Title: Physics and Math for Smart (Power) Grids

Speaker: Dr. Michael Chertkov, Los Alamos National Laboratory

Abstract: We are asking modern power grids to serve under conditions for which they were not originally designed. We also expect the grids to be smart, in how they function, how they withstand contingencies, how they respond to fluctuations in generation and load, and how the grids are controlled. To meet these ever-increasing expectations requires extending power grid models beyond the scope of traditional power engineering. New applied mathematics and statistical physics based approaches are illustrated in this talk on examples associated with power transmission and distribution respectively.

First, we describe an efficient and highly scalable Chance Constrained Optimal Power Flow (CC-OPF) algorithm providing risk-aware control of the transmission system under uncertainty associated with fluctuating renewables (wind farms). [This "transmission" related part of my talk is based on collaboration with D. Bienstock and S. Harnett (Columbia).]

Then, we discuss ODE and PDE modeling of the distribution feeder, in particular explaining effects of many inductive motors and distributed photo-voltaic generators on stability of the feeder.

Bio: Dr. Chertkov's areas of interest include statistical and mathematical physics applied to energy networks, machine learning, control theory, information theory, computer science, fluid mechanics, optics and communications.

Dr. Chertkov received his Ph.D. in physics from the Weizmann Institute of Science in 1996, and his M.Sc. in physics from Novosibirsk State University in 1990. After his Ph.D., Dr. Chertkov spent three years at Princeton University as a R.H. Dicke Fellow in the Department of Physics. He joined Los Alamos National Lab in 1999, initially as a J.R. Oppenheimer Fellow in the Theoretical Division. He is now a technical staff member in the same division.

Dr. Chertkov has published more than 100 papers in these research areas and is currently leading "Physics of Algorithms" and "Optimization and Control Theory for Smart Grids" projects at LANL. He is an editor of the Journal of Statistical Mechanics (JSTAT), co-chair of IEEE SmartGridComm 2012, and he is a fellow of the American Physical Society (APS) since 2011.