

Editorial

Mixed integer programming

The IMA Special Workshop on Mixed-Integer Programming was held in Minneapolis on July 25–29, 2005, at the Institute for Mathematics and its Applications. The aim of the conference was to bring together both researchers and practitioners in this rapidly developing field, and to foster future collaborations. The organizers were Alper Atamturk (Berkeley), Daniel Bienstock (Columbia), Sanjeeb Dash (IBM Research), Adam N. Letchford (Lancaster) and Jeff Linderoth (Lehigh). The IMA, IBM and SAS generously provided financial support. The conference, which attracted approximately 100 delegates from over 10 countries, included 22 invited talks, a poster session and a roundtable discussion on the future of the field.

Peter Hammer kindly gave us the opportunity to publish this special issue of *Discrete Optimization* devoted to papers arising from the workshop. After a thorough refereeing process, we have selected eight papers. We believe that these papers give an excellent ‘snapshot’ of the state-of-the-art in integer and mixed-integer programming, reflecting well the current trends in the field.

- The paper by Achterberg applies the successful technique of *conflict analysis*, used by some SAT solvers, to branch-and-cut based mixed-integer programming. The paper is representative of a growing interest in developing hybrid AI-OR techniques for difficult discrete optimization problems.
- Another trend is the design of more sophisticated procedures for automatically generating strong valid inequalities for mixed-integer programs. The paper by Guan, Ahmed and Nemhauser investigates a new *constraint pairing* scheme for generating such inequalities. The successful computational results demonstrate the value of their scheme.
- One of the most vexing issues in computational integer programming is symmetry, and specialized methods are being devised to combat it. Margot, in his paper, generalizes his group-theoretic techniques for combating symmetry in 0/1 linear programs to general integer linear programs.
- Another recent development is the discovery of powerful new general-purpose heuristic methods for mixed-integer programming. The paper by Bertacco, Fischetti and Lodi extends the highly successful *feasibility pump* heuristic so that it can handle general integer variables in a more natural and effective way. The paper by Achterberg and Berthold also presents a modification of the feasibility pump, so as to find solutions with better objective value.
- Only in recent years have researchers begun to realize the full potential of combining column generation and cutting planes within a single integrated algorithm. The paper by Ji and Mitchell, concerned with a certain partitioning problem that has applications in statistical clustering, provides a good example of this approach.
- The much-studied *network-loading problem*, which has important applications in telecommunications, has proved remarkably difficult to solve with existing mixed-integer programming techniques. The paper by Avella, Mattia and Sassano shows how to generate strong cutting planes for this problem, enabling larger instances to be solved to optimality.
- Finally, the paper by Bienstock and Mattia is concerned with a highly topical theme: preventing large-scale *blackouts* in power transmission networks. Using sophisticated modeling and integer programming techniques, they are able to design networks that are capable of surviving under a range of realistic scenarios.

We wish to express our thanks to the organizers of the workshop, those who attended the workshop, the authors who submitted papers to the special issue and the referees. We also thank Peter Hammer for giving us the opportunity to develop this special issue, and the editorial staff of *Discrete Optimization* for their role in its preparation.

Guest Editors

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