Electric Power and Power Electronics Institute

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ADVANCES IN MODELING AND ANALYSIS OF THREE-PHASE ELECTRICITY DISTRIBUTION NETWORKS

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Abstract

Distribution networks are the interface between the electric power grid and the end-users, and their accurate modeling is instrumental in enabling the implementation of advanced operation and control algorithms. In practice, distribution networks operate under unbalanced conditions and far from single-phase simplifications. This talk features recent advances in modeling and analysis of three-phase electricity distribution networks using the bus admittance matrix. Novel admittance models for step voltage regulators are presented, and the invertibility of the bus admittance matrix is analyzed for practical networks that include transmission lines with missing phases, step voltage regulators, and three-phase transformers with various connections. Leveraging the invertibility of the bus admittance matrix, the convergence of the Z-Bus method, which is a classical three-phase power flow solver, is established. A consequence is that the power flow problem in three-phase distribution networks with wye and delta ZIP loads has a unique solution over a region that can be explicitly calculated from the network parameters. The theoretical findings are demonstrated on various IEEE test distribution feeders, including the 8500-node network.

Biography

Nikolaos Gatsis received the Diploma degree in electrical and computer engineering from the University of Patras, Greece, in 2005. He received the M.Sc. degree in electrical engineering and the Ph.D. degree in electrical engineering with minor in mathematics, both from the University of Minnesota, Minneapolis, MN, in 2010 and 2012, respectively. Dr. Gatsis is currently an Assistant Professor with the Department of Electrical and Computer Engineering, University of Texas at San Antonio. His research interests include optimization of smart power grids and cyber-security of critical infrastructures. Dr. Gatsis has co-organized symposia in the area of smart power grids in IEEE GlobalSIP 2015 and 2016. He is currently serving as a Co-Guest Editor for a special issue of the IEEE JOURNAL ON SELECTED TOPICS IN SIGNAL PROCESSING on critical infrastructures.