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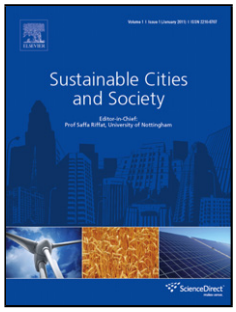

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Multi-Agent Supervisory Control for Optimal Economic Dispatch in DC Microgrids

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Abstract: The deepening impact of global warming has stimulated numerous researchers to come up with alternative energy sources and transportation facilities that create fewer emissions. DC distribution systems are attractive candidates for adapting high penetration of distributed generation and electric vehicles. Accordingly, this work proposes a distributed power management scheme to enhance the reliability and economic performance of isolated dc microgrids. In the presented approach, the dc microgrid is assumed to contain both renewable and nonrenewable generating units. At lower loading conditions, the proposed scheme stimulates a power-sharing strategy among renewable sources to increase system reliability, whereas nonrenewable sources are kept operating at their lower power limits. Alternatively, renewable sources are allowed to operate at their maximum power limits while maintaining optimum economic operation among nonrenewable sources to meet higher loading conditions.. To achieve these operational criteria, both renewable and nonrenewable DG units apply a consensus-based algorithm in a supervisory control level. Each DG unit exchanges information with its neighbors, thereby locally updating the no-load voltage setting of its primary control according to system voltage sensitivity analysis. The incorporation of DG droop-based primary control renders the proposed algorithms fully distributed with a reduced number of agents. The proposed algorithm has the additional advantage of restoring system voltage to its nominal value. The stability and convergence of the algorithm are analytically addressed, and real-time OPAL-RT simulations are performed in a hardware-in-the-loop (HIL) application to verify its effectiveness.

Keywords—DC microgrids, distributed power management, supervisory control, real-time simulations.

NOMENCLATURE

Acronyms			
ADNS	Active distribution networks (ADNs)	HIL	Hardware-in-the-loop
DCDSs	DC distribution systems	PEVs	plug-in electric vehicles
DG	Distributed generation		
Indices			
g	Superscript for DG buses	l	Superscript for loading buses

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