

# Department of Applied and Computational Mathematics and Statistics Colloquium



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## *An Integration of Deep Neural Networks and Deep Hierarchical Dynamic Statistical Models for Parsimonious Spatio-Temporal Forecasting*

Spatio-temporal data are ubiquitous in the sciences and engineering, and their study is important for understanding and predicting a wide variety of processes. One of the difficulties with statistical modeling of spatial processes that change in time is the complexity of the dependence structures that must describe how such a process varies, and the presence of high-dimensional complex datasets and large prediction domains. It is particularly challenging to specify parameterizations for nonlinear dynamic spatio-temporal models (DSTMs) that are simultaneously useful scientifically and efficient computationally. Statisticians have developed multi-level (deep) hierarchical models that can accommodate process complexity as well as the uncertainties in the predictions and inference. However, these models can be expensive and are typically application specific. On the other hand, the machine learning community has developed alternative “deep learning” approaches for nonlinear spatio-temporal modeling. These models are flexible yet are typically not implemented in a probabilistic framework. The two paradigms have many things in common and suggest hybrid approaches that can benefit from elements of each framework. This talk presents a brief introduction to the multi-level (deep) hierarchical DSTM (H-DSTM) framework, and deep models in machine learning, culminating with the deep neural DSTM (DN-DSTM). Particular focus will be on recent statistical approaches that combine elements from H-DSTMs and echo state network DN-DSTMs that are very parsimonious, computationally efficient and provide effective solutions for long-lead forecasting problems in environmental statistics.

**Monday, April 8, 2019**  
**4:15 PM – 5:15 PM**  
**127 Hayes-Healy Center**

Colloquium Tea 3:45 PM to 4:15 PM 101A Crowley Commons Room