CLAREMONT UNIVERSITY CONSORTIUM

CLAREMONT CENTER for MATHEMATICAL SCIENCES

CLAREMONT MATHEMATICS WEEKEND

Schedule of Events

Day 1 (January 28, 2017)

8:45 – 9:15 Registration / Coffee and Snacks
9:15 – 10:30 Presentations
10:30 – 10:45 Coffee Break
10:45 – 12:15 Presentations
12:15 – 1:15 Lunch Break
1:15 – 1:45 Memories of Mario Martelli
1:45 – 2:45 Presentations
2:45 – 3:00 Coffee Break
3:00 – 4:30 Presentations
4:30 – 5:00 Wine and Cheese

Day 2 (January 29, 2017)

12:00 – 1:00 Lunch
1:00 – 4:00 Claremont Sudoku Competition

Speaker: Michael Orrison

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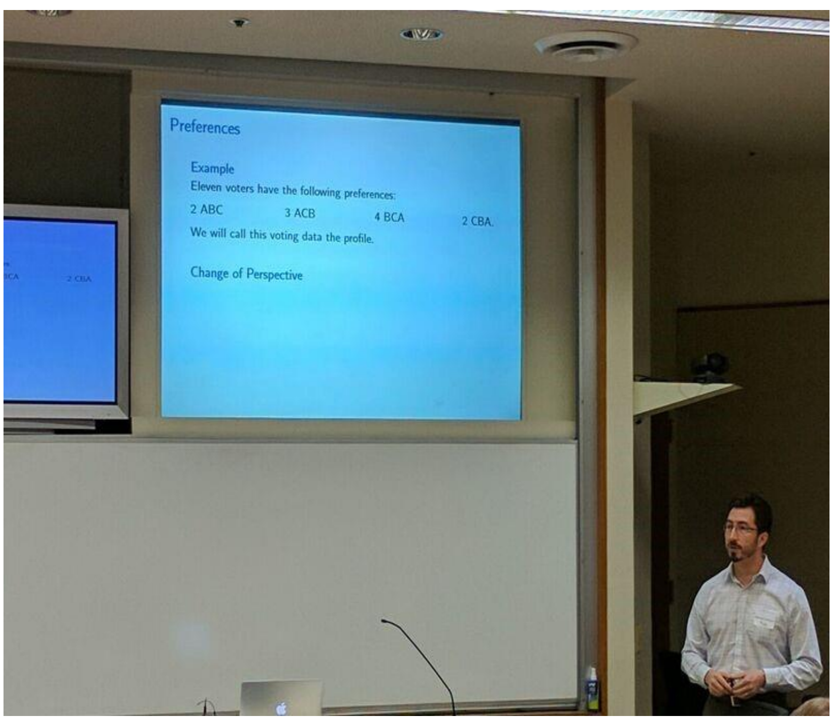
Publications

- Quantum enhancements and biquandle brackets (with S. Nelson and V. Rivera), Journal of Knot Theory and Its Ramifications 26 (2017), no. 5, 1750034 (24 pages).
- Representation theory of the symmetric group in voting theory and game theory (with K. Crisman), Contemporary Mathematics 685 (2017), 97-115.

Title: Basic Algebra of Voting



Abstract:

Voting is something we do in a variety of ways, and the mathematics behind different voting procedures can sometimes seem daunting and disconnected. In this talk, I will discuss how basic ideas from linear algebra, abstract algebra, and representation theory can be used to unify some of the foundational ideas in voting, and how such an approach to voting theory can provide an intriguing yet friendly gateway to the subject.

Speaker: Angel Chavez

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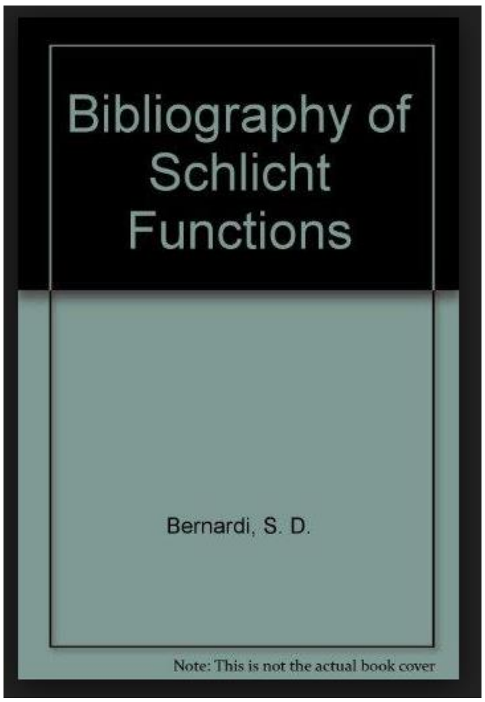
Title: How Big are the Coefficients of Schlicht Functions?



Abstract:

Louis de Branges proved Bieberbach's famous conjecture in 1985, which is a statement about the size of the Taylor coefficients for schlicht functions on the unit disk. Concretely, de Branges proved that the magnitude of the nth Taylor coefficient does not exceed n. In this talk, we'll discuss the history of the problem. In addition, we uncover some interesting techniques that are being used to understand how the sizes of the coefficients are actually distributed.

Speaker: Lenny Fukshansky

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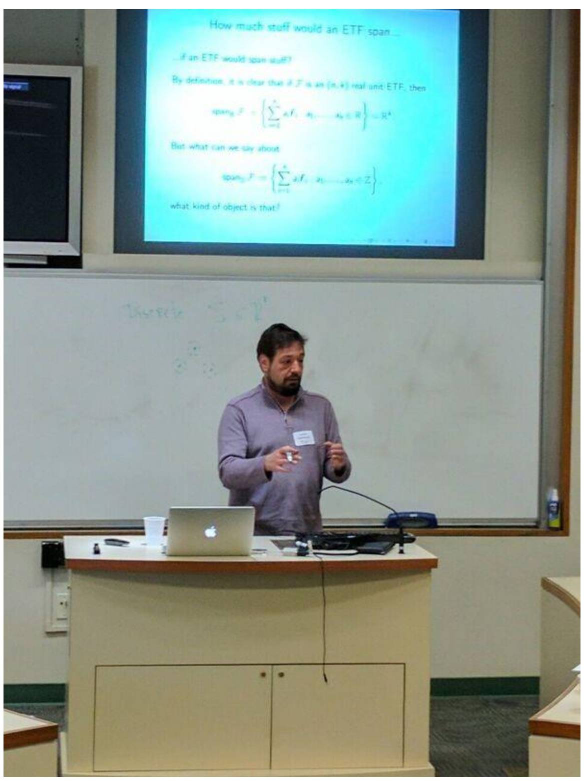
Publications

- Böttcher, Albrecht, et al. "Toeplitz determinants with perturbations in the corners." *Journal of Functional Analysis* 268.1 (2015): 171-193.
- Fukshansky, Lenny, Stephan Ramon Garcia, and Xun Sun. "Permutation invariant lattices." *Discrete Mathematics* 338.8 (2015): 1536-1541.



Title: Some arithmetic constructions with equiangular frames

Abstract:

A frame in a Euclidean space Rn is an overdetermined spanning set, satis- fying some basic conditions. Equiangular frames come from a geometric construction of maximal collections of equiangular lines. Such frames have originated in Discrete Geometry, but have also been extensively studied in Harmonic Analysis and its ap- plications: they can be viewed as generalizations of orthonormal bases for Rn, which carry additional “frequency" information, allowing for efficient recovery of erasures in data transmission over noisy channels. Trivially from the definition, the set of all real linear combinations of an equiangular frame is the entire space Rn, but what if we only take integer linear combinations – what kind of object is that? This question has a very interesting answer,

which we will discuss in this talk, starting from basic notions. This is joint work with A. Boettcher, S. R. Garcia, H. Maharaj, and D. Needell.

Speaker: Qidi Peng

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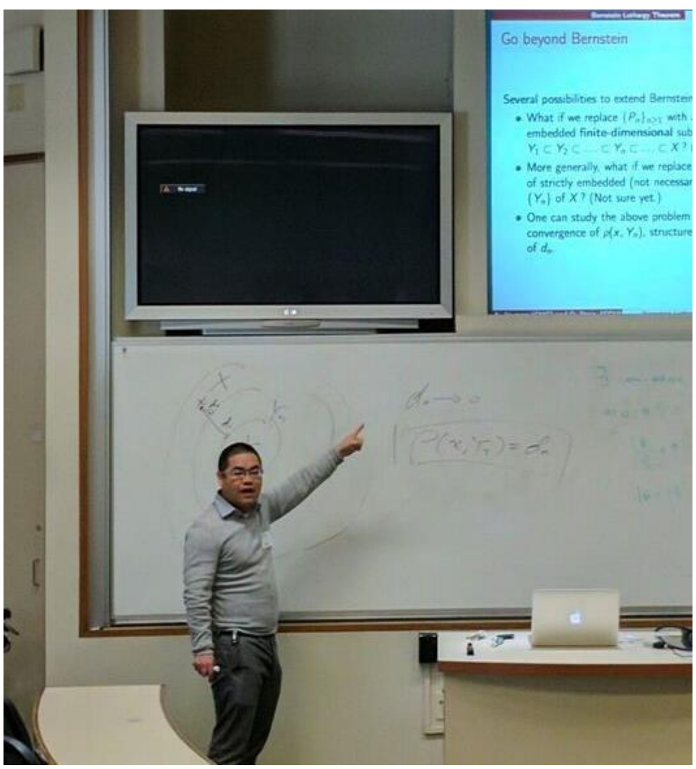
Publications

- Jin, Sixian, Qidi Peng, and Henry Schellhorn. "A representation theorem for smooth Brownian martingales." *Stochastics* 88.5 (2016): 651-679.
- Aksoy, Asuman G., and Qidi Peng. "On a theorem of SN Bernstein for Banach spaces." *arXiv preprint arXiv:1605.04592* (2016).

Title: Some improvements of a theorem of S. N. Bernstein for Banach spaces



Abstract:

We introduce some improvements on a theorem of S. N. Bernstein for Banach spaces. Let X be an arbitrary infinite-dimensional Banach space, {Yn} be a sequence of strictly embedded subspaces of X and {dn} be a non-increasing sequence of non-negative numbers tending to 0. Borodin (2006) shows that if dn converges to zero with a proper rate, then there is an element x in X such that the distance from x to Yn equals dn for each n. We prove that such rate of convergence could be improved. As a consequence, we improve Konyagin (2014)'s result under some mild subspace condition.

Speaker: Jemma Lorenat

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Publications

- Lorenat, Jemma. "Figures real, imagined, and missing in Poncelet, Plücker, and Gergonne." *Historia Mathematica* 42.2 (2015): 155-192.
- Lorenat, Jemma. "Synthetic and analytic geometries in the publications of Jakob Steiner and Julius Plücker (1827–1829)." *Archive for History of Exact Sciences* 70.4 (2016): 413-462.

Title: Solving and re-solving: the nineteenth century and the Malfatti problem

Abstract:

In 1803, Gian Francesco Malfatti posed the problem of constructing three parallel cylinders of maximal volume from a marble triangular prism. He then reduced the construction to that of inscribing three mutually tangent circles in a triangle. This apparently equivalent problem reappeared ad nauseam through the nineteenth cen- tury in mathematical journals, monographs and textbooks. The so-called Malfatti problem gained notoriety in recent decades when the accepted reduction was shown to be false–in fact; three mutually tangent circles never provide the optimal solution (Zal- galler and Los, 1992). Nevertheless, the dispersion of the Malfatti problem provides an illustrative thread through the evolution of nineteenth century geometry. From this perspective we observe developing theories, competition between geometric method- ologies, and the nationalization and internationalization of mathematical communities.

Speaker: Ami Radunskaya

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Publications

- Jackson, Trachette, and Ami Radunskaya, eds. Applications of Dynamical Systems in Biology and Medicine. Vol. 158. Springer, 2015.
- Albert, Hannah, et al. "Controlling a Cockroach Infestation." *Advances in the Mathematical Sciences*. Springer, Cham, 2016. 209-224.

Title: The Sound of Chaos

Abstract:
We are used to describing mathematics with symbols and graphs. We can also “listen” to mathematics. In this talk, I’ll give some examples of mathematical tunes, and illustrate the sonic path from pattern to chaos using one of my favorite families of functions. Beprepared to participate! (No prior musical experience required.)

Speaker: Chiu-Yen Kao

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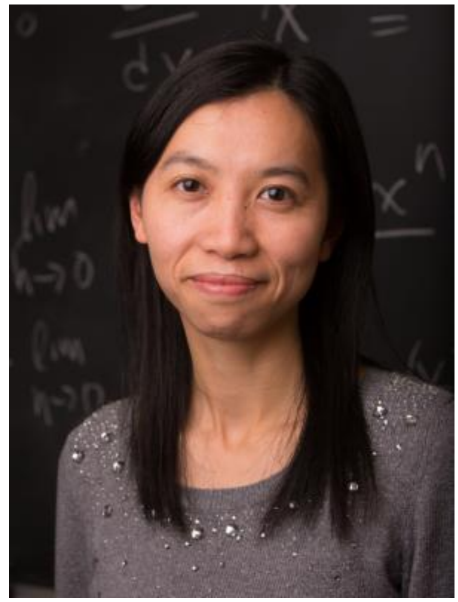
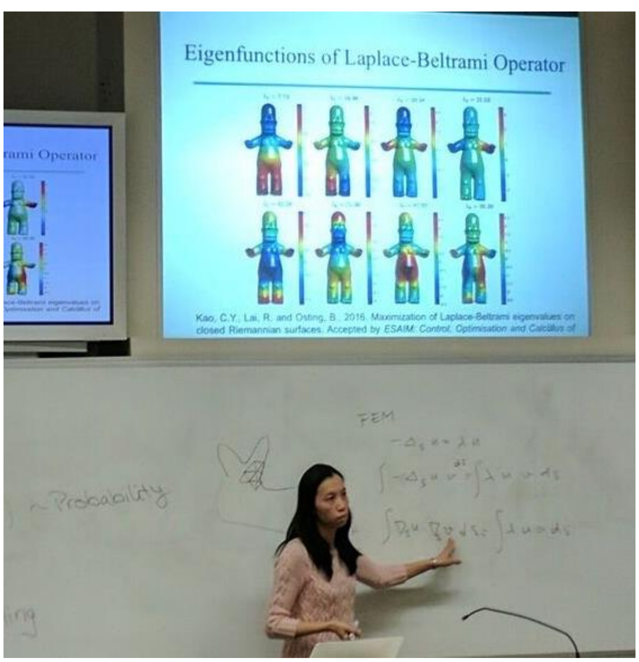


Publications

- “Lax-Friedrichs Multigrid Fast Sweeping Methods for Steady State Problems for Hyperbolic Conservation Laws” by Weitao Chen, Ching-Shan Chou, and Chiu-Yen Kao, Journal of Scientific Computing, 64(3), pages 591-618, 2015
- CY Kao, CW Shih, CH Wu . “Absolute stability and synchronization in neural field models with transmission delays.” Physica D: Nonlinear Phenomena 328, 21-33

Title: Recent Numerical Methods for Solving Partial Differential Equations (PDEs) on Surfaces



Abstract:

Solving PDEs on surfaces or more general manifolds has far-reaching applications. Examples of such application areas arise in fluid dynamics, population dynamics, image sciences, and computer vision. In this talk, we will discuss several approaches including parameterization, meshing and embedding techniques. In par- ticular we will focus on recent developments on closest point methods and radial basis function approaches.

Speaker: Blerta Shtylla

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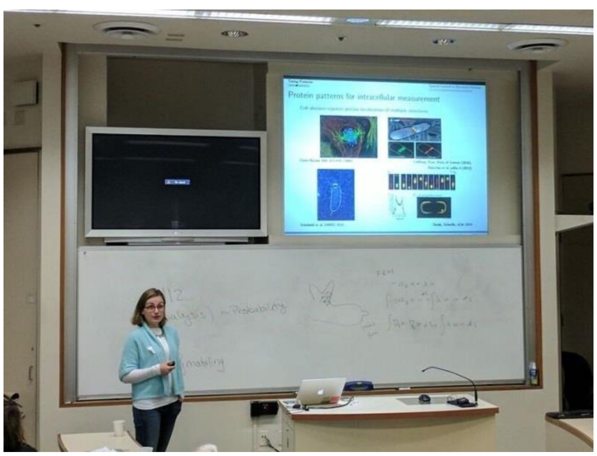
Publications

- Xue, Chuan, Blerta Shtylla, and Anthony Brown. "A stochastic multiscale model that explains the segregation of axonal microtubules and neurofilaments in neurological diseases." *PLoS computational biology* 11.8 (2015): e1004406.
- Waldrop, Lindsay D., et al. "Using active learning to teach concepts and methods in quantitative biology." *Integrative and comparative biology* 55.5 (2015): 933-948.

Title: Spatiotemporal protein patterns: The mathematics of cell division



Abstract:

Cell division is a highly dynamic stage of the cell cycle that requires both precise duplication of the cellular components as well as careful transport of the du- plicated material to each daughter cell. Cells have to solve both a mechanical problem arising from the need to move replicated components to specific cell locations, and a timing and accuracy problem which is rooted in the need to make sure that the genetic material is correctly duplicated and that these processes progress within a well-defined time-span. These two problems are resolved in elegant ways across different cell types through the use of sophisticated nano-machines and biochemical reactions. We give an overview of mathematical modeling that describes mechanisms by which cells not only move components but also control their positioning and timing so as to generate well defined protein patters that can then be used as spatial cues for division. We will cover some classical mathematical work on pattern formation and compare with our recent work applied to dividing bacterial cells. No biology background is necessary.

Speaker: Hrushikesh Mhaskar

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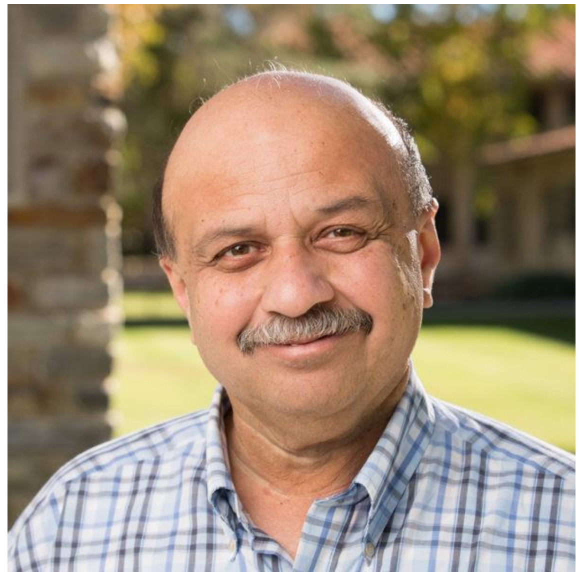
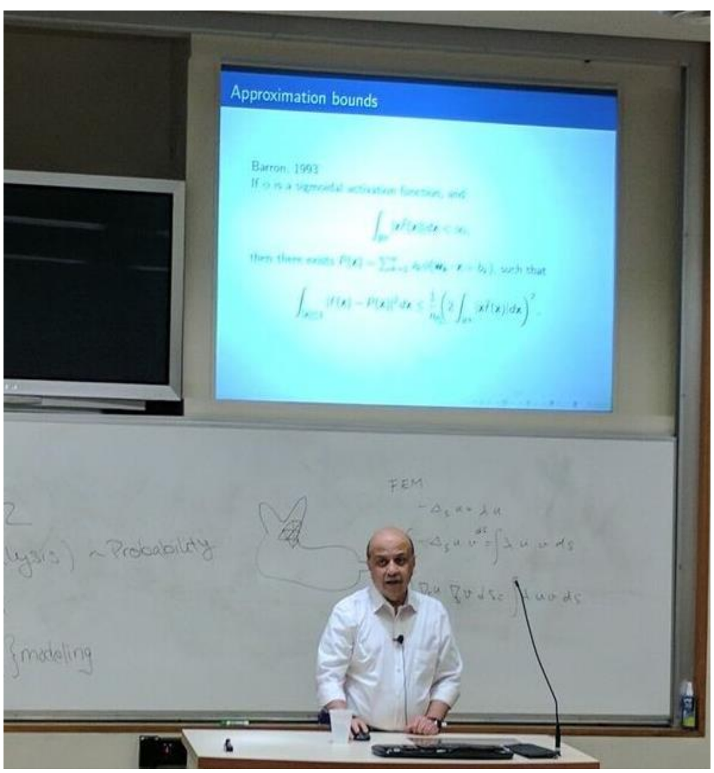


Publications

- Mhaskar, Hrushikesh, Qianli Liao, and Tomaso Poggio. "Learning functions: when is deep better than shallow." *arXiv preprint arXiv:1603.00988* (2016).
- Mhaskar, Hrushikesh N., and Tomaso Poggio. "Deep vs. shallow networks: An approximation theory perspective." *Analysis and Applications* 14.06 (2016): 829-848.

Title: Deep vs. shallow networks: an approximation theory perspective



Abstract:

We compare shallow and deep networks from the point of view of their approximation capabilities. It is argued that deep networks are better able to take advantage of inherent compositional structure of the target function so as to overcome the so called curse of dimensionality. We will review some old results in the case of shallow networks, and present some new ones in the case of deep networks to illustrate this thesis.

Speaker: Adolfo Rumbos

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Publications

- Recôva, Leandro, and Adolfo Rumbos. "An asymmetric superlinear elliptic problem at resonance." *Nonlinear Analysis: Theory, Methods & Applications* 112 (2015): 181-198.

Title: Stories about maxima, minima and minimaxes

Abstract:

In this talk we discuss a few principles from critical point theory and present some applications to the theory of differential equations. In particular, we see how variational principles can be used to establish existence and multiplicity of solutions for certain boundary value problems.