TRANSFORMING GRID OPERATION AND PLANNING

Future Power Grid Initiative Newsletter

November 2012

This November, FPGI hosted its second HPC for the Grid workshop at the Supercomputing conference in Salt Lake City. We are also presenting an overview of Shuai Lu's "Modeling of Distributed Energy Resources" project, which contributes to tackling the challenge of integrating renewable energy.

SC12 WORKSHOP

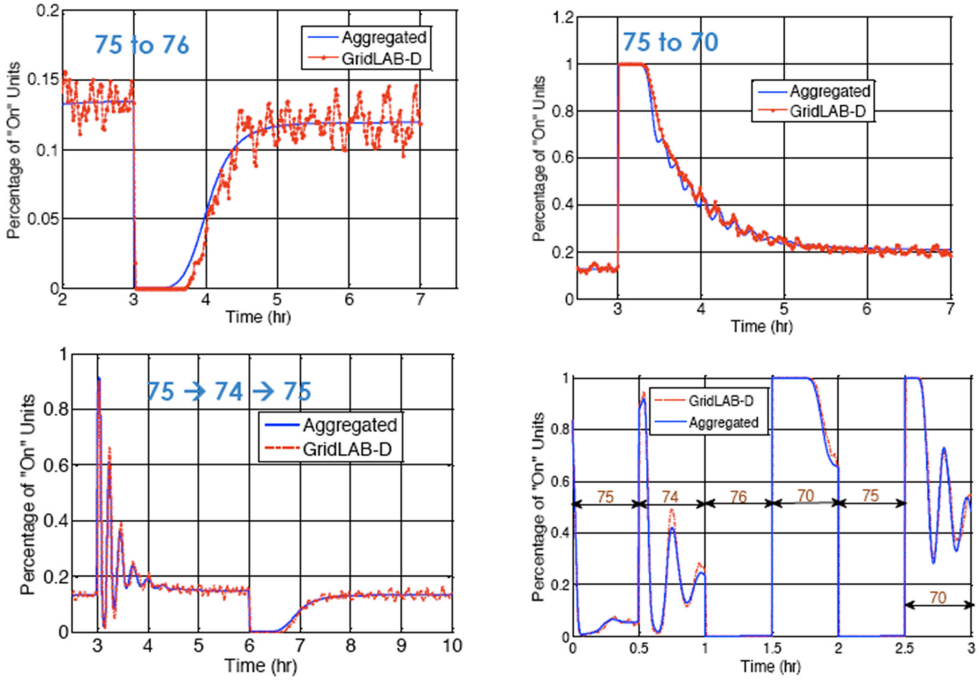
Initiative co-lead Jeff Dagle addressing the workshop

FPGI organized its second annual workshop in conjunction with SC12 in Salt Lake City on November 11. The objective for this workshop was to promote the use of high performance computing (HPC) and networking technologies for power grid applications. Researchers from PNNL, Iowa State University, and Argonne National Laboratory, and Opal-RT (Canada) reported faster-than-real-time computational performance to predict the dynamic trajectory of a power grid. PNNL's work with a 16,000-node power system showed more than 10 times faster than today's commercial tools. And Tractebel Engineering SA (Belgium) reported predictive capabilities with the pan-European power system. Another important aspect discussed was ways to understand the impact of potential contingencies. The results reported at the workshop show good linear scalability, that is, the times of speedup is almost ideally equal to the number of computer processors. Finally, Opal-RT reported active efforts in transferring advanced computing technologies to the industry. All in all, the workshop was a successful meeting that brought together thought leaders and discussed concrete examples of turning HPC into an enabler for the grid of the future and was featured in an article by ***Information Week Government***.

SPOTLIGHT: MODELING OF DISTRIBUTED ENERGY RESOURCES

The smart grid will feature several distributed energy resources (DERs), such as PV systems, EV batteries, A/C devices and electric water heaters, which will be able to respond to system control signals and events to improve operation reliability and efficiency. Modeling these resources plays an important role in the design of relevant technologies and policies, as well as planning and operational studies of electric power systems.

Due to the potential large number of DERs, it is impractical to model these resources in detail in the simulation of interconnected transmission systems. This project is focused on developing aggregated models that represent the performance of the entire population of distributed devices. State transition models will be developed to model the aggregated dynamics of the population. Parameter distribution of the state transition model will be estimated from real-time measurements and survey data. Uncertainty of models is then quantified from parameter distributions. In addition to reduced computation time, by reducing the number of parameters involved in the models, the variance of simulation results could also be reduced.



Validation of Aggregated HVAC Model with Detailed Model

The proposed work will lay the foundation for the DER planning and operational tool development for small scale distribution systems as well as large transmission networks. Utility operators will be equipped with better knowledge of DER behaviors when applying these resources. Multiple collaboration agreements have been reached with utility partners to collect data from ongoing/ expected smart grid demonstration projects and use it for the validation of the models. With access to this data, this project will aim at removing technical barriers and enable the simulation of functionalities of DERs and contribute to a better design and implementation process of the smart grid.

Upcoming Publications and Events

- Fuller JC, ML Hauer, S Ciraci, AR Fisher, and JA Daily. 2012. "Telecommunication Simulations for Power System Applications." Abstract submitted to 2013 IEEE PES ISGT, Washington, DC. PNNL-SA-90387.
- Dalton AC, and GM Gelston. 2012. "Situation Awareness and Decision Support in Power Grid Operations: a Human-Centric Perspective." Abstract submitted to 2013 IEEE International Inter-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision Support, San Diego, CA. PNNL-SA-91499.
- Liu Y, JM Chase, I Gorton, and MJ Rice. 2012. "A Service Oriented System Architecture for Exploring Multi-Source Distributed Power Models." In Journal of Systems and Software. PNNL-SA-91379.
- Ciraci S, and O Villa. 2012. "Exploiting Points-to Maps for De-/Serialization Code Generation." In ACM Sac 2013. PNNL-SA-92094.
- FPGI is hosting a workshop on *Challenges in Next-Generation Analytics for the Future Power Grid* November 29-30, 2012, Seattle, Washington.

FPGI FOCUS AREAS

Focus Area One addresses data networking and management issues, and enables the digital infrastructure for the future grid. This focus area will address the gaps in networking and real-time data management by developing advanced algorithms and software tools and techniques. **Focus Area Leads**: Bora Akyol (bora@pnnl.gov) and Harold Kirkham (harold.kirkham@pnnl.gov)

Focus Area Two targets research in the areas of advanced mathematical models, next-generation simulation and analytics capabilities for the power grid. Projects in Focus Area Two will use high-throughput data streams produced by projects in Focus Area One and integrate them with sophisticated mathematical models to conduct large-scale power grid simulation and analysis. Focus Area Two strives to advance the state-of-the-art in modeling and simulation in order to achieve much higher fidelity situational awareness and global comprehension for power grid stability, efficiency and flexibility. **Focus Area Leads**: Ian Gorton (ian.gorton@pnnl.gov), and Ning Zhou (ning.zhou@pnnl.gov)

Focus Area Three aims to convert large amounts of model and sensor data into information and knowledge to support decisions in grid operation, planning, and policymaking. This area concentrates on the development of coordinated visualization interfaces and decision support capabilities in a modular, extensible software environment that can be used for both real-time grid operations as well as long-term planning. **Focus Area Lead**: Paul Whitney (paul.whitney@pnnl.gov), and Bill Pike (william.pike@pnnl.gov)

ABOUT FPGI

The Future Power Grid Initiative (FPGI) will deliver next-generation concepts and tools for grid operation and planning and ensure a more secure, efficient and reliable future grid. Building on the Electricity Infrastructure Operations Center (EIOC), the Pacific Northwest National Laboratory's (PNNL) national electric grid research facility, the FPGI will advance the science and develop the technologies necessary for meeting the nation's expectations for a highly reliable and efficient electric grid, reducing carbon emissions and our dependence on foreign oil.

Past Newsletters

For past newsletters, please see our news page here http://gridoptics.pnnl.gov/articles/i/n/i/Initiative_News_57ae.html#newsletters.

Contact

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