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Experimental Assessment of a Grid-Forming Inverter in Microgrid Islanding Operation Mode

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Abstract : As Germany pursues its ambitious plan towards a power system based on renewable energy sources, the necessity to establish steady, robust microgrids becomes more evident. Inside the microgrid, there is at least one grid-forming inverter responsible for generating the coupling voltage and stabilizing the system frequency within the standardized accepted limits when the microgrid is forced to operate as a stand-alone power system. Grid-forming control for distributed inverters is required to enable steady control of a low-inertia power system. In this paper, a designed droop control technique is tested at the controller of an inverter as a component of a hardware test bed to understand the microgrid behavior in two modes of operation: i) grid-connected and ii) operating in islanding mode. This droop technique includes many current and voltage inner control loops, where the Q-V and P-f droop provide the required terminal output voltage and frequency. The technique is tested first in a simulation model of the inverter in MATLAB/SIMULINK, and the results are compared to the results of the hardware laboratory test. The results of this experiment illuminate the pivotal role of the grid-forming inverter in facilitating microgrid resilience during grid disconnection events and how microgrids could provide the functionality formerly provided by synchronous machinery, such as the black start process.

Keywords : microgrid, grid-forming inverters, droop-control, islanding-operation
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