Power Systems Engineering Research Center

Measurement-Based Estimation of Linear Sensitivity Distribution Factors and Applications

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Description

In order to monitor and maintain operational reliability, power system operators perform several static security analyses. For example, the results of online N-1 contingency analysis help operators determine whether or not the system will meet operational reliability requirements in case of outage in any one particular asset (e.g., a generator or a transmission line), and further whether or not corrective actions, such as generation re-dispatch in a constrained system, are required. These studies may include repeated computations, for each credible contingency, of power flow solutions using the full nonlinear power flow model or a linearized model. To reduce the computational burden of evaluating repeated power flow solutions, linear sensitivity distribution factors (DFs), such as injection shift factors (ISFs), power transfer distribution factors (PTDFs), and line outage distribution factors (LODFs), are used to predict the effect of an operating point change on the system. Existing approaches to computing DFs typically employ so-called DC approximations, which can provide fast contingency screening. They do not, however, have the flexibility of adapting to changes in network topology or generation and load variations, which can all affect the actual linear sensitivities.

In this talk, we will discuss a method to compute linear sensitivity distribution factors (DFs) in near real-time. The method does not rely on the system power flow model. Instead, it uses only high-frequency synchronized data collected from phasor measurement units to estimate the injection shift factors. Beyond eliminating the power flow model, we show that the proposed measurement-based approach provides more accurate results than the model-based approximations and can adapt to unexpected system topology and operating point changes. Through numerical examples, we illustrate the advantages of our proposed DF estimation approach over the conventional model-based one in the context of contingency analysis and generation re-dispatch.

Biography

Alejandro Domínguez-García is an Assistant Professor in the Electrical and Computer Engineering Department at the University of Illinois, Urbana, where he is affiliated with the Power and Energy Systems area. His research interests lie at the interface of system reliability theory and control, with special emphasis on applications to electric power systems and power electronics. He received a Ph.D. degree in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology, Cambridge, MA, in 2007 and a degree of Electrical Engineer from the University of Oviedo (Spain) in 2001. After finishing his Ph.D., he spent some time as a post-doctoral research associate at the Laboratory for Electromagnetic and Electronic Systems of the Massachusetts Institute of Technology. Domínguez-García received the NSF CAREER Award in 2010, and the Young Engineer Award from IEEE Power and Energy Society in 2012. He is an editor of the IEEE Transactions on Power Systems. He is also a Grainger Associate since August 2011.

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