Farmingdale State College
State University of New York

Department of Mathematics

Conference Program

MATHEMATICS OF SIGNALS

September 23, 2016
Location: Campus Center Ballroom
Registration is free, R.S.V.P. to irina.neymotin@farmingdale.edu

The Sound of Topology: Bach canons as 2-dimensional surfaces
A musical score is also a 2-dimensional continuum, with a time dimension running horizontally, and pitch represented vertically. In this perspective, musical symmetries (inversion, repetition with or without change of pitch, augmentation, etc.) correspond to geometrical symmetries of a surface. When part of the musical score can be repeated ad lib., as is the case with a canon, that part is essentially a cylinder; then making geometrical identifications dictated by the musical symmetry can lead to interesting topologies. In particular some of J. S. Bach's canons from BWV 1087 produce Möbius strips, and Canon 5 from The Musical Offering corresponds to a torus.

Anthony Phillips
Professor of Mathematics, SUNY at Stony Brook.
Ph.D., Princeton University
Research Interests: Topology, Applications to Mathematical Physics

Nonlinear Filtering using Sparse Signal Models
The theory and practice of linear filters is well established; however, nonlinear filters often outperform linear filters. An effective and systematic approach to nonlinear filtering is based on sparse signal models, wherein the signal (i.e., time series) is modeled as having a sparse representation. This approach relies on the formulation of suitable non-smooth optimization problems, and its implementation relies on efficient optimization algorithms. This talk describes sparsity-based filtering and several applications, including: noise reduction for speech and ECG, engine fault detection, radar interference suppression, and the filling-in of missing data.

Ivan Selesnick
Professor of Electrical and Computer Engineering,
NYU.
Ph.D., Rice University
Research interests: digital signal processing, sparsity in signal processing, wavelet-based signal/image/video processing.

Graphical methods for visualizing the temporal dynamics of birdsong learning
Juvenile songbirds acquire their songs by imitating songs of adult birds in their social group. It takes them about two months, and hundreds of thousands of repetitions. Recording all those sounds is now possible, providing a complete documentation of the learning process, but it presents a daunting challenge: how to look at all those data? What sort of descriptive model is likely to capture the complex temporal dynamics and shed light on the underlying computational process? This talk will present graphical methods we developed for visualizing song development and discuss the process of revealing mechanisms of vocal learning.

Ofer Tchernichovski
Professor of Psychology, Hunter College, CUNY.
Ph.D., Tel Aviv University
Research interests: using songbirds to study devices of vocal learning.

Detection of Sleep Spindles in EEG
This talk focusses on a problem in computational neuroscience – the detection of sleep spindles and K-complexes. Sleep spindles and K-complexes aid in classifying stage 2 NREM of human sleep EEG. It is believed that sleep spindles play an important role in memory consolidation during sleep and synaptic plasticity. Traditionally, these transient wave-forms are identified manually by trained experts in sleep clinics; a process which is subjective and time-consuming. This talk will present an automated algorithm for detecting sleep spindles and K-complexes simultaneously and its use in the understanding the pathogenesis of Alzheimer's disease.

Ankit Parech
Instructor of Mathematics,
NYU.
Ph.D., NYU.
Research interests: sparse signal processing, convex and non-convex optimization, computational neuroscience.

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