GSPP 2019 - Abstracts and Schedule

Bounded remainder sets for rotations on compact groups

Akshat Das

1:15 - 1:30pm

Bounded remainder sets for a dynamical system are sets for which the Birkhoff averages of return times differ from the expected values by at most a constant amount. These sets are rare and important objects which have been studied, especially in the context of Diophantine approximation, for over 100 years. In the last few years, there have been a number of results which have culminated in explicit constructions of bounded remainder sets for toral rotations in any dimension, of all possible allowable volumes. In this talk, we are going to give a survey of these results, the recent constructions of bounded remainder sets for rotations on the adelic torus by Alan Haynes, Joanna Furno and Henna Koivusalo, and finally give a brief description of the construction of bounded remainder sets for rotations on the adelic torus in any dimension. Our results combine ideas from harmonic analysis, dynamical systems, and the theory of mathematical quasicrystals. This is joint work with Joanna Furno and Alan Haynes.

One-bit phase retrieval via random half-dimensioned projections

Dylan Domel-White

1:30 - 1:45pm

Phase retrieval is the general problem of recovering (up to a unimodular constant) a vector $x \in \mathbb{F}^n$ from so-called phaseless measurements of the form $x \mapsto \|Px\|^2$, where P is an orthogonal projection. As a variant of this problem, we consider the setting where only one bit of information is retained from each phaseless measurement, namely whether it is above or below some threshold. In this talk, I will give an outline of some of my work with Dr. Bodmann on this subject, specifically when the one-bit measurements come from random projections P of rank equal to half the ambient dimension.

The pattern of you

Prajakta Bedekar

1:45 - 2:00pm

Reaction-diffusion equations help model pattern formation through interactions of very few chemicals. We will look at examples for these systems and how they help model some patterns observed in nature, such as the folds on the brain, and the layers of cells in the embryo.

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15 Minute Break

2:00 - 2:15pm

A kinetic theory approach to pedestrian motion

Daewa Kim

2:15 - 2:30pm

We consider a kinetic theory approach to model the evacuation of a crowd from bounded domains. Pedestrians modify their walking direction by considering four factors: (1) the goal to reach the exit, (2) the desire to avoid collision with walls, (3) the search for less congested areas, and (4) the tendency to follow the stream unconsciously in a panic situation. Also, we introduce a particular crowd model know as ASCRIBE that has the interesting property of tracking the level of contagion. By combining these two models, we consider the coupled model of the one-dimension kinetic pedestrian model with the disease contagion model.

Distributed ensemble Kalman filter in numerical weather prediction

Kayla Bicol

2:30 - 2:45pm

In order to accurately forecast the weather, meteorologists rely on numerical weather prediction (NWP) that involves mathematical modeling and using real-time observational data of the atmosphere. In particular, Data Assimilation is a statistical procedure used in NWP that combines observations with an atmospheric state estimate from a model which will be used to generate the initial condition of the next model run. This introductory talk will present how the Kalman Filter accomplishes the goal of assimilating data into the model run initial condition, and then there will be details about a project conducted at the Naval Research Laboratory in Summer 2018.

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15 Minute Break

2:45 - 3:00pm

Optimizing sequential decisions in the drift-diffusion model

Khanh Nguyen

3:00 - 3:15pm

To survive, organisms must constantly learn about and adapt to their changing environment. Some changes are outside of an animal's control, while others are the direct result of their actions. Binary choice tasks have been used extensively to identify strategies humans and animals use to make decisions. Experiments demonstrated that subjects can learn the latent probabilistic structure of their environment, improving decision performance. We show how optimal observers account for the probability that the correct choice on adjacent trials is correlated by using a prior belief on each trial that depends on their previous choice. This is akin to what has been observed experimentally, although previous modeling work has been heuristic, or has not focused on within-trial evidence accumulation.

Should we cheer or should we riot?
Decision making in transparent groups

Megan Stickler

3:15 - 3:30pm

The scene is familiar from movies - a tense, expectant silence covers the crowd. The plan just proposed by their charismatic leader is daring - and desperate. Eyes furtively meet eyes and exchange the question: Should we cheer, or should we riot? In transparent groups where all members can observe each others' reactions, the first response can have a disproportionate effect on the entire group's decision-making process. This talk discusses a model for exploring that effect and how it evolves when varying the number of group members, and when varying the group's level of impulsiveness.

Synaptic plasticity in correlated balanced networks

Alan Akil

3:30 - 3:45pm

Neurons in the cortex exhibit temporally irregular, but correlated spiking during ongoing sensory experiences. It is still unclear what mechanisms drive the emergence of global activity patterns, while supporting local fluctuations. Models that exhibit an emergent balance between excitation and inhibition produce responses remarkably similar to those in the cortex, but in their original version, they lead to asynchronous states. Recently, mechanisms supporting correlated activity have been proposed. Yet no theories about how this activity is maintained and shaped by changes in synaptic weights exist. How do emergent patterns in correlated activity drive changes in synaptic architecture, and how do these changes, in turn, shape the activity of the network? Could changes in synaptic architecture self-amplify, and drive the network out of balance? To answer these questions, we develop a general theory of plasticity in correlated balanced networks. We show that balance is attained and maintained both in asynchronous and correlated states. We find that correlated activity drive significant changes in the synaptic connectivity and firing rates under an inhibitory plasticity rule. However, for excitatory-to-excitatory plasticity rules, correlations do not impact weights and firing rates. Our general framework allows us to determine under which conditions correlated activity drives changes in synaptic connectivity, which in turn, shape activity patterns in balanced networks.

Calculate and announce winners!

3:45 - 4:00pm