



**The Potentials and Promises of the Future Way of Computing
for Smart Grids**

Ganesh Kumar Venayagamoorthy
**Real-Time Power and Intelligent Systems Laboratory, Missouri University of
Science and Technology, Rolla. MO 65409, USA**

Telephone: 5733416641

E-mail: ganeshv@mst.edu

Abstract

The electric power network of today is a complex adaptive system under semi-autonomous distributed control at the generation, transmission and distribution systems. It is spatially and/or temporally complex, nonconvex, nonlinear, nonstationary with uncertainties. The integration of renewable energy sources such as wind farms, solar farms and plug-in hybrid vehicles further adds complexity and challenges to the various controllers at all levels of the power network. A lot of efforts have gone into the development of a smart grid to align the interests of the electric utilities, consumers and environmentalists. Intelligent computational methods are required for planning and optimization, fast control of power system elements, processing of field data and coordination across the grid. Distributed and coordinated intelligence at all levels and across levels of the electric power grid – generation, transmission and distribution is inevitable if a true smart grid is to be reality. The traditional way of modeling, control and optimization needs to be augmented, or even replaced in some cases, with intelligent techniques capable of rapid adaptation, having dynamic foresight, being fault-tolerant and robust to disturbances and randomness.

Computational intelligence (CI) is the study of adaptive mechanisms to enable or facilitate intelligent behavior in complex, uncertain and changing environments. These adaptive mechanisms include those artificial intelligence paradigms that exhibit an ability to learn or adapt to new situations, to generalize, abstract, discover and associate. The paradigms of CI mimic nature for solving complex problems. CI is successor of artificial intelligence and *is the way of the future computing*. This paper describes the potentials and promises of the computational intelligence for smart grid operation and control.

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Summit Category

Pick one from the following:

- 1) Power Generation (clean coal, enhanced oil recovery, tar sands, heavy oil, nuclear)
- 2) Renewable Energy (wind, solar, geothermal)
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- 5) Materials (for fuel cells, supercapacitors, lithium ion batteries, photovoltaics, solar energy conversation, hydrogen storage)

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- 6) Energy Conservation and Environment
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