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Department of Electrical and Computer Engineering

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Title: "Computational Intelligence Methods for Intentional Controlled Islanding of Power Systems"

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Abstract:
Electrical power systems occasionally experience cascading outages leading to large-scale blackouts. Intentional controlled islanding (ICI), also called system splitting or controlled system separation, has been proposed as an effective corrective control action to mitigate these catastrophic events. ICI is aimed to be used as a final resort to attempt to save the system from a partial or a complete blackout. When the system is subject to a severe disturbance and the conventional control systems are unable to keep the system stable, ICI can determine in real-time (within a few seconds in practice) a set of lines to be disconnected across the transmission system to create sustainable and stable subsystems, also known as islands.

When adopting ICI, three key aspects must be addressed: "where to island", "when to island" and "what to do after islanding". In this work, several ICI schemes are proposed for addressing the first one. The proposed schemes aim to split the system with minimal power-flow disruption or minimal power imbalance within islands, for any given number of islands, while maintaining generator coherencies and other static and dynamic constraints (e.g., transmission line availability, connectivity). Since the stability of islands created is mainly dependent on the coherency of the generators inside the islands, a two-step approach for defining coherent generators in disturbed power systems based on the similarity among their inter-area oscillations and swing curves is also proposed. The question of when to island is critical for the success of the ICI scheme, since the possible issues of false alarm and false dismissal have to be handled. A unified methodology based on area-based Center of Inertia (COI)-referred rotor angle index is introduced to determine the most suitable time for splitting the system. This timely definition of the time for islanding can be combined with approaches to determine the points where to island the system. Furthermore, in this work, the concept of a controlled islanding strategy combined with an approach of Parallel Power System Restoration (PPSR) planning is considered. A proposed ICI algorithm is extended to consider power system restoration constraints (e.g., complete observability, sufficient blackstart (BS) capability and sufficient generation capacity to match the load consumption within each island). These new constraints can be viewed as a power system restoration planning stage. In conclusion, a unified framework that consists of a novel ICI scheme and a risk assessment methodology is proposed to assess the risk of ICI schemes on the electricity system. The unified framework provides insights on the benefits and risks of implementing ICI, considering the uncertainties and concerns related to its reliability.

Biography:

Panayiotis Demetriou was born in Larnaca, Cyprus, on June 04, 1987. He obtained the BSc in Electrical Engineering from the University of Cyprus, Nicosia, in 2011. In 2012, he obtained the MSc Power Systems Engineering with distinction from The University of Manchester. Currently, he is a Ph.D. student at the Department of Electrical and Computer Engineering, University of Cyprus. Since 2012, he is also a researcher at the KIOS Research and Innovation Center of Excellence working on intelligent controlled islanding for power system and power system restoration. His main research interests are on the application of intelligent methods to controlled islanding, wide area power system monitoring, protection, and control, power system dynamics and smart grids. Mr. Demetriou is a member of the Cyprus Technical Chamber. He volunteered as a reviewer to several IEEE conferences and transactions.