Operator-valued Kernel based Vector Autoregressive Models for Gene Regulatory Network Inference

Type of talk

PhD seminar

Speaker

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Abstract

Reverse-modeling of dynamical systems from time-course data still remains a challenging and canonical problem in knowledge discovery. For this learning task, a number of approaches primarily based on sparse linear models or Granger causality have been proposed in the literature. However when the dynamics are nonlinear, there does not exist a systematic answer that takes into account the nature of the underlying system. We introduce a novel family of vector autoregressive models based on a new operator-valued kernel to identify the dynamical system and retrieve the target network. As in the linear case, a key issue is to control the model's sparsity. This control is performed through the joint learning of the structure of the kernel and the basis vectors. To solve this learning task, we propose an alternating optimization algorithm based on proximal gradient procedures that learn both the structure of the kernel and the basis vectors. Results on the DREAM3 competition gene regulatory benchmark networks of size 10 and 100 show the new model outperforms existing methods. Another application of the model on climate data identifies interesting and interpretable interactions between natural and human activity factors thus confirming the ability of the learning scheme to retrieve dependencies between state-variables.

Reference

Lim, Néhémy, et al. "Operator-valued Kernel-based Vector Autoregressive Models for Network Inference." (2013).