Power Systems Engineering Research Center

Protection Based on Dynamic State Estimation (a.k.a. Setting-less Protection): Status and Vision

Sakis Meliopoulos
Georgia Power Distinguished Professor
School of Electrical and Computer Engineering
Georgia Institute of Technology
sakis.m@gatech.edu

PSERC Public Webinar
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Description: The capabilities of protective relays have increased dramatically as higher and higher end microprocessors are used in modern numerical relays and more elaborate communication interfaces are provided. At the same time the complexity has increased primarily because numerical relays are set to mimic the traditional electromechanical counterparts. In addition, despite the progress of the last few decades, some problems persists: we still do not have good 100% reliable approaches for certain fault types, such as high impedance faults, faults near neutrals, etc. A new approach to protection will be presented, one that will lead to simplified but secure and reliable protection schemes by fully utilizing existing and expected technology advancements. Dynamic state estimation was one of several approaches to setting-less protection evaluated with the following criteria: (a) feasibility, (b) dependability, (c) security, (d) reliability, and (e) speed of protection. The approach was pursued and demonstrated on a number of protection problems, specifically, transmission line protection, capacitor bank protection, transformer protection, reactor protection, induction motor protection and distribution line protection. The research demonstrated that the dynamic state estimation based approach provides a secure and dependable protection scheme, it does not require coordination with other devices or protection schemes, and settings are minimal (comparable to differential protection); thus the term “setting-less”. The dynamic state estimation based approach requires complex analytics to be performed on the data acquired with the data acquisition system of the relay. The research has also proved through numerical experiments and laboratory experimentation that the analytics can be performed within the sampling period of typical data acquisition systems for relays with substantial margin. The technology promises to drastically reduce relay mis-operations, solve protection gaps and in general increase the reliability of power systems. We will discuss status of this technology, planned field demonstrations and the overall program direction. This research is also described in two PSERC project reports [2013, 2014].

Biography: Sakis (A. P.) Meliopoulos is the Georgia Power Distinguished Professor at the Georgia Institute of Technology. He is actively involved in education and research for improved safety and electromagnetic compatibility of electric power installations, protection and control of power systems and the application of new technology in these areas. Since 1999 he has been the Georgia Tech Site Director

of PSERC. Dr. Meliopoulos has pioneered several new analysis and design techniques for bulk power reliability analysis, safety, protection and electromagnetic compatibility of electric power systems. Most well-known is the EPRI transmission reliability program TRELLS (now renamed TransCARE), the GPS-synchronized harmonic state measurement system for transmission systems (first (1993) wide area measurement system on NYPA and still operational), the distributed dynamic state estimation method (SuperCalibrator), his invention of the Smart Ground Multimeter, the EPRI grounding analysis programs, the WinIGS (Integrated Grounding System analysis and design), the GEMI (Grounding and ElectroMagnetic Interference) computer code, and the mGrid computer code – a methodology and implementation for precise analysis of multi-wire power systems with distributed energy resources. Dr. Meliopoulos has modernized many power system courses at Georgia Tech, introduced new courses, and initiated the power system certificate program for practicing engineers, and has introduced visualization and animation methodologies that dramatically increase the teaching efficiency of complex power system concepts. Dr. Meliopoulos is a Fellow of the IEEE. He holds three patents and 13 invention disclosures at Georgia Tech. He has published three books, a chapter in the Standard Handbook for Electrical Engineers, and over 300 technical papers. He has received a number of awards, including the Georgia Tech Outstanding Continuing Education Award (2002 and 2014), the IEEE Richard Kaufman Award (2005), and the George Montefiore international award (2010).

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Professor Ajjarapu welcomes feedback on the webinars and suggestions for future ones.