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Pareto tribe evolution with equilibrium-based decision for multi-objective optimization of multiple home energy management systems

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Abstract--This paper proposes a novel Pareto tribe evolution (PTE) with equilibrium-based decision for multi-objective optimization of multiple home energy management systems (HEMS). The multiple HEMS are divided into three types according to their electrical appliances, thus the curse of dimension resulted from massive controllable electrical appliances can be effectively addressed. Three objective functions including maximization of consumer satisfaction, minimization of energy cost, and minimization of peak-to-average ratio of the load profile are simultaneously optimized by PTE, in which the best compromise solution is determined through Nash equilibrium based decision making according to the obtained Pareto front (PF). In order to obtain a uniform and widespread PF, the efficient search mechanism for tribe division, reproduction and migration are presented to achieve an exact local search and a synergistic search among all the individuals. The performance of PTE for multi-objective optimization of multiple HEMS has been evaluated with 100-HEMS.

Keywords – Pareto tribe evolution; Nash equilibrium; Multi-objective optimization; Multiple household energy management systems

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