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Koopman Operator Techniques in Data-Driven Power Systems Technology

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Abstract:
Many methods for assessment and enhancement of power system dynamic performances such as stability have been developed. The traditional methods are mainly model-based, that is, using a mathematical model that represents the target dynamic performances of a power system. In contrast to the model-based approach, it is of practical importance to develop methods that indicate and actuate spatio-temporal features of dynamic performance from measured data. In fact, SCADA system continuously collect information on the system's state, and recent advance of real-time PMUs offers an advanced data collection method. In this talk, I will outline our efforts to develop data-driven methodology and tools for assessment and enhancement of power system dynamic performances. The development is based on the so-called Koopman operator---a linear, infinite-dimensional operator that is defined for arbitrary nonlinear dynamical systems and contain full information of the nonlinear systems. Modes derived through point spectrum of the Koopman operator, referred to as Koopman Modes (KMs), provide a nonlinear extension of linear oscillatory modes. First, I will show an approach to stability assessment by applying the KM analysis to measured physical power flow data. Second, I will present a technique for identification of coherent swings and machines based on the KM analysis. Third, if time is permitted, we will discuss a data-driven model predictive control of power system nonlinear dynamics based on the Koopman operator. Throughout this talk, I will describe how the Koopman operator formalism is crucial to our data-centric development in power system analysis and control.

Bio:

Prof Susuki received his Ph.D. degree in engineering from Kyoto University, Kyoto, Japan, in 2005. In 2005-2016, he was the faculty at the Department of Electrical Engineering at Kyoto University, Japan. In 2016 he joined the Department of Electrical and Information Systems at Osaka Prefecture University, where he is currently an Associate Professor. In 2008-2010, he was a Visiting Research Fellow at the Department of Mechanical Engineering, University of California, Santa Barbara, under JSPS Postdoctoral Fellowship for Research Abroad. His research interests are in applied nonlinear dynamics, power and energy systems technology, and control applications. He is a member of IEEE, SIAM, and several other technical societies.

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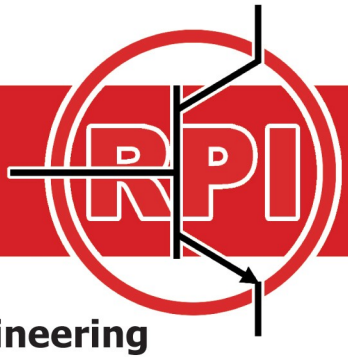

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