An energy market stackelberg game solved with particle swarm optimization

Panagiotis Kontogiorgos,[1] Elena Sarri,[1] Michael N. Vrahatis,[2] George P. Papavassilopoulos[1]

[1]Department of Electrical and Computer Engineering, National Technical University of Athens, Athens, Greece,

[2]Department of Mathematics, University of Patras, GR-26110 Patras, Greece,

panko09@hotmail.com, elena@netmode.ntua.gr, vrahatis@math.upatras.gr, yorgos@netmode.ece.ntua.gr

Abstract

Complex interactions between stakeholders in deregulated markets are formulated using game theory notions. This study is motivated by energy markets and addresses Stackelberg games with a leader that decides first his strategy and many followers, each one with his own characteristics. A static Stackelberg game corresponding to a Voluntary Load Curtailment (VLC) program for energy consumers is formulated. This leads to a bilevel programming problem that is generally difficult to solve, due to nonlinearities, nonconvexities that arise and the large dimensionality of the problem due to the existence of many followers. In these problems metaheuristic algorithms become attractive. In the present study an algorithm for solving such problems is developed, using Particle Swarm Optimization (PSO), which is based on collective intelligent behaviors in nature and has gained wide recognition in recent years. Some examples are then solved using the proposed algorithm in order to evaluate its efficiency and examine the interactions between the players of the game.

Key words: Complex Systems, Energy Market, Stackelberg, Particle Swarm Optimization