Transient stability analysis and optimization of power systems with high level of distributed generation integration using electronic emulation

Th. Kyriakidis, Rachid Cherkaoui, M. Kayal
EPFL STI/IEL/ELAB
Corresponding author: theodoros.kyriakidis@epfl.ch

Abstract

On-going shift from vertical monopolies to deregulated markets poses new challenges for the power grid. Feeble investment in transmission and distribution facilities and struggle for optimization (OPF) in economic and ecological terms imposes operating conditions close to the limits of the aged existing infrastructure. In parallel, forecasted advantages of distributed generation (DG) have sparked ardent academic and industrial interest and have led to an increasing penetration of DG into the lower levels of the grid. Aggregation schemes are investigated for its integration: e.g. the Microgrid and the Virtual Power Plant (VPP) concepts enable taking DG into account as controllable entities during planning and real-time operation. The advent of DG changes the nature of the grid exacerbating the computational needs for its operations.

The aforementioned, raise transient stability concerns for the system. Balancing economical/ecological optimality against security (SCOPF) is a multidimensional issue, up to date mostly dealt with in a fragmentary fashion, as immense computational requirements hinder the development of a comprehensive solution. To cope with this a paradigm shift towards distributed computing is strongly suggested. Dedicated electronic hardware developed in ELAB, provides the basis to build on, towards a vision for a co-designed H/W & S/W tool dedicated to analysis and optimization of power systems with provision for emerging smart grid DG concepts such as microgrids and VPPs.