ICIAM Today – Tuesday Recap

Highlights from talks:

The Olga Taussky-Todd Lecture

Éva Tardos (Cornell University, USA) delivered the 2015 Olga Taussky-Todd Lecture in Monday evening. In memory of Olga Taussky-Todd, this honor has been given at each ICIAM since 2007 to a woman scientist for outstanding contributions in applied mathematics and /or scientific computation. In her lecture, *Learning and Efficiency in Games with Dynamic Population*, Dr. Tardos provided an intriguing consideration on the quality of outcomes in games when the population of players is dynamically changing, and where participants have to adapt to the dynamic environment. Their study shows that in large classes of games (including congestion games), if players use a form of learning that helps them to adapt to the changing environment, this guarantees high social welfare, even under very frequent changes.

The Pioneer Prize Lecture

Böjrn Engquist (The University of Texas at Austin, USA) delivered a lecture, *Seismic Full Waveform Inversion and the Monge-Ampère Equation*, focusing on the fast computation and the choice of metric in the comparison of PDE constrained optimization in the form of full waveform inversion with applications in seismology. Dr. Engquist proposed the optimal transport and Wasserstein metric in solving the Monge-Ampère equation. Because of the special nature of this lecture, his talk also related the recent research to some earlier contributions from the Pioneer Prize motivation.

Su Buchin Prize Lecture

Tatsien Li (Fudan University, China) delivered a lecture that entitled, *From Phenomena of Synchronization to Exact Synchronization and Approximate Synchronization for Hyperbolic Systems*. His talk elegantly described their pioneer studies on the synchronization for infinite dimensional dynamical systems of partial differential equations instead of finite dimensional systems of ordinary differential equations, and connected with the control theory via boundary controls in a finite time interval. Moreover, the talk introduced criteria of Kalman's type as necessary conditions for various kinds of approximate boundary synchronization.

Lagrange Prize Lecture

Andrew J. Majda (New York University, USA) delivered a lecture, *An Applied Math Perspective on Climate Science, Turbulence, and Other Complex Systems*, addressing grand challenges in climate science as extremely complex system, such as turbulent dynamical system and engineering turbulence that require statistical, stochastic methods and thinking combined with nonlinear dynamics ideas. Moreover, his talk discussed central applied math/science issues in this field, including accurate

prediction and representation of suitable statistics for observations from nature, model error, uncertainty quantification, and rapid data assimilation or filtering to aid prediction.

Invited lectures

Shige Peng (Shandong University, China) gave a stimulating invited talk, *Covering the Uncertainty of Distributions by Nonlinear Expectation, Nonlinear PDE and BSDE*. The talk elucidated that the uncertainty of probability distributions can be described and calculated by nonlinear expectation. Furthermore, nonlinear parabolic PDE plays a crucially important role in the modeling and calculation of uncertainty problems. Dr. Peng then introduced the theoretical foundation of their new law of large numbers and central limit theorem in the framework of nonlinear expectation. The talk also discussed the corresponding continuous time frameworks.

Ricardo H. Nochetto (University of Maryland, USA) delivered an invited lecture, *A PDE Approach to Numerical Fractional Diffusion*. The talk shed light on the design and analysis of efficient solution techniques for problems involving fractional powers of elliptic operators. Starting from a localization PDE result for these operators, their study develops local techniques for the solution: a priori and a posteriori error analyses, adaptivity and multilevel methods.

Ludger D. Sax (Grid Optimization Europe– System Planning Gas & Water, Germany) presented an impressive invited talk entitled *Grid and Grid Control Optimization in Europe*. The talk provided a comprehensive overview of how engineers and mathematicians in EU apply contemporary mathematics and state-of-the-art technology to establish modern mathematical methods in the planning and control of gas transport networks to maximize grid capacity at minimum cost and to ensure the security of supply.

Eric Vanden-Eijnden (New York University, USA) gave an invited talk, *Modeling of Rare Transition Events*, which offered an engaging opportunity to understand the dynamics of rare transition events through the study of the ensemble of transition paths between different metastable states. The talk reviewed the basic ingredients of the transition path theory and discussed connections with the more classical transition state theory. It also discussed how the string method arises in order to find approximate solutions in the framework of the transition path theory.

Lisa Fauci (Tulane University, USA) delivered her invited talk, *Explorations in the Biofluiddynamics of Locomotion*, presenting recent progress in the development of a computational model of a lamprey with proprioceptive feedback and examining the emergent swimming behavior of the coupled fluid-muscle-body system. The talk demonstrated that even when body kinematics at zero Reynolds number are specified, there are still interesting fluid dynamic questions that have yet to be answered.

Ravi Kannan (Microsoft Research, India) presented an invited lecture on *Randomized Algorithms in Linear Algebra*. Small random sample of rows/columns of any matrix is a decent proxy for the matrix, provided sampling probabilities are proportional to squared lengths. In the talk, Dr. Kannan offered an overview on theorems, applications, and challenges in using sampling to reduce matrix sizes for Linear Algebra computations.

What to look for on Wednesday

Invited Lectures

8:30-9:30

- Title: Refinement strategies for spline based methods
  Room: Ballroom A
  Annalisa Buffa, Istituto di Matematica Applicata e Tecnologie Informatiche, Italy
  Chair: D.N. Arnold
- Title: Stabilization of control systems: From the water clocks to the regulation of rivers
  Room: Ballroom B
  Jean Michel Coron, Université Pierre et Marie Curie, France
  Chair: Enrique Zuazua
- Title: Weak universality of the KPZ equation
  Room: Ballroom C
  Martin Hairer, Warwick University, UK
  Chair: John Ball

10:00-11:00

- Title: What's new in high-dimensional integration? – designing Quasi Monte Carlo for applications
  Room: Ballroom A
  Ian Sloan, The University of New South Wales, Australia
  Chair: Chi-Wang Shu
- Title: Computational Progress in Linear and Mixed Integer Programming
  Room: Ballroom B
  Bob Bixby, Gurobi Optimization, Inc., USA
  Chair: Martin Grötschel
- Title: Image Restoration: A Data-Driven Perspective
  Room: Ballroom C
  Zuowei Shen, National University of Singapore, Singapore
  Chair: Zongben Xu

11:10-12:10

- Title: Solution Techniques for the Stokes System: A Priori and A Posteriori Modifications, Resilient Algorithms
  Room: Ballroom A
  Barbara Wohlmuth, Technische Universität München, Germany
  Chair: Jinchao Xu

- Title: On Convergence of the Multi-Block Alternating Direction Method of Multipliers
  Room: Ballroom B
  Yinyu Ye, Stanford University, USA
  Chair: Yaxiang Yuan
- Title: On the interplay between intrinsic and extrinsic instabilities of spatially localized patterns
  Room: Ballroom C
  Yasumasa Nishiura, Tohoku University, Japan
  Chair: Taketomo Mitsui

Special Lecture

19:00-20:00

- **The John von Neumann Lecture**
  Title: Once upon a graph: How to get from now to then in massive networks
  Room: Ballroom C
  Jennifer Tour Chayes, Microsoft Research
  Chair: L. Pamela Cook

Notice:

Program Updates on Wednesday

IM-We-E-04 (16:00-18:00)
Room: 308
16:00-16:30

- Title: Tool orientation optimization for 5-axis machining with C-space method
  Author(s): **Chun-Ming Yuan *; Li-Yong Shen**
  Academy of Mathematics and Systems Science (AMSS), CAS, China

16:30-17:00

- Title: Avoiding 5-axis singularities using additional matrix transformation
  Author(s): **Lixian Zhang*; Yong Wen; Xiao-Shan Gao; Hongbo Li**
  Academy of Mathematics and Systems Science (AMSS), CAS, China

17:00-17:30

- Title: Approximately proper reparametrization of rational curves and surfaces
  Author(s): **Li-Yong Shen***
  University of the Chinese Academy of Sciences, China

17:30-18:00

- *Title: mu-bases on Dupin cyclides
  Author(s): **Xiaohong Jia***
  Academy of Mathematics and Systems Science (AMSS), CAS, China