Variational inequalities for solving possibilistic risk-averse electricity market equilibrium

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Abstract-

It is widely known and accepted that Nash equilibrium suitably models agents\' behavior in electricity markets, since it is coherent with the common sense of their simultaneous profits maximisation. In the literature, these approaches are usually addressed using deterministic representations, despite the fact that electricity markets are highly conditioned by the uncertainty in demand or in agents\' bidding strategies. Only some equilibrium-modelling approaches under uncertainty can be found in the literature, most of them using probability distributions. However, probability approaches may lead to very complex formulations and generally require restrictive assumptions (such as normality or independence) that can hardly be verified in real complex problems. A conjectured-price-response equilibrium model that uses LR-possibility distributions to represent the uncertainty of the residual demand curves faced by the participant agents is proposed. Modelling the risk-aversion attitudes of the agents, the resulting possibilistic equilibrium is transformed into a simplified deterministic one, which is solved with a new globally convergent algorithm for variational inequalities problems. Some interesting results for a real-size electricity system show the robustness of this new approach when compared with other risk-neutral approaches.

Index Terms- Convergence, Power markets, Pricing, Probability, Risk analysis

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