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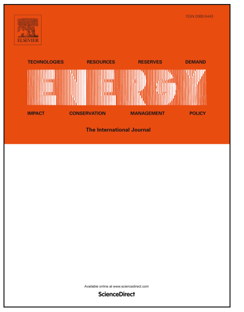

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Min Zhou, Bo Wang, Tiantian Li, Junzo Watada

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A data-driven approach for multi-objective unit commitment under hybrid uncertainties

Min Zhou[a], Bo Wang[a,*], Tiantian Li[a], Junzo Watada[b]

[a] School of Management and Engineering, Nanjing University, Nanjing 210093, China
[b] Graduate School of Information, Production and Systems, Waseda University, Kitakyushu 808-0135, Japan

Abstract

Recent years, renewable energy has taken growing penetration in power systems due to the energy shortage and environmental concerns. As a result, system operators encounter increasing difficulties in solving unit commitment optimization. In this paper, a data-driven unit commitment model is proposed to handle the hybrid uncertainties of wind power and future load. First, a non-parameter kernel density method is utilized to represent the above hybrid uncertainties, and a novel bandwidth selection strategy for the above method is then proposed to capture the inherent correlation between uncertainty representation and unit commitment. Second, a Monte Carlo simulation is developed to integrate the hybrid uncertainties into Value-at-Risk to get a comprehensive system reliability measurement. Third, considering that system operators might be interested in the inherent conflict between reliability and economy, minimizing operation costs and maximizing system reliability are taken as two objectives in the model. To get more practical schedules, the transmission line constraint is considered as well when building the mathematical model. Additionally, by integrating the reinforcement learning mechanism, a novel multi-objective particle swarm optimization algorithm is proposed to solve the complicated nonlinear model. Finally, several experiments were performed to demonstrate the effectiveness of this research.

Keywords: Multi-objective unit commitment, non-parameter kernel density method, hybrid uncertainties, reinforcement learning-based particle swarm optimization algorithm.

Acronyms	
UC	Unit commitment
SOs	System operators
SUC	Stochastic unit commitment
EENS	Expected energy not served
LOLP	Loss of load probability
VALL	Value at lost load
RUC	Robust unit commitment
VaR	Value-at-Risk
DD-MOUC	Data-driven multi-objective UC
NPKDM	Non-parameter kernel density method
TLC	Transmission line constraint
MILP	Mixed integer linear programming
LR	Lagrangian relaxation
PSO	Particle swarm optimization
MOPSO	Multi-objective PSO
DT-MOPSO	Dominance time-based MOPSO
TV-MOPSO	Time-varying MOPSO
RL-MOPSO	Reinforcement learning-based MOPSO

*Corresponding author.