Abstract

In this thesis, an algorithm is proposed to solve the mathematical optimisation problem of the demand response application of an energy exchange between an aggregator and prosumers in a city district. The energy exchange is managed by the aggregator scheduling the prosumers' flexible loads.
The approach made in this thesis is to solve the optimisation problem by dividing it into two sub-problems for which optimisation algorithms already exist. These existing algorithms are united to solve the original problem. The one sub-problem is the exchange problem that represents the energy exchange between the aggregator and the prosumers that can be solved by the Exchange ADMM algorithm. The other sub-problem is the optimisation of all exchange-participants, since they have individual objective functions and constraints. Prosumers have flexible loads whose on/off state is modelled mathematically by binary integer decision variables and the objective function of the aggregator and the prosumers can be linear or quadratic. Hence, those sub-problems are Mixed Integer Quadratic Programming problems that can be solved by the MIQP ADMM algorithm. Exchange ADMM and MIQP ADMM are united to the Exchange MIQP ADMM algorithm.
The evaluation shows that the Exchange MIQP ADMM algorithms finds the optimal solution for a simplified convex mode, where the integer variables are assumed to be reals. For the non-simplified integer mode, the Exchange MIQP ADMM converges but does not find the optimal solution. To improve the convergence in the non-simplified integer mode, a warm start method is implemented that starts in convex mode and continues in integer mode after the optimal convex solution is found. This method works well if the algorithms' stopping criteria is loosened for the continuing integer mode so that the solution is still feasible but slightly non-optimal solutions are accepted.

Keywords: DR, City district, Local energy systems, Exchange ADMM, MIQP ADMM