



## Seminar Announcement

**Anatoly Zlotnik**  
**Staff Scientist**

**Los Alamos National Laboratory**

Thursday, October 20, 2016

Green Hall, Room 0120

10:10AM

### Optimal Control of Physical and Market Operations in Dynamic Energy Systems

**Abstract:** The primary sources of electricity generation in the United States and Europe are shifting towards distributed renewable resources and natural gas-fired power plants. The dependence on gas-fired generation for both baseload and marginal production transfers the intermittent and rapidly-changing dynamics of intra-day power system operation onto natural gas transmission infrastructure. Gas pipeline systems are not designed to support quickly-changing deliveries, and the increase in overall load often causes these systems to reach their capacity. This results in challenges to the physical operation of these systems, high price volatility, and even curtailments of gas and/or electricity delivery to customers. This increasingly critical situation motivates many new problems in control and optimization, as well as energy economics, that have important implications for national energy security. I will describe a new control system model for the PDE dynamics of compressible gas flow through large-scale pipeline networks with time-varying injections, withdrawals, and control actions of compressors and regulators. The model enables the rapid solution of PDE-constrained optimal control problems for pipeline systems in time to provide daily flow schedules that can be used to integrate market and physical operations using concepts similar to standard practices in power system operation. Maximizing an objective to obtain gas from points of lowest price and deliver to points of highest price while meeting all physical and engineering constraints optimizes economic welfare for pipeline system users under transient conditions while guaranteeing secure operation and system integrity. Furthermore, dual variables provide spatiotemporal marginal prices for gas throughout the network in a manner that is consistent with the physics of gas flow. The concept may lead to automated and reliable intra-day pipeline operations under transient and uncertain conditions and enable coordination to support power grids when both these systems are operating near their capacity.

**Bio:** Anatoly Zlotnik is a staff scientist in the Applied Mathematics and Plasma Physics group of the Theoretical Division at Los Alamos National Laboratory, where he was previously a postdoctoral research associate at the Center for Nonlinear Studies and affiliated with the Physics of Condensed Matter and Complex Systems group. He is principal investigator for the laboratory's role within the Gas-Electric Co-Optimization (GECO) project of the Advanced Research Projects Agency - Energy (ARPA-E). Before joining the laboratory he studied at Washington University in St. Louis, where he obtained his Ph.D. in Systems Science and Mathematics in 2014.