

Skoltech Center for Energy Systems

Expert conference on

**Advanced Mathematical Methods For Energy Systems:
From Theory to Practice**

Dates: 9-10 June, 2015

Location: Hotel Radisson Royal, Ukraina,
Moscow, Russia

Power systems around the world are undergoing a period of unprecedented change. The emerging 21st Century power system will be characterized by bi-directional flows from a very large number of uncontrollable and stochastic generators (both renewable ones and gas-powered as in Russia) to often poorly predictable demand.

Consumer demand ceases to be predictable due to smart meters disrupting typical demand patterns by responding to changing operating conditions and due to consumers' own wind/solar generation. Increased penetration of energy storage, both stationary and mobile due to a take-up of electric vehicles, offers buffering possibilities in dispatch so that generation does not have to be equal to demand at all times. There are also strong interactions between power, gas and heat/cooling networks (especially in Russia because of wide utilization of district heating). To respond to those challenges, power system control is moving from deterministic, hierarchical and preventive to stochastic, distributed and corrective hence reducing conservative security margins. All that requires new tools and methodologies employing advanced mathematical methods, developing of which is the main goal of Skoltech Center for Energy Systems¹ (<http://crei.skoltech.ru/energysystems/>) which organizes the conference.

The aim of this event is to gather researchers from institutions collaborating with Skoltech Center for Energy Systems, selected invited guests from Russia and abroad, and the industry to share expert opinions and achievements in the field of application of advanced mathematical methods in energy systems. Open forum with industry will be held on day two to discuss problems of practical applications of advanced mathematical methods.

Simultaneous translation will be provided.

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¹ Skolkovo Institute of Science and Technology (Skoltech) is a private graduate research university in Skolkovo, Russia, a suburb of Moscow. Established in 2011 in collaboration with MIT, Skoltech will educate global leaders in innovation, advance scientific knowledge, and foster new technologies to address critical issues facing Russia and the world. Applying international research and educational models, the university integrates the best Russian scientific traditions with twenty-first century entrepreneurship and innovation.

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AGENDA

Day 1: 9 June 2015

8.45 -9.15 Registration and coffee

9.15-9.30 Introduction to the conference and update on Skoltech Center for Energy Systems

Janusz Bialek, Director of Skoltech Center for Energy Systems, Russia

9.30 – 11.00 Stability control

Chair: Steven Low (The California Institute of Technology (Caltech), USA)

1. Florian Doerfler (Swiss Federal Institute of Technology in Zurich (ETHZ)), Switzerland): “Decentralized and optimal control of inter-area oscillations in power networks”
2. Glenn Vinnicombe (University of Cambridge, United Kingdom): “Decentralised Performance Guarantees for Electrical Power Systems”
3. Alexander Fradkov (Institute of Problems in Mechanical Engineering of Russian Academy of Science (RAS), Russia): “Control of transient stability and synchronization of energy networks”

11.00 – 11.15 Coffee break

11.15- 12.45 Tools for future energy networks Part 1

Chair: Michael Chertkov (Skoltech, Russia)

1. Boris Polyak (Trapeznikov Institute of Control Sciences of RAS, Russia): “Quadratic transformations: convexity vs nonconvexity”
2. Steven Low (Caltech): “Design and stability of load-side frequency control”
3. Sergey Suetin (Steklov Mathematical Institute of RAS, Russia), Sina Sadeghi Baghsorkhi (University of Michigan (UM), USA): “Embedding AC Power Flow with Voltage Control in the Complex Plane : The Case of Analytic Continuation via Pade Approximants”

12.45- 13.45 Lunch

13.45 – 15.15 Coupled energy infrastructures

Chair: Mark O’Malley (University College Dublin, Ireland)

1. Oleg Khamisov (Energy Systems Institute, Siberian Branch of RAS, Russia): “Optimization methods and equilibrium modeling for power and heat energy systems”
2. Catalina Spataru (University College London, UK): “The Future Whole Energy System: Stability, Reliability and Security”
3. Michael Chertkov (Skoltech, Russia): "Risk-aware Optimization and Control of Energy Systems"

15.15 – 15.30 Coffee break

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15.30 – 17.00 Uncertainty analysis in power systems

Chair: Felix F. Wu (The University of Hong Kong, Hong Kong)

1. John Moriarty (University of Manchester, UK): “Bayesian inference on a jump-diffusion Ornstein-Uhlenbeck process for modelling electricity spot prices, and applications to the economically optimal control of flexible energy systems”
2. Ian Hiskens (UM, USA): “Effects of Uncertainty on Power System Dynamic Performance”
3. Asu Ozdaglar (Massachusetts Institute of Technology (MIT), USA): "Competition in Electricity Markets with Renewable Sources"

Day 2: 10 June 2015

9.15 – 11.15 Tools for future energy networks Part 2

Chair: Ian Hiskens (UM, USA)

1. Felix F. Wu (The University of Hong Kong) “Smart Grid with Intelligent Periphery (Smart GRIP)”
2. Ruben Sanchez-Garcia (University of Southampton, UK): "Power network partitioning using spectral graph theory"
3. Munther Dahleh (MIT, USA): “Risk assessment in the power grid”
4. Raanan Miller (MIT, USA): “The MIT Utility of the Future project”

11.15 – 11.30 Coffee break

11.30- 13.00 Stability metrics and margins

Chair: Munther Dahleh (MIT, USA)

1. Anatoly Dymarsky (Skoltech, Russia): “New approaches to voltage collapse protection - identifying safe region in the parameter space”
2. Konstantin Turitsyn (MIT, USA): "Fast security and stability assessment"
3. Mardavij Roozbehani (MIT, USA): “Metrics of Resilience and Distance to Failure in Power Systems”

13.00- 14.00 Lunch

14.00 – 16.00 Open Forum with the industry:

“The push and pull: what mathematical advances does the industry really need?”

Chair and moderator of the discussion: Mark O'Malley (University College Dublin, Ireland)

1. Janusz Bialek (Skoltech, Russia): “Summary of the findings and the discussion so far at the conference”
2. Open discussion with the industry

16.00 – 16.15 Close and summary

Janusz Bialek, Director of Skoltech Center for Energy Systems
