Introduction to the Complex Systems Track

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This is the first year of the new Track on Complex Systems. No doubt the idea of what a complex system is will be different to different people. For the purpose of this Track, a complex system may be large or small in scale. An important characteristic, however, is that such a system exhibit a behavior under stress that is difficult to predict. This may be because models are not well understood (i.e. load models in electric power systems, behavioral models in social and economic systems). It may be because the number of variables is so large that it is beyond simulation capabilities of current computers, or because the relation between a large number of variables is so complex that current mathematics or simulation methods are inadequate. This track seeks to explore methods at the frontier of understanding complex system phenomena and the electric power system is a worthy example of such a system.

There are five mini-tracks in this Track. The mini-track on Information Management seeks to explore techniques for managing and visualizing large-scale models that may be distributed across multiple operating authorities. Papers that cover both distribution and transmission network applications are scheduled for presentation.

Another Mini-track focuses on topics related to the ability of complex systems such as power systems to survive disturbances with minimal impact on performance. Specific topics to be presented are steady-state and dynamic security assessment where the impacts of pre-specified contingencies are analyzed and Available Transfer Capability (ATC) which quantifies the ability of the interconnected system to accept increases in power transfers.

Many large complex systems exhibit evidence of self-organized criticality. Issues such as the role of network size and topology along with the influence of network loading and operation on self-organized criticality are of interest. Evidence that large network disturbances are of a self-organized type and mechanisms of self-organized behavior in large networks are to be presented.

Hybrid systems can be viewed as systems that allow interactions between discrete events and continuous dynamics. As such, they are natural models for complex interactive networks and systems such as manufacturing, power, communications, and transportation systems. A satisfactory theory for such systems, which draws from several disciplines including control theory, computer science, and applied mathematics, will have an enormous impact on the design, synthesis, and operations of many practical systems. Computational and algorithmic approaches to such problems encounter considerable difficulties. In addition to modeling and analysis of such systems, this mini-track explores novel computational paradigms that are able to accommodate uncertainties in the system at various levels.

Finally, there are three sessions in the mini-track on Markets and Economics. The aim of this mini-track is to explore the ability of commercial trading models to effectively represent the complex physical behavior of an electricity industry, an issue that is critical to the success of electricity industry restructuring. Important aspects of this issue include the design of efficient spot markets and ancillary service markets, and mechanisms to incorporate network effects in electricity trading models. Papers will be presented that address these and other aspects of this important problem.