

Special Issue on
Bilevel Programming and Optimal Control, Equilibrium Systems, and Applications to Engineering and Information Security

CALL FOR PAPERS

Plenty of new applied problems have recently arisen which can be efficiently solved only within the frameworks of mixed-integer bilevel programming models (MIBLP) or bilevel optimal control patterns (BOCP). For instance, a bilevel formulation is a must for the natural gas cash-out problem, the deregulated electricity market equilibrium model, the biofuel problems, and the mode of designing coupled energy carrier networks. Bilevel models to describe human migration processes have also become very popular. Bilevel programming and/or optimal control structures have also proven to be appropriate in applications to strategic product design, homeland security applications (including information security models), and taxation policy. Numerous authors consider bilevel programming or control problems with uncertainties, for example, with the lower level problem being a linear or nonlinear interval program.

Engineering applications of bilevel optimization and combinatorial problems also include facility location, environmental regulation, energy and agricultural policies, hazardous materials management, and optimal designs for chemical and biotechnological processes.

Although many real-life applications ideally fit the bilevel programming (BLP) and bilevel optimal control (BOC) framework, their implementation is quite scarce as yet, due mainly to the lack of efficient algorithms for tackling medium- and large-scale BLP and BOC problems. Solving a BLP (or BOC) problem, even the simplest one, is a difficult task (*NP-hard* one). Many alternative methods may be used, but there is no general algorithm guaranteeing the convergence or optimality for each problem.

Mixed-integer BLPs (MIBLP) with part of variables being integer are even harder for the conventional optimization techniques. For instance, a replacement of the lower level optimization problem with the KKT conditions may fail if some lower level variables are discrete. Therefore, a solid theoretical base including elements of combinatorial methods is necessary to propose efficient algorithms aimed at finding local or global solutions of such problems.

Many real problems in the abovementioned areas due to their nature and the increasing problem sizes that need to be tackled can be efficiently treated only using stochastic or hybrid (stochastic/deterministic) methods. Therefore stochastic and hybrid optimization methods are of interest including, but not limited to, Monte Carlo and quasi-Monte Carlo methods for global and constrained optimization, Bayesian approaches for optimal control and applications in engineering and information security, approaches based on hidden Markov and semi-Markov models, and variety of uncertainty quantification approaches.

The primary purpose of the special issue is to discuss these problems with the researchers working in these areas.

Potential topics include but are not limited to the following:

- ▶ Fundamentals of variational inequality theory, BLP, BOC, and combinatorial optimization
- ▶ Conjectural variations equilibrium and its applications to decision processes
- ▶ BLP and BOC problems and their reduction to single-level ones
- ▶ Bilevel Optimal Control (BOC) problems and their applications
- ▶ Logistic problems with uncertainties/interval optimization
- ▶ Heuristic algorithms solving BLP and BOC problems
- ▶ Equilibrium in models of classical and mixed oligopoly
- ▶ Combinatorial problems and the coding theory
- ▶ Generalized positional calculus systems: descriptions and applications in specialized digital devices
- ▶ Monte Carlo and quasi-Monte Carlo methods and algorithms for global and constrained optimization and Engineering and Information Security
- ▶ Hybrid methods and algorithms for global and constrained optimization and applications in engineering and information security
- ▶ Bayesian approaches for optimal control and applications to engineering and information security
- ▶ Methods and algorithms for the information coding and compression
- ▶ Information security devices: theory and applications

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