CLAREMONT CENTER for MATHEMATICAL SCIENCES

CLAREMONT MATHEMATICS WEEKEND

Schedule of Events
Day 1 (January 27, 2018)
9:30 – 10:00 Registration / Coffee and Snacks
10:00 – 12:00 Presentations
12:00 – 1:30 Lunch Break
1:30 – 3:10 Presentations
3:10 – 3:40 Coffee Break
3:40 – 4:45 Presentations
5:00 – 6:00 Wine and Cheese

Day 2 (January 28, 2018)
12:00 – 1:00 Lunch
1:00 – 4:00 Math Modeling with Matlab Competition

Speaker: Mark Huber

Department of Mathematics & Computer Science
Claremont McKenna
Claremont, CA 91711
mhuber@cmc.edu

Publications

- M. Huber, “The Fundamental Theorem of Perfect Simulation”, arXiv:1704.03561(2017)
- M. Huber, “An estimator for Poisson means whose relative error distribution is known”,arXiv:1605.09445(2016)

Title: Robust Estimation Methods for Monte Carlo data

Abstract:

Data derived from Monte Carlo experiments is often more flexible than data from traditional experiments. This flexibility allows for the construction of new estimates that are robust in the sense that performance guarantees exist on the output. In this talk I'll talk about one such estimator for data where a bound is known on the relative variance of the output. To first order, the number of samples needed matches less reliable estimates such as those coming from Central Limit approximations.

Speaker: Henry Schellhorn

Institutes of Mathematica Sciences
710 N College Ave
Claremont Graduate University
Claremont, CA 91711
henry.schellhorn@cgu.edu

Publications

- Schellhorn, Henry, and Ran Zhao. "A String Model of Liquidity in Financial Markets." *arXiv preprint arXiv:1608.05900* (2016).
- Jin, Sixian, Qidi Peng, and Henry Schellhorn. "A representation theorem for smooth Brownian martingales." *Stochastics* 88.5 (2016): 651-679.
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Title: Free Market on the Freeway: A Trading Mechanism for Sharing Lanes

Abstract:

Self-driving cars will be part of the future of transportation. While it is difficult to forecast how self-driving cars will arrange to share lanes on a freeway, we investigate an original approach whereby cars on a slow lane may have to pay a small fee to enter a faster lane, and the deal between the two cars is made in real-time. The main mathematical problem is to determine the competitive prices in this "economy" where each good consists of a particular location (x) on a particular lane (y) at a particular time (t). To determine this price, we consider a stochastic macroscopic traffic model in two dimensions, which is an extension of the celebrated Lighthill-Whitham-Richards (LWR) model. Besides convergence of the numerical scheme, our research addresses several mathematical economics issues, like efficiency of the competitive equilibrium, and existence of a no- arbitrage price. We use an options pricing approach to solve the model. The advantage of this approach is that we do not need to make any assumption on the preferences of the drivers. We implement our model using real data from Caltrans. [collaboration with Yuan Cheng, Yashwanth Namireddy (CGU)]

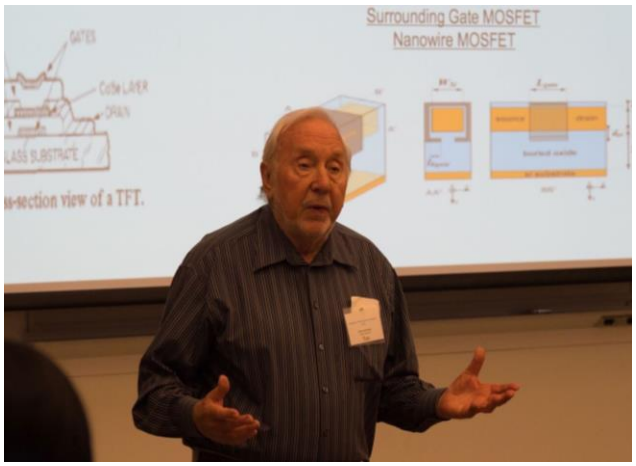
Speaker: Ellis Cumberbatch

Institutes of Mathematica Sciences
710 N College Ave
Claremont Graduate University
Claremont, CA 91711
ellis.cumberbatch@cgu.edu

Publications

- Aksoy, Asuman G., and Ellis Cumberbatch. "Uncovering GEMS of Mathematics." *Journal of Humanistic Mathematics* 7.2 (2017): 384-393.
- Cumberbatch, Ellis, and Alistair Fitt, eds. *Mathematical modeling: case studies from industry*. Cambridge University Press, 2001.

Title: Short Channel Transistor Modeling, Problems Old and New



Abstract:

After a brief description of modeling for a regular MOSFET (one gate) transistor, I shall introduce the PDE's for the double gate device. Solutions were found to the ODE's for the potentials in the central section of this device, first by the method of matched asymptotic expansions, later by finding a full set of integrals. Possible extensions to junctionless FETs, tunnel FETs and carbon nano tubes will be described. [collaboration with Stefan Llewellyn Smith (UCSD)]

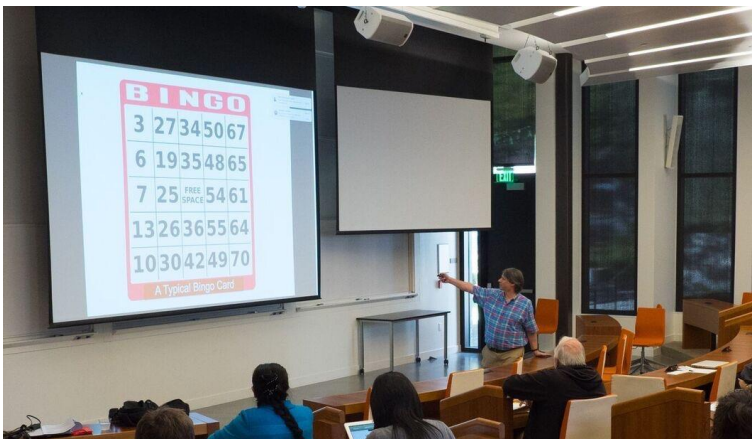
Speaker: Arthur Benjamin

Department of Mathematics
Harvey Mudd College
Claremont, CA 91711
benjamin@math.hmc.edu

Publications

- Arthur, Benjamin, et al. "Winter habitat predictions of a key Southern Ocean predator, the Antarctic fur seal (Arctocephalus gazella)." *Deep Sea Research Part II: Topical Studies in Oceanography* 140 (2017): 171-181.
- Arthur, Benjamin, et al. "Correction: Return Customers: Foraging Site Fidelity and the Effect of Environmental Variability in Wide-Ranging Antarctic Fur Seals." *PloS one* 12.6 (2017): e0179322.

Title: Bingo Paradoxes



Abstract:

Imagine you are walking past a crowded Bingo parlor with hundreds of people playing. Suddenly you hear one person excitedly call out "Bingo!". Is it more likely that they have 5 in a row or 5 in a column (or are they the same)? Or is the most probable outcome diagonal? The answers may surprise you.

Arthur, Benjamin, et al. "Winter habitat predictions of a key Southern Ocean predator, the Antarctic fur seal (Arctocephalus gazella)." *Deep Sea Research Part II: Topical Studies in Oceanography* 140 (2017): 171-181.

Speaker: Weiqing Gu

Department of Mathematics
Harvey Mudd College
Claremont, CA 91711
gu@math.hmc.edu

Publications

- de Pillis, Lisette G., Weiqing Gu, and Ami E. Radunskaya. "Mixed immunotherapy and chemotherapy of tumors: modeling, applications and biological interpretations." *Journal of theoretical biology* 238.4 (2006): 841-862.
- de Pillis, Lisette G., et al. "Chemotherapy for tumors: An analysis of the dynamics and a study of quadratic and linear optimal controls." *Mathematical Biosciences* 209.1 (2007): 292-315.

Title: Applying Differential Geometry in Big Data Analytics

Abstract:

There are big data problems everywhere in this world. Traditional statistical methods do not suffice to solve these problems. There is an urgent need for applying new and advanced mathematical techniques to extract knowledge and insights from large data and make decisions based on them.
In this talk, I will use some examples to present how to use the techniques in differential geometry especially using manifold theories for approaching big data problem. Specifically, I will focus on how to

• Visualize data
• Reduce data dimension
• Extract data features
• Define appropriate distance functions
• Identify anomalies
• Achieve data-to-decision

Speaker: Kimberly Ayers

Department of Mathematics
610 N College Ave
Pomona College
Claremont, CA 91711
kimberly.ayers@pomona.edu

Publications

- K. Ayers, J. Ackerman,"A Behavioral Characterization of Discrete Time Dynamical Systems over Directed Graphs", Qualitative theory of dynamical system. (2014)
- Kimberly Ayers, Sijing (S.J.) Shao, Emily Speranza, Thomas Rudelius, Xavier Garcia, Anthony Sanchez, "Limit and Morse Sets for Deterministic Hybrid Systems", Qualitative Theory of Dynamical Systems. (2012)

Title: A Chaotic Introduction

Abstract:

What does the word ``chaos" mean to you? Randomness? Disorder? Mayhem? What about the butterfly effect? (Not the terrible Ashton Kutcher movie.) As it turns out, chaos - mathematically speaking is not random at all, but rather exhibits interesting patterns. In this talk,we'll define chaos and the butterfly effect-mathematically. We'll go through some of the history of the discovery of chaos, and explore famous examples and theorems. We'll finally conclude with a brief discussion of some open problems in chaos theory.

Speaker: Sam Nelson

Department of Mathematics & Computer Science
Claremont McKenna
Claremont, CA 91711
sam.nelson@cmc.edu

Publications

- Nelson, Sam, and Patricia Rivera. "Bikei invariants and gauss diagrams for virtual knotted surfaces." *Journal of Knot Theory and Its Ramifications* 25.03 (2016): 1640008.
- Needell, Deanna, and Sam Nelson. "Biquasiles and dual graph diagrams." *Journal of Knot Theory and Its Ramifications* 26.08 (2017): 1750048.

Title: Biquandles and Enhancements

Abstract:

A biquandle is an algebraic structure which encodes the Reidemeister moves of Knot Theory analogously to the way group encode symmetry. In this talk we will see the biquandle axioms arise and how they are used in defining knot and link invariants.

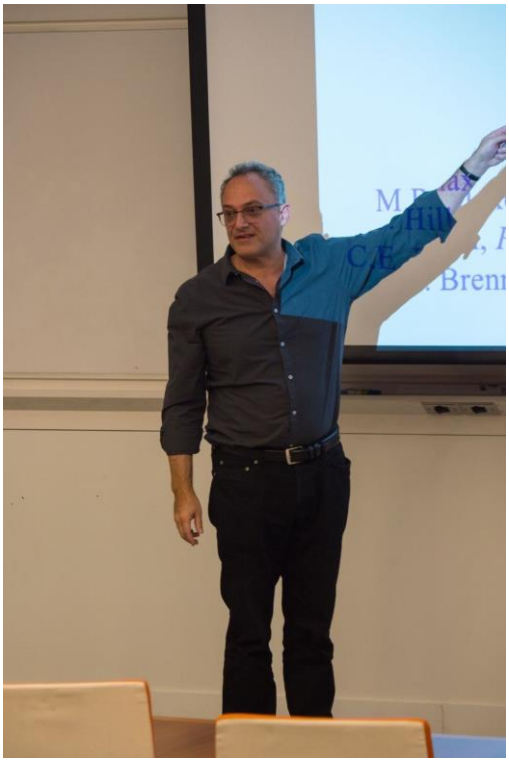
Speaker: Ali Nadim

Institutes of Mathematica Sciences
710 N College Ave
Claremont Graduate University
Claremont, CA 91711
ali.nadim@cgu.edu

Publications

- Gueyffier, Denis, et al. "Volume-of-fluid interface tracking with smoothed surface stress methods for three-dimensional flows." *Journal of Computational physics* 152.2 (1999): 423-456.
- Olufsen, Mette S., et al. "Numerical simulation and experimental validation of blood flow in arteries with structured-tree outflow conditions." *Annals of biomedical engineering* 28.11 (2000): 1281-1299.

Title: Effects of Steady and Oscillatory Rotation on Viscous Flows



Abstract:

We describe two different problems of recent interest involving viscous fluids and rotation. In the first case, we consider the trajectories of solid particles in a centrifuge but with high-frequency oscillatory rotation. By analyzing the nonlinear dynamical system that governs the trajectories, we find that in some parameter regimes dense particles may move toward the rotation axis, in contrast with ordinary centrifugation. The main effect responsible for that turns out to be the Coriolis force. In the second example, we examine a thin viscous film coating a rotating sphere. We derive and analyze the thin-film equations including the effects of gravity, surface tension and centrifugal forces and find that the film approaches an equilibrium profile that may include dry spots on top and bottom of the sphere, depending on parameter values. [The first case is joint work with Shujing Xu, and the second with Di Kang and Marina Chugunova.]

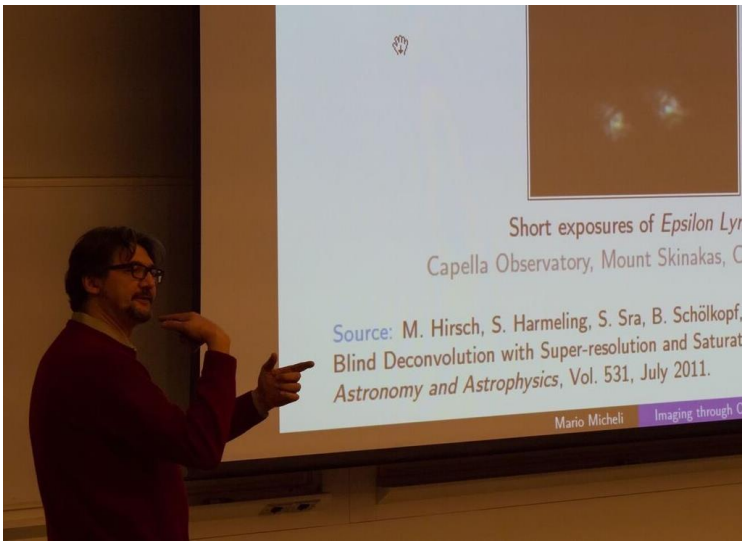
Speaker: Mario Micheli

Department of Mathematics
Harvey Mudd College
Claremont, CA 91711
micheli@math.hmc.edu

Publications

- Lari, Martina, et al. "The Neanderthal in the karst: first dating, morphometric, and paleogenetic data on the fossil skeleton from Altamura (Italy)." *Journal of human evolution* 82 (2015): 88-94.
- Micheli, Mario, et al. "A linear systems approach to imaging through turbulence." *Journal of mathematical imaging and vision* 48.1 (2014): 185-201.

Title: Imaging through Optical Turbulence



Abstract:

I this talk I will briefly introduce the phenomenon that is commonly referred to as optical "turbulence" in imaging. It is caused by the time and space-varying refraction index of the air which is due, among other factors, to temperature, air pressure, humidity, and wind conditions between the acquired scene and the image-capturing device. The resulting image sequence is also affected by the different and changing lighting conditions within the scene, by the actual distance between the observed objects and the camera, and by other artifacts introduced by the device itself. The above described distortion may be modeled, at least to a first approximation, as the combined effect of (i) a space- and time-dependent blur and (ii) a time-dependent deformation of the image domain. I will describe an algorithm for the correction of optical turbulence, as well as several open questions and directions for future research.