

Graduate Student Talks

ALGEBRA

Elizabeth Field (University of Illinois at Urbana-Champaign)
Trees, dendrites, and the Cannon-Thurston map

Abstract: When the inclusion of a hyperbolic subgroup into a hyperbolic group extends to a continuous map between their Gromov boundaries, this boundary map is called the Cannon-Thurston map. Given a short exact sequence of hyperbolic groups, $1 \rightarrow H \rightarrow G \rightarrow Q \rightarrow 1$, Mahan Mitra has shown that the Cannon-Thurston map exists from the boundary of H to the boundary of G . To every point z in the Gromov boundary of Q , Mitra associates an “ending lamination” on H consisting of certain pairs of points in the boundary of H identified by the Cannon-Thurston map. We prove that for each such z , the quotient of the boundary of H by the equivalence relation generated by this ending lamination is a dendrite: a tree-like topological space.

ANALYSIS+PDE

Jeungeun Park (The University of Iowa)
Title: Traveling wave solutions of nonlinear conservation laws for image processing

Abstract: In this talk, nonlinear advection-diffusion equations, previously designed for image denoising and edge detection, are introduced. Each of the equations combines Burgers’ convection with a nonlinear diffusion, and one of the equations was proposed by Perona and Malik. Particularly, this talk focuses on the Perona and Malik type equations by considering more general diffusion and convection terms. We investigate the existence of traveling wave solutions to the general Perona and Malik type equations. Also we establish the nonlinear stability of traveling waves.

Mary Vaughan (Iowa State University)
Fractional derivatives in one-sided weighted Sobolev spaces

Abstract: Fractional derivatives can be defined in the most general way in the distributional sense. We start from this point and then show that the Marchaud point-wise formulas for these operators indeed hold for functions in more general classes. The classes we consider are weighted Sobolev spaces with one-sided Sawyer weights. These classes capture the one-sided nature of fractional derivatives. The point-wise and norm limits as the orders of the derivatives converge to an integer are also analyzed.

FUNCTIONAL ANALYSIS

Dorsa Ghoreishi (University of Indiana at Bloomington)
Weak Phase retrieval and Phaseless reconstruction;

Abstract: Phase retrieval and phaseless reconstruction for Hilbert space frames is a very active area of research. Recently, it was shown that these concepts are equivalent. In this paper, we make a detailed study of a weakening of these concepts to weak phase retrieval and weak phaseless reconstruction. We will give several necessary and/or sufficient conditions for frames to have these weak properties. We will prove three surprising results: (1) Weak phaseless reconstruction is

equivalent to phaseless reconstruction. I.e. It never was weak; (2) Weak phase retrieval is not equivalent to weak phaseless reconstruction; (3) Weak phase retrieval requires at least $2m - 2$ vectors in an m -dimensional Hilbert space. We also gives several examples illustrating the relationship between these concepts.

Cong Zhou(University of Indiana at Bloomington)
Hinčin's Theorem for non-tracial R -diagonals

Abstract: Hinčin proved that any limit law, associated with a triangular array of infinitesimal random variables, is infinitely divisible. The analogous result for additive free convolutions of tracial R -diagonal $*$ -distributions was proved. We prove the corresponding result for additive free convolutions of nontracial R -diagonal $*$ -distributions.

GEOMETRY+TOPLOGY

Eylem Zeliha Yildiz (Michigan State University)
There exist absolutely exotic compact contractible Stein 4-manifold pair.

Abstract: During this short presentation I will give a brief description of constructing Akbulut-Ruberman type of exotic 4-manifolds and using their technics we will construct an absolutely exotic compact contractible Stein 4-manifold pair. Joint work with Selman Akbulut.

Xinghua Gao (University of Illinois Urbana-Champaign)
Orderability of Dehn Fillings

Abstract: Boyer, Gordon, and Watson conjectured that an irreducible rational homology 3-sphere is not an L-space if and only if its fundamental group is left-orderable. In this talk, I will show how to prove left-orderability of a fundamental group by constructing $\widetilde{PSL_2\mathbb{R}}$ representations.

MATH BIO

Anh Nguyen (University of Iowa)
Perceptual Alternation in Auditory Streaming as An Evidence Accumulation Process

Abstract: The auditory system plays a critical role in human life, providing us useful information about the surroundings. The sound waves entering our ears are composed into frequency components by the cochlear nucleus and then transduced into electrical signals by hair cells in the inner ear. The information is then sent to numerous destinations in the brain including the cortex, where the information is further processed and integrated with inputs from other sensory systems. Although the initial representations of sound in the early stage such as cochlear nucleus is well understood, little is known about later stage processing such as perceptual organization or formation of auditory objects. This functionality enables us to sort the mixture of sounds from different sources into specific acoustic information, a process called auditory scene analysis. During my Ph.D., I work on a project to investigate how acoustic events are grouped over time to form internal mental representations of sound streams. A set of stimuli that has been used intensively in behavioral experiments consists of sequences of alternating high (A) and low (B) pure tones presented as repeated triplets, ABA_ ABA_... Depending on the frequency separation (df) between the two tones, subjects report either of two percepts: “integration” (a single, coherent stream of

high and low tones) and “segregation” (two parallel distinct streams). We propose a model that implements evidence accumulation over time at the readout of the signal-detection component to reproduce experimental results. Our model provides insights into the dynamical mechanisms of perceptual switching and the role of A1 in percept formation.

Polly Yu (University of Wisconsin at Madison)
Stability of Mass Action Systems with Delays

Abstract: One of the simplest models for biological systems is mass action kinetics. These coupled systems of nonlinear ODEs are derived by assuming that interactions happen instantaneously. Some mechanism takes time to complete, e.g. the formation of double stranded DNA. Then the system might be better modelled by a system of delay differential equations (DDEs). In general, a steady state of the ODE system may lose its stability when delay terms are introduced. We give an algebraic condition on the reaction network that guarantees the asymptotic stability of steady states, for any rate constants and delay parameters. In particular, it can be shown that DNA duplex formation (by the nucleation-propagation mechanism) has a unique locally stable steady state, independent of rate constants and delay parameters. (Joint work with Gheorghe Craciun, Maya Mincheva, Casian Pantea.)