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Dynamic Programming Based Algorithm for the Unit Commitment of the Transmission-Constrained Multi-Site Combined Heat and Power System

Authors : A. Rong, P. B. Luh, R. Lahdelma

Abstract : High penetration of intermittent renewable energy sources (RES) such as solar power and wind power into the energy system has caused temporal and spatial imbalance between electric power supply and demand for some countries and regions. This brings about the critical need for coordinating power production and power exchange for different regions. As compared with the power-only systems, the combined heat and power (CHP) systems can provide additional flexibility of utilizing RES by exploiting the interdependence of power and heat production in the CHP plant. In the CHP system, power production can be influenced by adjusting heat production level and electric power can be used to satisfy heat demand by electric boiler or heat pump in conjunction with heat storage, which is much cheaper than electric storage. This paper addresses multi-site CHP systems without considering RES, which lay foundation for handling penetration of RES. The problem under study is the unit commitment (UC) of the transmission-constrained multi-site CHP systems. We solve the problem by combining linear relaxation of ON/OFF states and sequential dynamic programming (DP) techniques, where relaxed states are used to reduce the dimension of the UC problem and DP for improving the solution quality. Numerical results for daily scheduling with realistic models and data show that DP-based algorithm is from a few to a few hundred times faster than CPLEX (standard commercial optimization software) with good solution accuracy (less than 1% relative gap from the optimal solution on the average).

Keywords : dynamic programming, multi-site combined heat and power system, relaxed states, transmission-constrained generation unit commitment
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