and Response Properties of Sensory Hair Cells

Alexander Neiman, Ohio University, USA; Andrey Shilnikov, Georgia State University, USA

9:35-9:55 The Hindmarsh-Rose Neuron Model: Understanding the Bifurcation Scenario by Combining Continuation and Brute-force Computational Methods

*Marco Storace* and Daniele Linaro, University of Genoa, Italy Thursday, May 26 Intermission 10:00 AM-10:05 AM

# CP45 Biological Applications II

10:05 AM-11:25 AM

Room:Ballroom I

Chair: David Swigon, University of Pittsburgh, USA

#### 10:05-10:20 Stretch-Dependent Proliferation in a One-Dimensional Elastic Continuum Model of Cell Layer Migration

*Tracy L. Stepien* and David Swigon, University of Pittsburgh, USA

## 10:25-10:40 A Multicomponent Model for Heterogeneous Biofilms

Brandon S. Lindley, Naval Research Laboratory, USA; Qi Wang, University of South Carolina, USA; Tianyu Zhang, Montana State University, USA

## 10:45-11:00 Continuum Model of Collective Cell Migration in Wound Healing and Colony Expansion

*David Swigon*, Julia Arciero, and Qi Mi, University of Pittsburgh, USA

## 11:05-11:20 Modeling Compressive Nonlinearity of Mammalian Hearing

*Robert Szalai*, Alan R. Champneys, and Martin Homer, University of Bristol, United Kingdom

# CP46

## Cardiac Modelling

10:05 AM-11:05 AM

## Room:Ballroom III

Chair: John Alford, Sam Houston State University, USA

### 10:05-10:20 Models of Unidirectional Propagation in Heterogeneous Excitable Media

John G. Alford, Sam Houston State University, USA

## 10:25-10:40 Spatiotemporal Dynamics of Calcium-Driven Alternans in Cardiac Tissue

*Per Sebastian Skardal* and Juan G. Restrepo, University of Colorado at Boulder, USA; Alain Karma, Northeastern University, USA

### 10:45-11:00 Bifurcation and Chaotic Dynamics in a Cardiac Model with Memory

*Linyuan Jing* and Abhijit Patwardhan, University of Kentucky, USA Thursday, May 26

## **CP47**

Oscillators II

10:05 AM-11:05 AM

## Room: Wasatch B

Chair: Ernest Barreto, George Mason University, USA

# 10:05-10:20 Breaking the Symmetry of the Bimodal Kuramoto System

*Ernest Barreto*, Bernard C. Cotton, and Paul So, George Mason University, USA

### 10:25-10:40 What Does Thermodynamic Limit Tell Us About Chimera States?

*Oleh Omel'chenko* and Matthias Wolfrum, Weierstrass Institute for Applied Analysis and Stochastics, Germany

#### 10:45-11:00 A Transport Equation for Pulse-Coupled Phase Oscillators and a Lyapunov Function for Its Global Analysis

*Alexandre Mauroy*, and Rodolphe Sepulchre, Université de Liège, Belgium

## Thursday, May 26

# **CP48**

## Neuroscience II

10:05 AM-11:25 AM

Room:Ballroom II

Chair: Michal Zochowski, University of Michigan, USA

#### 10:05-10:20 A Mechanism of Abrupt Transitions Between Firing Frequency Regimes in Entorhinal stellate Cells

Horacio G. Rotstein, New Jersey Institute of Technology, USA; Tilman Kispersky, Brandeis University, USA; John White, University of Utah, USA

# 10:25-10:40 Crawling Without {CPG}: A Neuromechanical Model

Paolo Paoletti and L. Mahadevan, Harvard University, USA

## 10:45-11:00 Multiple Phase Locked States in Half-Center Oscillators

Sajiya Jalil, Igor Belykh, and Andrey Shilnikov, Georgia State University, USA

#### 11:05-11:20 Astrocyte Mediated Modifications in Functional Neuronal Network Strucutre

Sarah Feldt, Jane Wang, Elizabeth Shtrahman, Eva Olariu, and *Michal Zochowski*, University of Michigan, USA

## CP49 Chaotic Dynamics II

10:05 AM-11:25 AM

## Room: White Pine

Chair: Renate Wackerbauer, University of Alaska, Fairbanks, USA

#### 10:05-10:20 Synchronization of Spatiotemporal Chaos in Rayleigh-Bénard Convection

Alireza Karimi and Mark Paul, Virginia Polytechnic Institute & State University, USA

## 10:25-10:40 Length Scale of Interaction in Spatiotemporal Chaos

Renate A. Wackerbauer and Dan Stahlke, University of Alaska, Fairbanks, USA

### 10:45-11:00 Designing a Computing System Based on a Chaotic Dynamical System by Use of Numerical Analysis

Behnam Kia, Mark Spano, and William Ditto, Arizona State University, USA

# 11:05-11:20 Chaotic Properties in Violin Sounds

Masanori Shiro, National Institute of Advanced Industrial Science and Technology, Japan; Yoshito Hirata, University of Tokyo, Japan; Kazuyuki Aihara, JST/University of Tokyo, Japan Thursday, May 26

## **CP50** Applications in Physics 10:05 AM-11:25 AM

Room:Magpie B

Chair: Korana Burke, University of California, Merced, USA

## 10:05-10:20 Quantum Chaotic Scattering in Graphene Systems

Rui Yang, Liang Huang, and Ying-Cheng Lai, Arizona State University, USA; Celso Grebogi, King's College, University of Aberdeen, United Kingdom

## 10:25-10:40 Chaotic Ionization of Bidirectionally Kicked Rydberg Atoms

Korana Burke and Kevin A. Mitchell, University of California, Merced, USA; Barry Dunning, Brendan Wyker, and Shuzhen Ye, Rice University, USA

#### 10:45-11:00 A New Experimental Probe for Investigating the Dynamics of Relativistic Electrons in Storage Rings

*Christophe Szwaj*, PhLAM/Université Lille I, France

## 11:05-11:20 Quantum Scars in Graphene Billiards

*Liang Huang* and Ying-Cheng Lai, Arizona State University, USA; Celso Grebogi, King's College, University of Aberdeen, United Kingdom; David Ferry, Arizona State University, USA

## Thursday, May 26

# CP51

## Pattern Formation II

10:05 AM-11:25 AM

Room:Magpie A

Chair: Luca Giuggioli, University of Bristol, United Kingdom

#### 10:05-10:20 A New Type of Relaxation Oscillations in a Model for Enzyme Reactions

*Ilona Kosiuk*, Max Planck Institute for Mathematics in the Sciences, Germany; Peter Szmolyan, Vienna University of Technology, Austria

#### 10:25-10:40 Dissipative 3D Vortices, Their Filaments' Tension and Response Functions

*Irina Biktasheva*, University of Liverpool, United Kingdom; Dwight Barkley, University of Warwick, United Kingdom; Vadim N. Biktashev, University of Liverpool, United Kingdom; Andrew J. Foulkes, University of Manchester, United Kingdom

## 10:45-11:00 Stability Analysis of Pulsative Solutions of Legiato-Lefever Equation

Tomoyuki Miyaji, Kyoto University, Japan; *Isamu Ohnishi*, Hiroshima University, Japan; Yoshio Tsutsumi, Kyoto University, Japan

### 11:05-11:20 Collective Movement of Animals and the Emergence of Territorial Patterns

*Luca Giuggioli*, Jonathan Potts, and Stephen Harris, University of Bristol, United Kingdom

# CP52

Dynamical Systems III

10:05 AM-11:05 AM

## Room:Superior B

Chair: Bruce Rogers, Duke University, USA

## 10:05-10:20 Microwave Chaotic Oscillators Using Time-Delayed Feedback

*Hien Dao*, John Rodgers, and Thomas E. Murphy, University of Maryland, College Park, USA

## 10:25-10:40 Swarm Clustering Arising from Consensus Algorithms

Bruce Rogers, Duke University, USA

## 10:45-11:00 Effect of Micro Structure Anisotropy on Dynamically Self Assembled Two Dimensional Structures

*Gunjan Thakur* and Igor Mezic, University of California, Santa Barbara, USA Thursday, May 26

## CP53 Nonlinear Wayes

10:05 AM-11:05 AM

## Room:Maybird

Chair: Grégory Faye, INRIA Sophia Antipolis, France

## 10:05-10:20 Stability Analysis for Periodic Waves of a Fourth Order Beam Equation

Milena Stanislavova and Aslihan Demirkaya, University of Kansas, Lawrence, USA

### 10:25-10:40 Anomalous Thermalization of Nonlinear Wave Systems

*Pierre Suret*, Universite de Lille 1, France; Claire Michel, H.R. Jauslin, and A. Picozzi, Université de Bourgogne, France; Stephane Randoux, Universite de Lille 1, France

## 10:45-11:00 Bifurcation of Hyperbolic Planforms in a Relation with a Model of Texture Perception

*Grégory Faye*, INRIA Sophia Antipolis, France; Pascal Chossat, CNRS and University of Nice, France; Olivier Faugeras, INRIA Sophia Antipolis, France Thursday, May 26

# **CP54**

Engineering Applications II

10:05 AM-11:25 AM

Room:Superior A

Chair: Michal Odyniec, NST, USA

## 10:05-10:20 Chaos Control in a Transmission Line Model

Ioana A. Triandaf, Naval Research Laboratory, USA

10:25-10:40 Dynamical Systems in Circuit Designer's Eyes Michal Odyniec, NST, USA

## 10:45-11:00 Satisfiability of Elastic Demand in the Smart Grid

Dan-Cristian Tomozei, Technicolor Paris Research Lab, France; Jean-Yves Le Boudec, EPFL, France

## 11:05-11:20 Modelling and Parameters Indentification of Permanent Synchronous Motors

Paolo Mercorelli, Ostfalia University of Applied Sciences, Germany

## CP55 Dynamical Systems IV

10:05 AM-11:25 AM

## Room: Wasatch A

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

# 10:05-10:20 Forecasting Bifurcations for Sensing Applications

Bogdan I. Epureanu, University of Michigan, Ann Arbor, USA

## 10:25-10:40 Dynamic Stability of Rigid Objects with Frictional Supports

*Peter L. Varkonyi*, Budapest University of Technology and Economics, Hungary; David Gontier, Ecole Normale Superieure de Paris, France; Joel W. Burdick, California Institute of Technology, USA

#### 10:45-11:00 Unfolding the Catastrophe of the Elastic Web of Links

*Róbert K. Németh* and Attila G. Kocsis, Budapest University of Technology and Economics, Hungary

#### 11:05-11:20 Heteroclinic Breakdown Beyond All Orders in Generic Analytic Unfoldings of the Hopf-Zero Singularity

*Tere M. Seara*, Immaculada Baldoma, and Oriol Castejon, Universidad Politecnica de Catalunya, Spain

## **Coffee Break**



Room:Golden Cliff

## Thursday, May 26

IP9

## Moving Pattern Formation from the Real World to the Lab, and the Reverse

11:55 AM-12:40 PM

## Room:Ballroom

Chair: Jonathan Dawes, University of Bath, United Kingdom

This talk will describe three pattern formation experiments where natural systems were imported directly into the laboratory. The overall shape and subsequent rippling instability of icicles is a complex free-boundary growth problem. It has been linked theoretically to similar phenomena in stalactites. We grew laboratory icicles determined the motion of their ripples. Washboard road is the result of the instability of a flat granular surface under the action of rolling wheels. The rippling of the road sets in above a threshold speed and leads to waves which travel down the road. We studied these waves both in the laboratory and using 2D molecular dynamics simulation. Columnar joints are uncanny formations of ordered cracks in certain lava flows. We studied these both in a lab analog system and in the field. Each of these three cases nicely illustrates the pleasures and pitfalls of such "naturalistic" pattern formation experiments. Collaborators: Antony Szu-Han Chen, Nicolas Taberlet, Jim McElwaine, Lucas Goehring and L. Mahadevan

Stephen Morris University of Toronto, Canada

## **Closing Remarks**

12:40 PM-12:50 PM Room:Ballroom

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# SIAM Conference on Applications of Dynamical Systems

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May 22 - 26, 2011 Snowbird Ski and Summer Resort Snowbird, Utah USA

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# SIAM Conference on Applications of Dynamical Systems

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# D

Daffertshofer, Andreas, MS102, 9:20 Wed

Danforth, Chris, MS13, 3:00 Sun Danforth, Chris, MS24, 5:10 Sun Danial, Syed Nasir, CP26, 10:15 Tue Danino, Tal, MS52, 3:25 Mon Dankowicz, Harry, MS74, 9:45 Tue Dao, Hien, CP52, 10:05 Thu Daraio, Chiara, IP2, 2:00 Sun DasGupta, Bhaskar, MS100, 8:30 Wed Dasler, Philip, CP22, 10:35 Mon Davidsen, Jörn, MS33, 6:25 Sun de Swart, Huib, MS21, 3:25 Sun Deane, Jonathan, MS47, 4:15 Mon Del Castillo-Negrete, Diego, MS31, 6:25 Sun Demirkaya, Aslihan, CP53, 10:05 Thu Dena, Angeles, PP1, 8:30 Tue Denker, Manfred, MS48, 3:00 Mon Desroches, Mathieu, MS5, 8:20 Sun Desroches, Mathieu, MS5, 9:35 Sun DeVille, Lee, MS8, 9:35 Sun DeVries, Levi, CP10, 10:45 Sun D'Huys, Otti, MS125, 5:10 Wed Di, Liu, MS8, 8:45 Sun Di Bernardo, Mario, MS19, 3:00 Sun Di Bernardo, Mario, MS30, 5:10 Sun Di Carlo, Dino, MS66, 5:35 Mon Diedrichs, Danilo, PP1, 8:30 Tue Diekman, Casey O., MS136, 8:20 Thu Dierkes, Kai, MS106, 9:20 Wed Ding, Edwin, MS75, 9:45 Tue Diniz Behn, Cecilia, MS79, 3:00 Tue Diniz Behn, Cecilia, MS90, 5:10 Tue Diniz Behn, Cecilia, MS90, 5:10 Tue Doelman, Arjen, MS21, 3:00 Sun Doelman, Arjen, MS46, 3:50 Mon Doering, Charles R., MS1, 8:20 Sun Draelants, Delphine, CP25, 10:55 Tue Driskell, Lisa D., PP1, 8:30 Tue Duan, Jingiao, MS48, 3:00 Mon Duan, Jinqiao, MS48, 4:15 Mon Duan, Jingiao, MS59, 5:10 Mon Duan, Wen, MS56, 6:00 Mon Dubljevic, Stevan, MS132, 5:35 Wed Dunmyre, Justin, MS16, 3:00 Sun Dunmyre, Justin, MS136, 8:20 Thu Dunmyre, Justin, MS136, 8:45 Thu Durian, Douglas, MS20, 3:25 Sun

Dzakpasu, Rhonda, CP36, 10:35 Wed

Ε Ebert, Ute, MS128, 5:10 Wed Ebert, Ute, MS128, 6:00 Wed Edwards, Donald, MS117, 4:15 Wed Edwards, Roderick, MS72, 8:30 Tue Edwards, Roderick, MS72, 8:30 Tue Eisenhower, Bryan, MS40, 8:55 Sun Eisenhower, Bryan, MS40, 8:30 Mon Eisenhower, Bryan, MS51, 3:00 Mon Eisenman, Ian, MS45, 3:25 Mon Eldering, Jaap, PP1, 8:30 Tue Elia, Cinzia, MS134, 9:10 Thu Elmegaard, Michael, PP1, 8:30 Tue Epureanu, Bogdan I., CP55, 10:05 Sun Ermentrout, Bard, MS65, 5:10 Mon Erzgraber, Hartmut, CP12, 10:35 Mon Erzgraber, Hartmut, MS139, 8:20 Thu Estrada, Ernesto, CP4, 10:05 Sun

## F

Farries, Michael, MS55, 3:25 Mon Faye, Grégory, CP53, 10:45 Thu Fenichel, Eli, MS91, 6:00 Tue Fenton, Flavio H., MS121, 3:00 Wed Fenton, Flavio H., MS121, 3:00 Wed Feudel, Ulrike, MS113, 3:00 Wed Feudel, Ulrike, MS113, 3:00 Wed Feudel, Ulrike, MS124, 5:10 Wed Fink, Christian G., MS115, 3:00 Wed Firpo, Marie-Christine, MS31, 6:00 Sun Fletcher, Patrick A., PP1, 8:30 Tue Flunkert, Valentin, CP42, 10:35 Wed Fonoberov, Vladimir, CP23, 10:55 Tue Foo, Jasmine, MS108, 9:20 Wed Ford, Kevin, MS87, 3:50 Tue Forget, Gael, MS13, 3:25 Sun Forgoston, Eric, MS108, 8:30 Wed

Forgoston, Eric, CP43, 10:35 Wed Fox, Adam M., PP1, 8:30 Tue François, Paul, MS52, 4:15 Mon Franzke, Christian, MS122, 5:10 Wed Fraser, Andrew M., CP13, 10:55 Mon Froyland, Gary, MS12, 3:25 Sun *Froyland, Gary, MS112, 3:00 Wed* 

# G

Galan, Roberto F., MS126, 6:25 Wed Galanthay, Theodore E., CP9, 10:05 Sun Gallas, Jason, MS143, 8:45 Thu Galtier, Mathieu N., CP19, 10:55 Mon Garcia, Ricardo, MS74, 8:55 Tue Garland, Joshua T., CP22, 10:15 Mon Gasser, Ingenuin, MS62, 6:00 Mon Gayah, Vikash, MS62, 6:25 Mon Gelens, Lendert, MS82, 3:50 Tue George, Alexander D., MS109, 9:45 Wed

Georgescu, Michael, MS51, 3:50 Mon Gershgorin, Boris, CP13, 10:35 Mon Ghazaryan, Anna, MS27, 6:00 Sun Ghazaryan, Anna, MS116, 3:00 Wed Ghazaryan, Anna, MS127, 5:10 Wed Ghazaryan, Anna, MS138, 8:20 Thu Gheisarieha, Mohsen, CP17, 10:55 Mon Ghosh, Bijov K., MS50, 4:15 Mon Giuggioli, Luca, CP51, 11:05 Thu Gizzi, Alessio, MS44, 8:55 Mon Glendinning, Paul, MS58, 5:10 Mon Glendinning, Paul, MS58, 6:25 Mon Glimm, Tilmann, MS71, 9:20 Tue Gluckman, Bruce J., MS79, 3:00 Tue Gluckman, Bruce J., MS90, 5:10 Tue Gluckman, Bruce J., MS90, 6:00 Tue Goetz, Arek, MS58, 5:10 Mon Goldwyn, Joshua, MS102, 9:45 Wed

Gorochowski, Thomas, MS30, 5:10 Sun Graham, Michael D., MS94, 5:35 Tue Grebogi, Celso, MS95, 5:10 Tue Grebogi, Celso, MS133, 8:20 Thu Griffith, Boyce E., MS121, 3:50 Wed Grigoriev. Roman. MS132, 5:10 Wed Grigoriev, Roman, MS132, 5:10 Wed Gross, Thilo, MS43, 9:45 Mon Gross, Thilo, MS63, 5:10 Mon Gruhn, Silvia, MS16, 3:50 Sun Guo, Yixin, CP36, 10:55 Wed Gustafsson, Kristian, PP1, 8:30 Tue Gutfraind, Alexander, MS130, 5:10 Wed Gutfraind, Alexander, MS130, 6:00 Wed Guy, Robert D., MS110, 8:30 Wed Guy, Robert D., MS110, 9:20 Wed

## Η

Ha, Joon, MS55, 3:50 Mon Haller, George, MS12, 3:00 Sun Haller, George, MS12, 3:00 Sun Haller, George, MS23, 5:10 Sun Hallerberg, Sarah, MS111, 3:50 Wed Han, Zhun, MS69, 8:55 Tue Hancioglu, Baris, MS39, 8:30 Mon Haque, Mainul, CP30, 10:35 Tue Haragus, Mariana, MS138, 8:20 Thu Hardway, Heather D., MS71, 9:45 Tue Harris, Kameron D., MS24, 6:00 Sun Hasler, Martin, MS19, 3:00 Sun Hata, Shigefumi, CP14, 10:35 Mon Hattab, Hechmi, CP27, 10:55 Tue Hauser, Marcus, MS33, 6:00 Sun Hayes, Jonathan, PP1, 8:30 Tue Hayrapetyan, Gurgen, MS46, 3:00 Mon Hayrapetyan, Gurgen, MS46, 3:25 Mon Hayrapetyan, Gurgen, MS57, 5:10 Mon Hell, Juliette, MS85, 3:00 Tue Herald, Meagan C., MS131, 6:25 Wed

Hermann, Geoffroy, PP1, 8:30 Tue Higuera, Maria, CP17, 10:35 Mon Hillar, Christopher, MS15, 4:15 Sun Hines, Paul, MS78, 3:00 Tue Hipolito, Rafael, MS9, 9:10 Sun Hirata, Yoshito, PP1, 8:30 Tue Hiskens, Ian, MS78, 3:25 Tue Hittmeyer, Stefanie, MS70, 8:30 Tue Hittmeyer, Stefanie, MS81, 3:00 Tue Hittmeyer, Stefanie, MS81, 3:00 Tue Hjorth, Poul G., MS3, 8:20 Sun Hoefener, Johannes M., MS125, 6:25 Wed Hoffman, Aaron, MS53, 3:00 Mon Hoffman, Aaron, MS64, 5:10 Mon Hoffman, Aaron, MS64, 5:35 Mon Hoffman, Matthew J., MS13, 3:50 Sun Hogan, John, CP30, 10:55 Tue Hohenegger, Christel, MS94, 5:10 Tue Holland, Marika, MS45, 3:00 Mon Homburg, Ale Jan, MS37, 8:55 Mon Hook, James L., CP39, 10:35 Wed Houghton, Steve, MS82, 3:00 Tue Houghton, Steve, MS82, 4:15 Tue Howard, Peter, MS7, 8:45 Sun Howcroft, Chris, PP1, 8:30 Tue Hripcsak, George, MS88, 3:50 Tue

Houghton, Steve, MS82, 4:15 Tue Howard, Peter, MS7, 8:45 Sun Howcroft, Chris, PP1, 8:30 Tue Hripcsak, George, MS88, 3:50 Tue Huang, Liang, CP50, 11:05 Thu *Hubenko, Alice, MS100, 8:30 Wed* Hubenko, Alice, MS100, 9:20 Wed Huebner, Kay, MS45, 4:15 Mon Hui, Qing, CP29, 10:15 Tue Humpherys, Jeffrey, MS116, 3:25 Wed Humphries, Neil, CP29, 10:35 Tue *Humphries, Tony R., MS119, 3:00 Wed* Humphries, Tony R., MS119, 3:00 Wed Hunt, Brian R., MS13, 3:00 Sun Hupkes, Hermen Jan, MS53, 3:25 Mon Ibragimov, Akif, MS39, 8:30 Mon Ibragimov, Akif, MS50, 3:00 Mon Ibragimov, Akif, MS61, 5:10 Mon Iima, Makoto, MS110, 9:45 Wed Illing, Lucas, MS139, 8:20 Thu Insperger, Tamas, CP44, 10:15 Wed Ironi, Liliana, MS72, 8:55 Tue Ishii, Yutaka, MS58, 5:35 Mon Itskov, Vladimir, MS15, 3:00 Sun Itskov, Vladimir, MS15, 3:00 Sun Itskov, Vladimir, MS26, 5:10 Sun Itskov, Vladimir, MS26, 6:25 Sun Ivanova, Ganna, PP1, 8:30 Tue

## J

Jackson, Russel, MS138, 9:35 Thu Jalics, Jozsi Z., PP1, 8:30 Tue Jalil, Sajiya, CP48, 10:45 Thu James, Guillaume, MS14, 3:25 Sun Jeffrey, Mike R., MS5, 8:20 Sun Jensen, Mogens, MS52, 3:00 Mon Jiang, Libin, MS89, 6:25 Tue Jing, Linyuan, CP46, 10:45 Thu Johnson, Mat, MS64, 6:00 Mon Johnson, Stewart D., MS96, 5:10 Tue Johnson, Stewart D., MS96, 6:00 Tue Johnston, George L., PP1, 8:30 Tue Johnston, Matthew D., PP1, 8:30 Tue Jones, Christopher, IP1, 11:45 Sun Jones, Christopher, MS13, 3:00 Sun Jones, Christopher, MS24, 5:10 Sun Joshi, Badal, MS38, 8:30 Mon Joshi, Badal, MS38, 9:20 Mon Just, Winfried, MS15, 3:00 Sun

# K

Kahng, Byungik, MS47, 3:25 Mon Kan, Xingye, MS59, 6:00 Mon Kang, Yun, MS69, 8:30 Tue Kang, Yun, MS69, 9:45 Tue Kang, Yun, MS80, 3:00 Tue Kang, Yun, MS91, 5:10 Tue Kanter, Ido, MS114, 3:00 Wed Kantsler, Vasily, MS94, 6:00 Tue Kaper, Tasso J., MS5, 8:45 Sun Kapitula, Todd, MS7, 9:35 Sun Kareva, Irina, MS80, 3:50 Tue Karimi, Alireza, CP49, 10:05 Thu Károlyi, György, CP38, 10:15 Wed Karpeev, Dmitry, MS83, 3:50 Tue Karrasch, Daniel, PP1, 8:30 Tue Kawahara, Genta, MS104, 8:55 Wed Kelly, Scott D., MS66, 5:10 Mon Kelly, Scott D., MS66, 5:10 Mon Kennedy, Benjamin, MS119, 3:50 Wed Kevrekidis, Panayotis, MS14, 3:00 Sun Kevrekidis, Panayotis, MS116, 4:15 Wed Kevrekidis, Yannis, MS123, 6:00 Wed Kevrekidis, Yannis, PD2, 8:30 Wed Khadra, Anmar, MS56, 5:10 Mon Kia, Behnam, CP49, 10:45 Thu Killmann, Malenka, PP1, 8:30 Tue Kilpatrick, Zachary, PP1, 8:30 Tue Kim, Jung Eun, PP1, 8:30 Tue Kim, Peter S., MS137, 8:20 Thu Kim, Peter S., MS137, 9:35 Thu Kimura, Masayuki, PP1, 8:30 Tue Kinzel, Wolfgang, MS125, 6:00 Wed Kiss, Istvan, MS95, 6:00 Tue Kitajo, Keiichi, MS88, 3:00 Tue Kitajo, Keiichi, MS99, 5:10 Tue

Mon Kjerland, Marc, PP1, 8:30 Tue

Kitajo, Keiichi, MS99, 5:10 Tue

Kitzbichler, Manfred G., MS43, 9:20

Klepel, Konrad, PP1, 8:30 Tue Knowles, James, PP1, 8:30 Tue Kocsis, Attila G., CP1, 10:45 Sun Kogan, Irina, MS11, 8:20 Sun Kogan, Irina, MS11, 9:35 Sun Kori, Hiroshi, MS10, 8:45 Sun Korniss, Gyorgy, MS142, 9:10 Thu Kosiuk, Ilona, CP51, 10:05 Thu Kostelich, Eric J., MS13, 3:00 Sun Kostelich, Eric J., MS13, 4:15 Sun Kostelich, Eric J., MS24, 5:10 Sun Kottos, Tsampikos, MS2, 9:35 Sun Kovacic, Gregor, MS140, 8:45 Thu Kraenkel, Roberto A., MS29, 5:10 Sun Kraenkel, Roberto A., MS29, 5:35 Sun Kramar, Miroslav, MS103, 9:20 Wed Kramer, Mark, MS5, 9:10 Sun Kramer, Peter R., MS38, 9:45 Mon Kramer, Peter R., MS83, 3:00 Tue Kramer, Peter R., MS94, 5:10 Tue Kramer, Sean, PP1, 8:30 Tue Krauskopf, Bernd, MS70, 9:45 Tue Krechetnikov, Rouslan, CP15, 10:15 Mon Krogh-Madsen, Trine, MS132, 6:00 Wed Krueger, Helge, MS60, 6:25 Mon

Kuehn, Christian, MS111, 3:00 Wed Kuehn, Christian, MS111, 4:15 Wed Kuehn, Christian, MS122, 5:10 Wed Kulkarni, Varsha S., CP26, 10:35 Tue Kumar, Ashok L., MS65, 5:10 Mon Kumar, Ashok L., MS76, 8:30 Tue Kumar, Ashok L., MS76, 8:55 Tue Kundu, Soumya, PP1, 8:30 Tue Kundu, Soumya, PP1, 8:30 Tue Kurths, Juergen, MS19, 3:00 Sun Kurths, Juergen, MS19, 3:25 Sun Kurths, Juergen, MS30, 5:10 Sun

Italicized names indicate session organizers.

Kutz, J. Nathan, MS75, 8:30 Tue Kutz, J. Nathan, MS86, 3:00 Tue Kutz, J. Nathan, MS86, 3:00 Tue Kuznetsov, Alexey, CP20, 10:55 Mon

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Lafortune, Stephane, MS116, 3:00 Wed Lafortune, Stephane, MS127, 5:10 Wed Lafortune, Stephane, MS138, 8:20 Thu Lafortune, Stephane, MS138, 9:10 Thu Lai, Yi Ming, PP1, 8:30 Tue Lai, Ying-Cheng, MS2, 9:10 Sun Laing, Carlo R., MS68, 9:20 Tue Lamb, Charles, MS53, 4:15 Mon Landsberg, Adam S., CP36, 10:15 Wed Lapp, Tobias, MS113, 3:25 Wed Larger, Laurent, MS118, 3:25 Wed Larremore, Daniel, MS43, 8:55 Mon Latushkin, Yuri, MS7, 9:10 Sun Lee, Joo Sang, MS54, 4:15 Mon Lee, Wai S., MS75, 9:20 Tue Lefranc, Marc, MS41, 8:30 Mon Lefranc, Marc, MS41, 8:30 Mon Lefranc, Marc, MS52, 3:00 Mon Lehnertz, Klaus, MS133, 9:35 Thu Leok, Melvin, MS11, 9:10 Sun Leung, Shingyu, MS23, 5:35 Sun Levi, Mark, MS107, 8:30 Wed Levine, Herbert, MS102, 8:30 Wed Lewis, Owen, PP1, 8:30 Tue Lewis, Tim, MS16, 3:25 Sun Lewis, Tim, MS115, 3:00 Wed Lewis, Tim, MS126, 5:10 Wed Li, Xiaowen, CP14, 10:15 Mon Liao, Kang-Ling, PP1, 8:30 Tue Lightman, Stafford, IP3, 11:45 Mon Lim, Chjan C., MS142, 8:20 Thu Lim, Chjan C., MS142, 9:35 Thu Lin, Zhi, MS1, 8:20 Sun

Lindenberg, Katja, MS14, 3:50 Sun Lindley, Brandon S., CP45, 10:25 Thu Lipinski, Douglas M., CP28, 10:35 Tue Liu, Chin-Yueh, MS98, 5:35 Tue Liu, Chun, MS46, 4:15 Mon Liu, Ningyu, MS128, 5:35 Wed Liu, Rongsong, MS6, 8:20 Sun Liu, Rongsong, MS6, 9:35 Sun Livina, Valerie, MS111, 3:00 Wed Lloyd, David, MS93, 5:10 Tue Lloyd, David, MS93, 6:00 Tue Loire, Sophie, CP37, 10:35 Wed Lomeli, Hector E., MS97, 5:10 Tue Lomeli, Hector E., MS97, 5:10 Tue Long, Yunhan, PP1, 8:30 Tue Lopez, Juan M., CP5, 10:45 Sun Lopez, Juan M., MS42, 8:30 Mon Lopour, Beth A., MS90, 5:35 Tue Lu, Wenlian, MS26, 5:35 Sun Lvov, Yuri V., MS105, 8:30 Wed Lvov, Yuri V., MS105, 9:20 Wed Ly, Cheng, MS99, 6:00 Tue

# Μ

Ma, Yiping, MS82, 3:25 Tue Ma'ayan, Avi, MS100, 8:55 Wed Macau, Elbert E., MS118, 3:00 Wed Macau, Elbert E., MS118, 4:15 Wed Mader, Wolfgang, PP1, 8:30 Tue Mahoney, John R., CP28, 10:55 Tue Malka, Roy, MS120, 3:00 Wed Maloney, Craig, MS20, 4:15 Sun Mancho, Ana M., MS112, 3:25 Wed Manore, Carrie A., MS91, 5:35 Tue Manukian, Vahagn, MS116, 3:00 Wed Manukian, Vahagn, MS127, 5:10 Wed Manukian, Vahagn, MS138, 8:20 Thu Manukian, Vahagn, MS138, 8:45 Thu Marangell, Robert, MS116, 3:50 Wed Marchesin, Dan, MS36, 9:20 Mon Marella, Sashi, MS102, 8:55 Wed Marino, Simeone, MS131, 6:00 Wed Mariño, Ines P., MS118, 3:50 Wed Marques, Francisco, CP35, 10:55 Wed *Maruskin, Jared M., MS22, 3:00 Sun* Maruskin, Jared M., MS22, 3:50 Sun Masuda, Naoki, MS65, 5:35 Mon Matsuzawa, Hiroshi, MS127, 6:00 Wed Mattingly, Jonathan C., MS49, 4:15 Mon

Mauroy, Alexandre, CP47, 10:45 Thu McCalla, Scott, MS93, 5:10 Tue McCalla, Scott, MS93, 5:10 Tue McCullen, Nick, CP9, 10:45 Sun McGehee, Richard, MS34, 8:30 Mon McGehee, Richard, MS34, 8:55 Mon McKinley, Scott, MS38, 8:30 Mon McLaughlin, Richard, MS1, 9:35 Sun Meaud, Julien, MS106, 8:55 Wed Medvedev, Georgi S., MS4, 8:20 Sun Medvedev, Georgi S., MS4, 8:20 Sun Medvedev, Georgi S., MS15, 3:00 Sun Medvedev, Georgi S., MS26, 5:10 Sun Meerkamp, Philipp, MS70, 9:20 Tue Mehlig, Bernhard, MS113, 3:00 Wed Mehlig, Bernhard, MS124, 5:10 Wed Mehlig, Bernhard, MS124, 5:10 Wed Meiss, James D., MS103, 8:30 Wed Meiss, James D., MS112, 3:00 Wed Mellard, Jarad, MS21, 4:15 Sun Mercorelli, Paolo, CP54, 11:05 Thu Mezic, Igor, MS60, 5:10 Mon Mier-y-Teran, Luis, MS108, 8:55 Wed Miller Neilan, Rachael, MS69, 8:30 Tue Miller Neilan, Rachael, MS80, 3:00 Tue Miller Neilan, Rachael, MS91, 5:10 Tue Miller Neilan, Rachael, MS91, 5:10 Tue Mina, Petros, CP2, 10:05 Sun Mireles James, Jason, MS85, 3:50 Tue Misawa, Eduardo, PD1, 12:45 Tue Mitchell, Jonathan, MS120, 4:15 Wed Mitchell, Kevin A., MS17, 3:00 Sun Mitchell, Kevin A., MS17, 3:00 Sun Mitchell, Lewis, MS24, 5:10 Sun Mizumachi, Tetsu, MS27, 5:35 Sun Moehlis, Jeff, MS28, 5:10 Sun Moehlis, Jeff, MS84, 3:50 Tue Mohammed, Wael W., CP37, 10:15 Wed Mohr, Ryan, CP15, 10:55 Mon Molkov, Yaroslav, MS136, 9:10 Thu Montgomery, Richard, MS22, 3:25 Sun Mora, Karin, MS96, 5:10 Tue Morgansen, Kristi, MS35, 9:20 Mon Morris, Stephen, IP9, 11:55 Thu Morrison, P.J., MS31, 5:10 Sun Mosovsky, Brock, MS12, 3:50 Sun Motter, Adilson E., MS54, 3:50 Mon Mramor, Blaz, MS107, 8:30 Wed Mramor, Blaz, MS107, 8:55 Wed Mueller, Sebastian, MS17, 4:15 Sun Mulansky, Mario, MS9, 8:45 Sun Muldoon, Mark, MS103, 9:45 Wed Mulloney, Brian, MS16, 3:00 Sun Munao, Simone, MS85, 4:15 Tue Munoz, Laura, MS132, 6:25 Wed Murphy, Thomas E., MS114, 3:00 Wed Murphy, Thomas E., MS114, 4:15 Wed Murray, Rua, CP33, 10:15 Tue Mytkowicz, Todd D., MS103, 8:30 Wed

# Ν

Nabi, Ali, MS28, 5:10 Sun Nabi, Ali, MS28, 6:25 Sun Nadim, Farzan, MS26, 5:10 Sun Nakagaki, Toshiyuki, MS110, 8:30 Wed Nakagaki, Toshiyuki, MS110, 8:30 Wed Nakao, Hiroya, MS10, 8:20 Sun Nakao, Hiroya, MS10, 9:10 Sun Nan, Pingyu, PP1, 8:30 Tue Ncube, Israel, CP7, 10:45 Sun Neiman, Alexander, MS143, 9:10 Thu Németh, Róbert K., CP55, 10:45 Thu Nepomnyashchy, Alexander, MS77, 8:30 Tue Netoff, Theoden I., MS115, 3:25 Wed Nevai, Andrew, MS61, 6:25 Mon Newby, Jay M., PP1, 8:30 Tue Newhall, Katherine, MS98, 5:10 Tue Newton, Paul, MS141, 8:20 Thu Newton, Paul, MS141, 8:20 Thu Ngo, Duc, MS14, 4:15 Sun Nguyen, Toan, MS7, 8:20 Sun Nguyen, Toan, MS127, 5:35 Wed Ni, Xuan, CP22, 10:55 Mon Nielsen, Kenneth Hagde M., PP1, 8:30 Tue Nishikawa, Takashi, MS54, 3:00 Mon Nishikawa, Takashi, MS54, 3:00 Mon Nordmark, Arne, MS96, 6:25 Tue Novak, Chris, MS47, 3:50 Mon

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Odom, Stephen E., PP1, 8:30 Tue Odyniec, Michal, CP54, 10:25 Thu Ogawa, Yutaro, PP1, 8:30 Tue Ohnishi, Isamu, CP51, 10:45 Thu Olivar, Gerard, CP29, 10:55 Tue Olsson, Peter, MS20, 3:50 Sun Olver, Peter, MS11, 8:45 Sun Omel'chenko, Oleh, CP47, 10:25 Thu Omran, Ashraf, CP15, 10:35 Mon

Núñez, Carmen, MS129, 5:10 Wed

Nykamp, Duane, MS76, 8:30 Tue

Onnela, Jukka-Pekka, MS73, 8:55 Tue Ormerod, Paul, MS109, 8:55 Wed *Orosz, Gabor, MS62, 5:10 Mon* Orosz, Gabor, MS62, 5:10 Mon *Osan, Remus, MS135, 8:20 Thu* Osan, Remus, MS135, 8:20 Thu Osinga, Hinke M., MS67, 9:45 Tue Otani, Niels F., MS121, 4:15 Wed *Ott, Edward, MS2, 8:20 Sun* Ott, Edward, MS2, 8:45 Sun Otto, Felix, IP7, 11:45 Wed Otto, Kevin, MS40, 9:20 Sun Overbye, Thomas, MS89, 5:35 Tue

## Ρ

Padberg-Gehle, Kathrin, MS112, 3:50 Wed Pais, Darren, MS84, 4:15 Tue Paley, Derek A., MS35, 8:30 Mon Paley, Derek A., MS35, 8:30 Mon Paoletti, Paolo, CP48, 10:25 Thu Park, Choongseok, MS55, 3:00 Mon Park, Choongseok, PP1, 8:30 Tue Parshad, Rana D., CP33, 10:35 Tue Patrick, George, MS22, 3:00 Sun Paul, Ujjayan, CP5, 10:05 Sun Pavliotis, Greg, MS8, 8:20 Sun Pavliotis, Greg, MS8, 8:20 Sun Payton, Oliver D., MS74, 8:30 Tue Payton, Oliver D., MS74, 8:30 Tue Pazo, Diego, MS42, 8:30 Mon Peckham, Bruce B., CP33, 10:55 Tue Pecora, Louis M., MS2, 8:20 Sun Pecora, Louis M., MS2, 8:20 Sun Peet, Matthew M., MS137, 8:45 Thu Pego, Robert, MS7, 8:20 Sun Peikert, Ronald, MS23, 6:00 Sun Pelinovsky, Dmitry, MS53, 3:50 Mon

Peyla, Philippe, MS83, 3:25 Tue Phillips, Andrew, MS79, 3:25 Tue Piasecki, Slawomir, PP1, 8:30 Tue Pierrehumbert, Raymond T., IP4, 2:00 Mon Pikovsky, Arkady, MS9, 8:20 Sun Pikovsky, Arkady, MS9, 9:35 Sun Poetzsche, Christian, MS129, 5:10 Wed Poetzsche, Christian, MS129, 6:25 Wed Pogan, Alin, MS93, 6:25 Tue Politi, Antonio, MS42, 8:30 Mon Popovych, Oleksandr, MS28, 6:00 Sun Porfiri, Maurizio, MS19, 3:00 Sun Porfiri, Maurizio, MS19, 3:50 Sun Porfiri, Maurizio, MS30, 5:10 Sun Porter, Jeff, CP35, 10:35 Wed Porter, Mason A., MS73, 8:30 Tue Porter, Mason A., MS84, 3:00 Tue Porter, Mason A., MS84, 3:00 Tue Porter, Mason A., PD2, 8:30 Wed Postlethwaite, Claire M., MS37, 8:30 Mon Postlethwaite, Claire M., MS37, 8:30 Mon Poulakakis, Ioannis, MS4, 8:45 Sun Powell, James, MS69, 8:30 Tue Price, Ian, MS131, 5:10 Wed Proctor, Joshua, MS16, 4:10 Sun Promislow, Keith, MS27, 6:25 Sun Promislow, Keith, MS46, 3:00 Mon Promislow, Keith, MS57, 5:10 Mon Psemeneki, Tiffany M., CP34, 10:35 Wed Pujals, Enrique, IP5, 11:45 Tue Putkaradze, Vakhtang, CP1, 10:05 Sun

Quinn, Roger, MS32, 5:35 Sun

# R

Rachford, Frederic, MS101, 9:20 Wed Radmaneshfar, Elahe, MS95, 6:25 Tue Radons, Gunter, MS42, 9:20 Mon Rahaman, Sabiar, CP18, 10:15 Mon Rajendran, Karthikeyan, MS100, 9:45 Wed

Raman, Arvind, MS74, 9:20 Tue Ramírez-Ros, Rafael, MS97, 5:35 Tue Rangan, Aaditya, MS135, 9:10 Thu Rankin, James, CP19, 10:15 Mon Rasmussen, Martin, MS129, 5:35 Wed Raue, Andreas, MS41, 9:45 Mon Ravoori, Bhargava, MS139, 8:45 Thu Reeks, Mike, MS124, 6:00 Wed Remington, Karin, PD1, 12:45 Tue Rempe, Michael, MS79, 4:15 Tue Restrepo, Juan G., MS19, 4:15 Sun Restrepo, Juan G., MS43, 8:30 Mon Reynolds, Angela M., MS50, 3:25 Mon Rhoads, Blane, PP1, 8:30 Tue Riecke, Hermann, MS102, 8:30 Wed Riecke, Hermann, MS135, 8:45 Thu Riess, Thorsten, CP8, 10:05 Sun Rink, Bob, MS107, 8:30 Wed Ritter, Laura, MS39, 8:30 Mon Ritter, Laura, MS50, 3:00 Mon Ritter, Laura, MS61, 5:10 Mon Ritter, Laura, MS61, 5:10 Mon Riyapan, Pakwan, PP1, 8:30 Tue Roberts, Anthony J., MS8, 9:10 Sun Rodrigues, Serafim, MS5, 8:20 Sun Rodriguez, Marcos, CP10, 10:25 Sun Rogers, Bruce, CP52, 10:25 Thu Rogers, Jeff, PD1, 12:45 Tue Romance, Miguel, CP21, 10:15 Mon Romano, M. Carmen, MS41, 8:55 Mon

Romero-Bastida, Mauricio, MS42, 9:45 Mon

Rom-Kedar, Vered, MS75, 8:30 Tue Rom-Kedar, Vered, MS120, 3:00 Wed Rom-Kedar, Vered, MS131, 5:10 Wed Rosa, Epaminondas, MS118, 3:00 Wed Rosa, Epaminondas, MS118, 3:00 Wed Rosenbaum, Robert, MS65, 5:10 Mon Rosenbaum, Robert, MS65, 6:25 Mon Rosenbaum, Robert, MS76, 8:30 Tue Rosenblum, Michael, MS10, 8:20 Sun Rosenblum, Michael, MS10, 8:20 Sun Rossi, Louis F., MS141, 9:35 Thu Röst, Gergelv, MS6, 8:20 Sun Röst, Gergely, MS119, 3:25 Wed Rot, Thomas, MS85, 3:25 Tue Rothkegel, Alexander, MS122, 5:35 Wed Rotstein, Horacio G., CP48, 10:05 Thu Rottmann-Matthes, Jens, MS36, 9:45 Mon Rottschafer, Vivi, CP6, 10:05 Sun Roy, Rajarshi, MS114, 3:00 Wed Roy, Rajarshi, MS125, 5:35 Wed Rozhnova, Ganna, MS18, 3:25 Sun Rubchinsky, Leonid, MS55, 3:00 Mon Rubchinsky, Leonid, MS55, 3:00 Mon Rubin, Jonathan E., MS16, 3:00 Sun Rubin, Jonathan E., MS65, 6:00 Mon Rubin, Jonathan E., MS136, 8:20 Thu Rucklidge, Alastair M., MS37, 8:30 Mon Rucklidge, Alastair M., CP35, 10:15 Wed

*Rulkov, Nikolai, MS32, 5:10 Sun* Rulkov, Nikolai, MS32, 6:00 Sun Rypina, Irina, MS60, 6:00 Mon

**S** Sacré, Pierre, CP20, 10:35 Mon Saha, Raj, MS34, 9:20 Mon Saintillan, David, MS83, 4:15 Tue Saka, Yasushi, MS52, 3:50 Mon Sakovich, Anton, MS92, 6:00 Tue Salau, Kehinde, MS80, 4:15 Tue Samaev, Giovanni, MS68, 8:30 Tue Sander, Evelyn, MS81, 3:50 Tue Sandstede, Björn, MS53, 3:00 Mon Sanjuan, Miguel, CP34, 10:55 Wed Sato, Yuzuru, MS88, 3:00 Tue Sato, Yuzuru, MS88, 3:00 Tue Sato, Yuzuru, MS99, 5:10 Tue Sauer, Tim, MS95, 5:10 Tue Savin, Tatiana, MS77, 8:30 Tue Savin, Tatiana, MS77, 8:30 Tue Sayama, Hiroki, MS63, 5:35 Mon Schöll, Eckehard, MS125, 5:10 Wed Schecter, Stephen, MS36, 8:30 Mon Schecter, Stephen, MS36, 8:30 Mon Scheel, Arnd, MS57, 5:10 Mon Schelter, Bjoern, MS95, 5:35 Tue Schelter, Bjoern, MS133, 8:20 Thu Scheper, Christopher J., CP12, 10:55 Mon Schiff, Steven J., MS28, 5:10 Sun Schittler Neves, Fabio, MS37, 9:20 Mon Schmidt, Deena, MS15, 3:50 Sun Schnabel, Michael, MS130, 6:25 Wed

Schnabel, Michael, MS130, 6:25 Wed Schneider, Tobias, MS104, 9:20 Wed Schugart, Richard, MS50, 3:00 Mon Schwartz, Ira B., MS108, 9:45 Wed Scott, Sherry, MS49, 3:25 Mon Seara, Tere M., CP55, 11:05 Thu Sendina-Nadal, Irene, CP21, 10:55 Mon Sentman, Davis, MS128, 5:10 Wed Seoane, Jesus M., CP38, 10:35 Wed Serrano, Sergio, MS81, 4:15 Tue Sethia, Gautam C., MS125, 5:10 Wed Shaw, Leah, MS63, 5:10 Mon Shaw, Leah, MS63, 6:25 Mon Shaw, Steve, MS122, 6:25 Wed Shea-Brown, Eric, MS28, 5:35 Sun Sherwood, Eric, MS115, 4:15 Wed Sherwood, Eric, MS135, 8:20 Thu Shew. Woodrow L., MS43, 8:30 Mon Shew, Woodrow L., MS43, 8:30 Mon Shiau, LieJune, MS115, 3:00 Wed Shiau, LieJune, MS126, 5:10 Wed Shilnikov, Andrey, MS117, 3:00 Wed Shilnikov, Andrey, MS117, 3:50 Wed Shimono, Masanori, MS99, 5:35 Tue Shiro, Masanori, CP49, 11:05 Thu Shlizerman, Eli, MS87, 3:00 Tue Shlizerman, Eli, MS87, 3:25 Tue Shlizerman, Eli, MS98, 5:10 Tue Shuai, Zhisheng, MS6, 8:20 Sun Sieber, Jan, CP7, 10:05 Sun Sieber, Jan, MS111, 3:00 Wed Sieber, Jan, MS122, 5:10 Wed Sikorski, Kajetan, MS94, 6:25 Tue Silber, Mary C., MS45, 3:00 Mon Silber, Mary C., MS45, 3:50 Mon Silber, Mary C., PD2, 8:30 Wed Silva, Julio Daniel M., PP1, 8:30 Tue Simon, Peter L., MS116, 3:00 Wed Simpson, David J., MS58, 6:00 Mon Sinden, David, CP7, 10:25 Sun Singh, Anuraj, CP18, 10:35 Mon Sipahi, Rifat, MS30, 6:25 Sun Skardal, Per Sebastian, CP46, 10:25 Thu Skufca, Joseph, MS130, 5:35 Wed Smith, Leslie, MS105, 8:30 Wed So, Paul, MS30, 6:00 Sun Solla, Sara A., MS98, 6:25 Tue Sommerlade, Linda, MS133, 8:45 Thu

Sooknanan, Joanna, PP1, 8:30 Tue Sorrentino, Francesco, CP42, 10:55 Wed Spardy, Lucy, MS72, 9:20 Tue Speetjens, Michel, MS112, 4:15 Wed Spiller, Elaine, MS24, 5:35 Sun Stanley, H. Eugene, MS142, 8:20 Thu Starke, Jens, MS3, 8:45 Sun Starke, Jens, MS102, 8:30 Wed Steele, Charles, MS106, 9:45 Wed Stefanov, Atanas, MS53, 3:00 Mon Stefanov, Atanas, MS64, 5:10 Mon Stefanov, Atanas, MS64, 6:25 Mon Steinbock, Oliver, MS33, 5:35 Sun Stepan, Gabor, CP44, 10:35 Wed Stepien, Tracy L., CP45, 10:05 Thu Stoop, Ruedi, CP21, 10:35 Mon Storace, Marco, MS143, 9:35 Thu Stout, John E., PP1, 8:30 Tue Straube, Artur, MS124, 5:35 Wed Struchiner, Claudio, MS18, 3:00 Sun Struchiner, Claudio, MS29, 5:10 Sun Sturman, Rob, MS47, 3:00 Mon Sturman, Rob, MS47, 3:00 Mon Su, Jianzhong, MS39, 8:55 Mon Sun, Jie, MS84, 3:25 Tue Sun, Jie, MS130, 5:10 Wed Surana, Amit, MS40, 9:45 Sun Surana, Amit, MS40, 8:30 Mon Surana, Amit, MS51, 3:00 Mon Suret, Pierre, CP53, 10:25 Thu Susuki, Yoshihiko, MS60, 5:35 Mon Swain, Daniel T., MS35, 8:55 Mon Swigon, David, CP45, 10:45 Thu Szalai, Robert, MS106, 8:30 Wed Szalai, Robert, CP45, 11:05 Thu Szwaj, Christophe, CP50, 10:45 Thu

T

Tabak, Joel, MS56, 5:10 Mon Tabak, Joel, MS67, 8:30 Tue Tagg, Randall, PP1, 8:30 Tue Takahashi, Ryo, PP1, 8:30 Tue Talkachova, Alena, MS44, 9:20 Mon Tanveer, Saleh A., MS128, 6:25 Wed Taylor, Dane, CP32, 10:15 Tue Teka, Wondimu W., MS67, 8:55 Tue Tel, Tamas, MS113, 4:15 Wed Teodorescu, Razvan, MS77, 8:55 Tue Teramae, Jun-nosuke, MS88, 3:00 Tue Teramae, Jun-nosuke, MS99, 5:10 Tue Teramae, Jun-nosuke, MS99, 6:25 Tue Terman, David H., MS117, 3:00 Wed Thakur, Gunjan, CP52, 10:45 Thu Theocharis, Georgios, MS14, 3:00 Sun Theocharis, Georgios, MS92, 5:10 Tue Thiel, Marco, MS41, 8:30 Mon Thiel, Marco, MS52, 3:00 Mon Thiel, Marco, MS133, 9:10 Thu Thiffeault, Jean-Luc, MS1, 8:45 Sun Thomas, Peter J., MS72, 8:30 Tue Thomas, Peter J., MS72, 9:45 Tue Tigan, Gheorghe, CP39, 10:15 Wed Timmer, Jens, MS95, 5:10 Tue Timofeyev, Ilya, MS140, 9:10 Thu Timperio, Vincent, PP1, 8:30 Tue Tiron, Roxana, CP40, 10:35 Wed Toenjes, Ralf, PP1, 8:30 Tue Tomaiuolo, Maurizio, MS56, 5:35 Mon Tomozei, Dan-Cristian, CP54, 10:45 Thu Topaz, Chad M., MS3, 8:20 Sun Toporikova, Natalia, MS136, 9:35 Thu Toral, Raul, MS10, 9:35 Sun Touboul, Jonathan D., CP14, 10:55 Mon Towne, Warren, CP37, 10:55 Wed Triandaf, Ioana A., CP54, 10:05 Thu Tricoche, Xavier M., MS12, 3:00 Sun Tricoche, Xavier M., MS23, 5:10 Sun Tricoche, Xavier M., MS23, 5:10 Sun Trover, Todd, MS126, 6:00 Wed Tsai, Je-Chiang, MS36, 8:55 Mon Tsaneva-Atanasova, Krasimira, MS56, 5:10 Mon Tsaneva-Atanasova, Krasimira, MS67, 8:30 Tue Tsaneva-Atanasova, Krasimira, MS67, 9:20 Tue Tunc, Ilker, CP2, 10:45 Sun Tupper, Paul, MS49, 3:50 Mon Turitsyn, Konstantin, MS78, 3:00 Tue Turitsyn, Konstantin, MS78, 3:50 Tue Turitsyn, Konstantin, MS89, 5:10 Tue Tutberidze, Mikheil, CP8, 10:25 Sun

# U

Uchida, Atsushi, MS114, 3:50 Wed Uminsky, David T., MS141, 8:20 Thu Uminsky, David T., MS141, 9:10 Thu Underhill, Patrick, MS83, 3:00 Tue

## V

Vainchtein, Anna, MS64, 5:10 Mon Vainchtein, Dmitri, MS25, 5:10 Sun Vainchtein, Dmitri, MS25, 6:25 Sun Vakakis, Alexander F., MS14, 3:00 Sun Van Den Berg, Jan Bouwe, MS85, 3:00 Tue

van Heijster, Peter, MS27, 5:10 Sun van Heijster, Peter, MS57, 6:25 Mon van Saarloos, Wim, MS20, 3:00 Sun van Saarloos, Wim, MS20, 3:00 Sun van Veen, Lennaert, MS104, 8:30 Wed van Veen, Lennaert, MS104, 9:45 Wed Van Vleck, Erik, MS53, 3:00 Mon Van Vleck, Erik, MS64, 5:10 Mon Van Vleck, Erik, MS134, 8:20 Thu Vandervorst, Robert, MS85, 3:00 Tue Varkonyi, Peter L., CP55, 10:25 Thu Veerman, Frits, PP1, 8:30 Tue Veltz, Romain, PP1, 8:30 Tue Verhulst, Sarah, MS106, 8:30 Wed Vidal, Alexandre, MS67, 8:30 Tue Vinther, Frank, PP1, 8:30 Tue Viotti, Claudio, CP40, 10:15 Wed Vollmer, Juergen, MS113, 3:50 Wed

## W

Wackerbauer, Renate A., CP49, 10:25 Thu Wagener, Florian, MS111, 3:25 Wed

Wagenknecht, Thomas, MS82, 3:00 Tue Wagenknecht, Thomas, PP1, 8:30 Tue Walker, Jamie, MS56, 6:25 Mon Walton, Jay R., MS39, 8:30 Mon Walton, Jay R., MS50, 3:00 Mon Walton, Jay R., MS61, 5:10 Mon Wang, Wenxu, CP32, 10:35 Tue Wang, Yunjiao, PP1, 8:30 Tue Wang, Zhi-An, MS61, 6:00 Mon Ward, Jonathan A., MS62, 5:35 Mon Ward, Michael, MS46, 3:00 Mon Ward, Thomas, MS25, 5:35 Sun Waters, Sarah, IP8, 2:00 Wed Wattis, Jonathan, MS92, 5:35 Tue Watts, Margaret A., PP1, 8:30 Tue Webber, Matthew, PP1, 8:30 Tue Wedgwood, Kyle C., MS26, 6:00 Sun Weliwita, Jinendrika A., PP1, 8:30 Tue Westphal, Anthony, MS32, 6:25 Sun White, John, MS126, 5:10 Wed Widiasih, Esther, MS34, 9:45 Mon

Williams, Matthew O., MS86, 4:15 Tue
Willis, Ashley, MS104, 8:30 Wed
Wilson, Jay, MS101, 8:55 Wed
Wojcik, Jeremy, PP1, 8:30 Tue
Wolfe, Christopher L., MS42, 8:55 Mon
Wrobel, Jacek K., MS97, 6:00 Tue
Wu, Jian-Young, CP19, 10:35 Mon
Wu, Qiliang, MS127, 6:25 Wed
Wurm, Alexander, MS31, 5:10 Sun
Wurm, Alexander, MS31, 5:10 Sun

X Xu, Dashun, MS6, 8:45 Sun Xue, Chuan, MS39, 9:20 Mon

## Y

Yagasaki, Kazuyuki, CP27, 10:35 Tue Yamada, Richard, CP30, 10:15 Tue Yang, Dennis Guang, MS55, 4:15 Mon Yang, Li, MS57, 5:35 Mon Yang, Routing, MS137, 9:10 Thu Yang, Rui, CP50, 10:05 Thu Yang, Zhihui, MS59, 5:35 Mon Yong, Kamuela E., MS69, 9:20 Tue Yorke, James A., 8:30 Sun Yorke, James A., PD2, 8:30 Wed Yoshiyama, Kohei, MS21, 3:50 Sun Young, Todd, CP3, 10:05 Sun Young, Todd, MS120, 3:00 Wed Young, Todd, MS131, 5:10 Wed Young, Yuan-Nan, MS66, 6:25 Mon Yu, Yifeng, MS107, 9:20 Wed Yuan, Jinchao, MS51, 4:15 Mon

**Z** Zaal, Martijn, CP23, 10:35 Tue *Zagaris, Antonios, MS21, 3:00 Sun* Zagaris, Antonios, MS21, 3:00 Sun Zambrano, Samuel, CP38, 10:55 Wed Zeeman, Mary Lou, MS34, 8:30 Mon Zenkov, Dmitry, MS11, 8:20 Sun Zenkov, Dmitry, MS22, 4:15 Sun Zhang, Jiawei, PP1, 8:30 Tue Zhang, Wenjun, MS70, 8:55 Tue Zhao, Ken, PP1, 8:30 Tue Zheng, Jiongxuan, PP1, 8:30 Tue Zochowski, Michal, CP48, 11:05 Thu Zou, Yo, MS3, 9:10 Sun Zschaler, Gerd, MS63, 6:00 Mon Zuo, Wangda, MS40, 8:30 Sun
## DS11 Budget

### **Conference Budget**

#### SIAM Conference on Dynamical Systems May 22-26, 2011 Snowbird, Utah, USA

**Expected Paid Attendance: 680** 

	Total Support Services:	\$123,079
Services covered by SIAM		\$57,114
Services covered by Revenue		\$65,965
Support Services: *		
	Total Direct Expenses:	\$120,900
Other (supplies, staff travel, freight, misc.)		\$7,400
Conference Staff Labor		\$27,500
Advertising		\$8,700
Room (rental)		\$1,800
AV and Equipment (rental)		\$22,800
Telecomm		\$4,000
Food and Beverage		\$21,900
Invited Speaker		\$15,500
Organizing Committee		\$4,000
Printing		\$7,300
Direct Expenses		
Total		\$186,865
Registration	-	\$186,865
Revenue		

Total Expenses: \$243,979

\* Support services includes customer service, accounting, computer support, shipping, marketing and other SIAM support staff. It also includes a share of the computer systems and general items (building expenses in the SIAM HQ).

# Snowbird Ski and Summer Resort

Level B





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