Learning the Koopman Operator for Dynamic Simulations

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Recent work in the study of dynamic systems has focussed on data driven decomposition techniques that approximate the action of the Koopman operator on observable functions of the underlying phenomena. In particular, the data driven method of dynamic mode decomposition (DMD) has been explored, with multiple variants of the algorithm in existence, including extended DMD, DMD in reproducing kernel Hilbert spaces, a Bayesian framework, a variant for stochastic dynamical systems, and a variant that uses deep neural networks. Additionally, there has been work in classifying dynamical systems through kernel methods, as well as a supervised variant of the DMD algorithm. The goal in this talk is to briefly summarize the existing work on data driven learning of Koopman operator models, and then demonstrate model accuracy vs speed tradeoffs with examples drawn from biomedical cardiac magnetic resonance imaging or video, and simulations of a single ejector combustion process. I shall highlight accelerated variants of the machine learning algorithms, as well as directions for potential future work.