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Abstract In this paper, a robust energy management system is proposed for islanded microgrids, which at the same time considers static modelling of system frequency. The aim of this paper is to manage frequency excursions produced from load and renewable generation fluctuations. In microgrids, the use of inertia-less and small-scale energy resources risks the frequency stability. In order to overcome this problem, first, the frequency-dependent behavior of the distributed energy resources is formulated precisely within the centralized hierarchical energy and reserve management context of a microgrid, Then, in order to handling microgrid uncertainties in a robust way, information gap decision theory (IGDT) technique is proposed. Furthermore, to address a robust hierarchical energy and frequency reserve management architecture, the problem is transmitted into a single level mixed-integer linear programming (MILP) model and solved appropriately over a 24-h scheduling time horizon. Numerical simulation results obtained on a typical islanded smart microgrid are presented including demand response mechanism. The IGDT can help microgrid central controller (MGCC) to make operational decisions in front of major uncertainties. The obtained results verify that through the proposed IGDT-based energy management system, the MGCC can effectively stabilize the microgrid frequency along with its economic targets while considering severe uncertainties.

Keywords Microgrid, Hierarchical energy management, Frequency control, Information gap decision theory, Uncertainty.