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ADVANCED SYSTEMS ENGINEERING

SEMINAR SERIES

Data Driven Koopman Operator Theoretic Framework for Nonlinear System and Control Applications

Complexity of modern day systems pose a significant challenge to existing techniques for model identification, estimation and controller design when the system is nonlinear, high-dimensional and for which physics based governing equations are not readily available. This talk will describe a data driven Koopman operator theoretic framework whereby one can cross-fertilize ideas from dynamical systems, control theory and machine learning in order to address such challenges by characterizing the system solely from measurement data.

Koopman operator is a linear but an infinite-dimensional operator that governs the time evolution of measurement functions or outputs defined on the state space of any dynamical system. By exploiting the spectral properties of Koopman operator, we develop a new theoretical and computational framework to transform a nonlinear system into a “simpler” form such as linear time invariant, bilinear or a Lipchitz system, and thereby facilitate nonlinear analysis and design. This framework can be implemented in a model free fashion, is amenable to scalable/streaming computations, and readily complements/combines with control and machine learning methodologies. We demonstrate our data driven framework in a variety of aerospace and building applications involving problems related to nonlinear estimation, sensor selection, fault detection and isolation, and nonlinear time series analysis.

Amit Surana

Amit Surana received his Bachelor’s degree in Mechanical Engineering from Indian Institute of Technology Bombay in 2000, his M.S. in Mechanical Engineering and M.A. in Mathematics both from Pennsylvania State University in 2002 and 2003, respectively, and his PhD in Mechanical Engineering from Massachusetts Institute of Technology (MIT) in 2007. He was awarded the Padmakar P. Lele Outstanding Research and Thesis award at MIT for his PhD thesis work on nonlinear dynamics of three dimensional unsteady fluid flow separation.

Since 2007 he has served in various roles of increasing responsibility at United Technologies Research Center (UTRC), where he is now a Principal Research Scientist. During 2007-2009 at UTRC, he worked on problems related to model reduction, estimation and control in distributed parameter systems, uncertainty quantification in large scale dynamic networks, and sensor network control and coordination. His work on scalable uncertainty quantification received the 2015 Technical Excellence Award, the highest individual award at UTRC for contribution to Science & Engineering. Since 2010 he has been serving as a principal investigator of projects in the areas of collaborative robotics with emphasis on human machine teaming, and data analytics with an interdisciplinary approach combining techniques from dynamical systems, control theory and machine learning. He has published 16 journal publications, 38 peer reviewed conference publications and has filed 4 patent applications.

Monday, October 3rd, 2016

1:00pm - 2:00pm

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