

Tutorial

Advanced Computational Intelligence Methods for Power Systems Monitoring, Control and Optimization

by

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The electric power grid is a complex adaptive system under semi-autonomous distributed control. It is spatially and temporally complex, non-convex, nonlinear and non-stationary with a lot of uncertainties. The integration of renewable energy such as wind farms, and plug-in vehicles further adds complexity and challenges to the various operations, decision making and controls at all levels of the power grid – generation, transmission and distribution. Advanced computational methods are required for planning, monitoring, control and optimization of power system operations. This tutorial will first describe the basic and advanced methods of computational intelligence (CI) and then the CI applications for monitoring, control and optimization of power systems.

Keywords — adaptive control, computational intelligence, emissions, gridable vehicles, optimal control, smart grid, sustainable energy, unit commitment, wide area monitoring and control



G. Kumar Venayagamoorthy received his Ph.D. degree in electrical engineering from the University of KwaZulu Natal, Durban, South Africa, in Feb. 2002. Currently, he is an Associate Professor of Electrical and Computer Engineering, and the Director of the Real-Time Power and Intelligent Systems (RTPIS) Laboratory at Missouri University of Science and Technology (Missouri S&T). He was a Visiting Researcher with ABB Corporate Research, Sweden, in 2007. His research interests are in the development and applications of advanced computational algorithms for real-world applications, including power systems stability and control, smart grid, sensor networks and signal processing. He has published 2 edited books, 5 book chapters, and over 75 refereed journals papers and 250 refereed conference proceeding papers. He has been involved in approximately US\$ 7 Million of competitive research funding.

Dr. Venayagamoorthy is a recipient of several awards, including a 2007 US Office of Naval Research Young Investigator Program Award, a 2004 US National Science Foundation CAREER Award, the 2008 IEEE St. Louis Section Outstanding Educator Award, the 2006 IEEE Power Engineering Society Walter Fee Outstanding Young Engineer Award, the 2005 IEEE Industry Applications Society (IAS) Outstanding Young Member Award, the 2003 International Neural Network Society (INNS) Young Investigator Award, and Missouri S&T 2008, 2007 and 2006 Faculty Excellence Awards, 2006 Teaching Excellence Award and 2007 Teaching Commendation Award.

Dr. Venayagamoorthy has been involved in the leadership and organization of many conferences including the General Chair of the 2008 IEEE Swarm Intelligence Symposium (St. Louis, USA) and the Program Chair of 2009 International Joint Conference on Neural Networks (Atlanta, USA). He is currently the Chair of the IEEE Power and Energy Society (PES) Working Group on Intelligent Control Systems, the Chair of IEEE Computational Intelligence Society (CIS) Task Force on Power Systems Applications, the Vice-Chair of the IEEE PES Intelligent Systems Subcommittee, and the Chairs of IEEE CIS and IEEE Industry Applications Society St. Louis Chapters. He is a Fellow of the Institution of Engineering and Technology (IET), UK and the South African Institute of Electrical Engineers, a Senior Member of the IEEE and INNS, and a Member of the American Society for Engineering Education and the INNS Board of Governors.