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Increase-Decrease Game under Imperfect Competition in Two-stage Zonal Power Markets - Part II: Solution Algorithm

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M. Sarfati, M.R. Hesamzadeh, P. Holmberg

Abstract In part I of this paper, we proposed a Mixed-Integer Linear Program (MILP) to analyze imperfect competition of oligopoly producers in two-stage zonal power markets. In part II of this paper, we propose a solution algorithm which decomposes the proposed MILP model into several subproblems and solve them in parallel and iteratively. Our solution algorithm reduces the solution time of the MILP model and it allows us to analyze largescale examples. To tackle the multiple Subgame Perfect Nash Equilibria (SPNE) situation, we propose a SPNE-band approach. The SPNE band is split into several subintervals and the proposed solution algorithm finds a representative SPNE in each subinterval. Each subinterval is independent from each other, so this structure enables us to use parallel computing. We also design a pre-feasibility test to identify the subintervals without SPNE. Our proposed solution algorithm and our SPNE-band approach are demonstrated on the 6-node and the modified IEEE 30-node example systems. The computational tractability of our solution algorithm is illustrated for the IEEE 118-node and 300-node systems.

Keywords Modified Benders decomposition, Multiple Subgame Perfect Nash equilibria, Parallel computing, Wholesale electricity market, Zonal pricing

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Contact par.holmberg@ifn.se
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