DDDAMS-based Real-time Assessment and Control of Electric Microgrids

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ABSTRACT
In dynamically changing electricity microgrids, distributed computing solutions must view the real system as a dynamic entity and coordinate decisions at different levels. This requires continual and timely updating of its sensors, communications, and the models that support its control. In this research, our goal is to investigate a novel adaptive simulations architecture, namely Dynamic Data Driven Adaptive Multi-scale Simulations (DDDAMS), to obtain accurate system state estimations and initiate reliable operational tasks for microgrids by integrating dynamic data into the simulation in a timely manner through automatic fidelity switching. Proposed framework includes 1) real-time adaptive simulation, 2) grid computing modules (for computational resource management), 3) web services (for communications), 4) database, 5) various sensors, 6) real system, and 7) algorithms for state estimation, fidelity selection and assignment, and task generation involving Bayesian inferencing. The microgrid considered in this study embodies sources for both conventional and renewable energy generation as well as its side necessity of storage capacities including diesel generators, and test sites for solar, wind, and ocean energy. The latter two have become equally important nowadays due to the increasing growth in energy demand, insufficiency of natural resources, and newly established policies for low carbon footprint. A prototype of the proposed framework is built for a medium scale electric microgrid with a capability to isolate from the main utility with its dedicated substation and feeders. While being developed, the components of the proposed framework have been demonstrated for the economic load dispatch problem in microgrids using systematic formal methods, network simulation with collected sensory data, and expertise from subject matter experts.