An Efficient Algorithm for Solving Equilibrium Programs with Equilibrium Constraints

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Many equilibrium problems arising in energy markets have certain sets of players or decisions (leaders) that make optimal choices before the rest of the market (followers). In particular, the advent of shale gas in the United States has resulted in shale producers acquiring market advantage over the other players. One way of modeling this situation is using equilibrium programs with equilibrium constraints (EPECs), which are a type of two-level optimization problem that are computationally expensive to solve. Previous techniques to solve two-level optimization problems have either only been applicable to linear EPECs, or EPECs at a small scale. This talk provides a solution technique based on decomposition to tackle this class of problems. The biggest hurdle will be overcoming the complementarity constraints at the lower level, which classify the feasible region of the upper level problem as non-convex and often disjoint. The algorithm presented will be scalable, in that an increase in the number of players or variables will not result in a dramatic increase in computation time. Theoretical support of our method will be provided as well as an application to the US Natural Gas market.