IET Smart Grid, vol.5, no.5, pp.309-331, .

Power system modelling as stochastic functional hybrid differential-algebraic equations

F. Milano; M. Liu; M.A.A. Murad; G.M. Jónsdóttir; G. Tzounas; M. Adeen; A. Ortega Manjavacas; I. Dassios

Abstract-

This paper presents the software tools developed for the research project Advanced Modelling for Power System Analysis and Simulation (AMPSAS) funded by Science Foundation Ireland from 2016 to 2021. The main objective of AMPSAS was the development of novel analytical and computational tools to understand, efficiently design, and optimise ever-changing modern power systems and smart grids, through model-based approaches. In particular, the paper discusses (i) stochastic differential equations for modelling power systems, which are subject to large stochastic perturbations (e.g. wind and solar generation); (ii) the effect of controller and modelling imperfections, for example, delays, discontinuities, and digital signals, on both local and area-wide regulators in power systems; and (iii) the stability analysis and dynamic performance of power systems modelled through stochastic, delay and hybrid implicit differential-algebraic equations. The software tool developed during the execution of AMPSAS integrates areas of applied mathematics, automatic control, and computer science. Several implementation features and open challenges of this software tool are also discussed in the paper. A variety of examples that illustrates the features of this software tool are based on a dynamic model of the all-island Irish transmission system.

Index Terms- Differential-algebraic equations, Time domain integration, Numerical stability, Time delays, Stochastic processes, Power system dynamics

Citation:
Milano, F.; Liu, M.; Murad, M.A.A.; Jónsdóttir, G.M.; Tzounas, G.; Adeen, M.; Ortega, A.; Dassios, I. "Power system modelling as stochastic functional hybrid differential-algebraic equations", IET Smart Grid, vol.5, no.5, pp.309-331, .