Design Engineering has entered the Big Data era, where 90% of the world’s data has been generated in merely the last three years. Such availability of large-scale and diverse data is creating great opportunities as well as critical challenges for the design and analysis of complex engineered systems, i.e., power & energy systems. This seminar will present big data analytics in complex energy systems based on large penetrations of renewable energy and energy efficiency technologies. Variable renewable energy resources such as wind and solar power are becoming increasingly important sources of energy on the electric power system. The consistent growth of renewable energy calls for a paradigm shift in energy systems technologies. To address challenges in complex energy systems, the following methodologies were developed: (i) a comprehensive data-driven wind resource assessment framework for wind condition modeling and uncertainty quantification; (ii) an Unrestricted Wind Farm Layout Optimization methodology, which obviates traditional assumptions regarding turbine placement, turbine-wind flow interactions, variation of wind conditions, and types of turbines (single/multiple) to be installed; and (iii) improved wind and solar power forecasting using big data information processing technologies, leading to significant production cost reductions in power system operations. To effectively model and design complex engineered systems, a hybrid and uncertainty-based surrogate modeling methodology was developed. This hybrid surrogate seeks to simultaneously capture the global trend of the function as well as the local deviations.

Dr. Jie Zhang is currently working at the National Renewable Energy Laboratory as a Postdoctoral Researcher. Dr. Zhang is also an Adjunct Assistant Professor in the National Wind Resource Center at Texas Tech University. Dr. Zhang received his Ph.D. (2012) from the Department of Mechanical, Aeronautical, and Nuclear Engineering at Rensselaer Polytechnic Institute (RPI). His research expertise and interests are multidisciplinary design optimization, complex engineered systems, big data analytics, wind energy, solar energy, and power & energy systems.