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# DECENTRALIZED AUTONOMOUS CONTROL OF SUPER DISTRIBUTED ENERGY SYSTEMS

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Abstract. *In this paper, a numerical analysis of decentralized autonomous control for a cooperative system operated in the super distributed environment form the viewpoint of neighborhood structure is conducted. Since the behavior of such a system is dictated by a complicated interaction among electric power outputs produced by numerous dispersed generators, both macroscopic and microscopic behaviors of numerous dispersed generators based on the stability analysis of the Hopfield neural network are considered. Simulation results using a typical energy system model and the Neumann neighborhood are presented to show that the maintenance of supply-and-demand balance becomes easier when customers with a dispersed generation system can obtain sufficient information from their neighborhood.*

**Keywords:** Energy systems, Dispersed generation, Distributed systems, Hopfield neural network, Decentralized autonomous control, Neumann neighborhood

1. **Introduction.** With the deregulation of the power market and the development of high-performance dispersed generators such as fuel cells and micro gas turbines, a dramatic increase in customer-level dispersed generation is possible in the near future [1]. In the present paper, the term *super-distributed environment* refers to the situation in which dispersed generators are dominant in the power system in terms of both generated power and quantity of generator units. Furthermore, the term *super-distributed energy system* [5, 6, 7] is used to refer to dispersed generators, such as fuel cells or micro gas turbines, that can supply heat energy as well as electric power.

With the advent and expansion of high-performance, small, inexpensive computers, the concept of centralized computer systems based on mainframes has changed radically from building-oriented development to operation-oriented development, or in other words, from top-down design to bottom-up design, thus giving rise to modern distributed computing systems. Similarly, it appears likely that energy systems will soon undergo radical transformation whereby existing large-scale power plants will be replaced by thousands of small-scale dispersed generators.