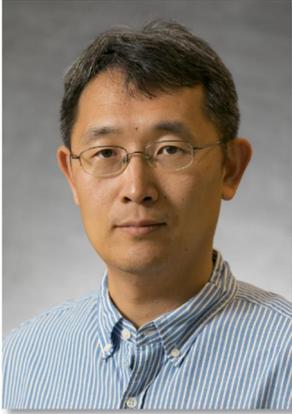


# The 38<sup>th</sup> Chinese Control Conference

## Pre-conference Workshop 1

### Control and Optimization for Networked Systems



**Speaker:** Kai Sun, the University of Tennessee, USA

**Title:** Nonlinear Modal Decoupling: a new paradigm of stability analysis and control for power systems and other multi-oscillator systems

**Abstract:** Anharmonic oscillations or vibrations are general phenomena of real-life dynamical systems such as power grids, mechanical systems and biological systems. Such systems can be modeled as large multi-oscillator systems and their global stabilities and behaviors away from equilibria are fundamentally difficult to analyze. For nonlinear multi-oscillator systems, we propose a new methodology named Nonlinear Modal Decoupling (NMD) that inversely constructs as many decoupled nonlinear oscillators as the system's oscillation modes of interests. These decoupled oscillators together provide a fairly accurate representation of the original system's behaviors within an extended region about the equilibrium under small and large disturbances. Every individual decoupled oscillator has only one degree of freedom and hence can easily be analyzed as a two-body problem, yet inferring dynamics and stability of the original system associate with the corresponding mode. This talk will present the NMD methodology in detail and use multi-generator power systems as examples to demonstrate NMD-based stability analysis and control. This new methodology can also be applied to nonlinear, multi-oscillator systems from other fields.

**Biography:** Kai Sun is an Associate Professor with the Department of Electrical Engineering and Computer Science in the University of Tennessee, Knoxville (UTK). He is also a member with the NSF/DOE Engineering Research Center for Ultra-Wide-Area-Resilient Electric Energy Transmission Networks (CURENT). He received his Bachelor's Degree in automation in 1999 and his Ph.D. degree in control science and engineering in 2004 both from Tsinghua University in Beijing. Before joining UTK, Dr. Sun was a project manager with the Electric Power Research Institute (EPRI) in Palo Alto, California from 2007 to 2012 for R&D programs in the area of grid operations, planning and renewable integration. Earlier, he worked as a research associate at Arizona State University in Tempe and a postdoctoral fellow at the University of Western Ontario in Canada. Dr. Sun is currently an editor of IEEE Transactions on Smart Grid, an associate editor of IEEE Access and an associate editor of IET Generation, Transmission and Distribution. He received the "Best 100 Ph.D. Dissertations of China" Award in 2006 from the Ministry of Education of China, EPRI Technology Innovation Excellence Award in 2008, EPRI Chauncey Award (the highest honor) in 2009, and NSF CAREER Award in 2016 and CRSTT Most Valuable Players Award by DOE/NASPI in 2016. His research areas include power system dynamics, stability and control and dynamics of complex networked systems.