Pacific Northwest NATIONAL LABORATORY

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Forecasting Net Interchange Levels Based on Uncertainty

SUMMARY

This technology involves a short-term prediction methodology (with minutes to hours in lead time) for power system states while quantifying the uncertainty of its prediction. Motivated by the challenges of increasing uncertainty and variation introduced into the power system by variable generation, PNNL has developed a forecasting methodology to reduce the costs and risks associated with operating a power system with high penetration of renewable resources. The current practice to balance generation and load requires purchasing reserves to manage the uncertainty of the future brought in by load, variable generation, and market behaviors. By predicting the system future states, the technology will enable proactive operation to improve the operational reliability and efficiency and minimize costs.

Because many underlying mechanisms influence power system states, the project team developed multiple prediction methods, such as regression methods and machine learning methods. The team then applied a Bayesian model averaging based ensemble approach for summarizing the prediction results and established a model structure for predicting net interchange schedule as a user case. The evaluation of the methodology's performance was done using field actual measurement data.

Further, this research developed a sensitivity-based smart sampling method reducing uncertainty in generating state prediction. Sensitivity-based smart sampling is a method that first performs sensitivity analysis to identify the most important uncertain model parameters. The next step then applies the high-order sampling method on the most important uncertain model parameters to achieve fast uncertainty quantification with high accuracy. This supports both estimating the prediction value, while at the same time quantifying the confidence interval of the prediction value in the statistical framework. The developed sensitivity-based smart sampling techniques can identify the most sensitive parameters, greatly reduce the computational cost, and speed up the convergence for effective uncertainty quantification.

ADVANTAGES

* Power system state predictor of behaviors
* Quantifies prediction errors or uncertainties
* Provides a look-ahead vision for system operation
* Reduces reserve purchasing requirements

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* Efficiently quantifies the uncertainty in state estimation of large-scale power systems

* Identifies the most sensitive parameters, greatly reduces the computational cost, and speeds up the convergence for effective uncertainty quantification

RELATED LINKS

» **Future Power Grid Initiative home page**

This work was developed as part of PNNL's "Future Power Grid Initiative," which will develop next-generation algorithms and tools for networking, modeling and simulation, and visualization and decision support to drive the transformation towards a more reliable and efficient future power grid.

http://gridoptics.pnnl.gov/

Technology Portfolio(s)

» Energy

» Electric Utility Operations

» Energy Conversion

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