

Faster-Than-Real-Time Hardware Emulation of Transients and Dynamics of a Grid of Microgrids

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Enhanced environmental standards are leading to an increasing proportion of microgrids (MGs) being integrated with renewable energy resources in modern power systems, which brings new challenges to simulate such a complex system. In this work, comprehensive modeling of a grid of microgrids for faster-than-real-time (FTRT) emulation is proposed, which can be utilized in the energy control center for contingencies analysis and dynamic security assessment. Electromagnetic transient (EMT) modeling is applied to the microgrid in order to reflect the detailed device processes of the converter and renewable energy sources, while the AC grid utilizes the transient stability modeling to reduce the computational burden and obtain a high acceleration value over real-time execution. Consequently, a dynamic power injection interface is proposed for the coexistence of the two simulation types. The reconfigurability and parallelism of the field-programmable gate arrays (FPGAs) enable the whole system to be executed in FTRT mode with 51 times acceleration over real-time. Meanwhile, three case studies are emulated and the results are validated by the off-line simulation tool Matlab/Simulink®.