ACMS Statistics Seminar

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Tuesday, October 1

154 Hurley Hall

3:30– 4:30 PM

Invariant Data Representations with Multiscale Mathematical Models for ConvNets

Convolutional neural networks (ConvNets) have revolutionized our approach to learning tasks for high dimensional signal data by processing a signal through a cascade of learned convolution operators and nonlinear operations, which successively extract information from the signal that can be used for downstream tasks such as classification or regression. Motivated by the successes of ConvNets, in this talk I will introduce the wavelet scattering transform, which can be viewed as a simplified mathematical model for them. This transform replaces the learned filters of ConvNets with predefined wavelets, which are multiscale, oscillating waveforms with zero average, and computes a cascade of alternating wavelet transforms and nonlinear operators. Unlike ConvNets, which are task driven, a scattering transform is motivated by invariance and stability properties inherent in the data. Here we will focus on problems at the interface of invariant representation learning and statistics, such as texture classification and synthesis, parameter estimation of random processes, energy prediction of amorphous solids, and multi-reference alignment inverse problems. We will show that invariant data measurements derived from the wavelet scattering transform can be a useful tool in tackling these problems.

The Department of Applied and Computational Mathematics and Statistics

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