ISCO

International Symposium on Combinatorial Optimization

ISCO is a biennial international symposium whose aim is to bring together researchers from all the communities related to combinatorial optimization. Each edition is preceded or followed by a Spring School. Articles of ISCO are selected by a program committee on the basis of 12-page submissions, and proceedings are published by Springer LNCS [LRM18, BGGM20, LBDM22]. Selected articles are also published in extended versions in special issues of international journals [FMR19, LMR22]. Two members of Pôle 2 are in the steering committee of ISCO (Ridha Mahjoub and Vangelis Th. Paschos). Ridha Mahjoub participated in the launch of the conference and its seven editions:

- Hammamet, Tunisia in 2010: `https://www.lamsade.dauphine.fr/~isco/ISCO2010/`
- Athens, Greece in 2012: `https://www.lamsade.dauphine.fr/~isco/ISCO2012/`
- Lisbon, Portugal in 2014: `https://www.lamsade.dauphine.fr/~isco/ISCO2014/`
- Vietri Sul Mare, Italy in 2016: `https://www.lamsade.dauphine.fr/~isco/ISCO2016/`
- Marrakech, Morroco in 2018: `https://www.lamsade.dauphine.fr/~isco/ISCO2018/`
- Montreal, Canada in 2020: `https://symposia.cirrelt.ca/ISCO2020/en/Home`
- Online conference in 2022: `https://isco2022.sciencesconf.org`

References

[BGGM20] Mourad Baïou, Bernard Gendron, Oktay Günlük, and Ali Ridha Mahjoub, editors. *Combinatorial Optimization - 6th International Symposium, ISCO 2020, Montreal, QC, Canada, May 4-6, 2020, Revised Selected Papers*, volume 12176 of *Lecture Notes in Computer Science*. Springer, 2020.

[FMR19] Satoru Fujishige, Ali Ridha Mahjoub, and Franz Rendl. Preface: The fourth international symposium on combinatorial optimization (ISCO) 2016. *J. Comb. Optim.*, 37(1):418–422, 2019.

[LBDM22] Ivana Ljubic, Francisco Barahona, Santanu S. Dey, and Ali Ridha Mahjoub, editors. *Combinatorial Optimization - 7th International Symposium, ISCO 2022, Virtual Event, May 18-20, 2022, Revised Selected Papers*, volume 13526 of *Lecture Notes in Computer Science*. Springer, 2022.

[LMR22] Jon Lee, Ali Ridha Mahjoub, and Giovanni Rinaldi. Preface: Combinatorial optimization ISCO 2018. *Discret. Appl. Math.*, 308:1–3, 2022.

[LRM18] Jon Lee, Giovanni Rinaldi, and Ali Ridha Mahjoub, editors. *Combinatorial Optimization - 5th International Symposium, ISCO 2018, Marrakesh, Morocco, April 11-13, 2018, Revised Selected Papers*, volume 10856 of *Lecture Notes in Computer Science*. Springer, 2018.

Ivana Ljubić
Francisco Barahona
Santanu S. Dey
A. Ridha Mahjoub (Eds.)

LNCS 13526

Combinatorial Optimization

7th International Symposium, ISCO 2022
Virtual Event, May 18–20, 2022
Revised Selected Papers

Springer

Preface

This volume contains 24 regular papers presented at ISCO 2022, the 7th International Symposium on Combinatorial Optimization, during May 18–20, 2022. The conference was held online, attracting more than 250 registered participants from all around the world. This edition of ISCO also included presentations of short papers. ISCO 2022 was preceded during May 16–17 by the doctoral school entitled "An introduction to quantum algorithms for optimization" given by Giacomo Nannicini (IBM, USA). Four eminent invited speakers also gave talks at the symposium: Jon Lee (University of Michigan, USA), Petra Mutzel (Bonn University, Germany), Rekha R. Thomas (University of Washington, USA), and Rico Zenklusen (ETH Zürich, Switzerland).

The ISCO series aims to bring together researchers from all communities related to combinatorial optimization, including algorithms and complexity, mathematical programming, operations research, stochastic optimization, graphs, and polyhedral combinatorics. It is intended to be a forum for presenting original research on all aspects of combinatorial optimization, ranging from mathematical foundations and theory of algorithms to computational studies and practical applications, and especially their intersections. In response to the call for papers, ISCO 2022 received 50 regular submissions. Each submission was reviewed by three to five Program Committee members with the assistance of external reviewers. The submissions were judged on their originality and technical quality. The review process was extremely selective and many good papers could not be accepted. As a result, 24 regular papers were selected, giving an acceptance rate of 48%. The revised versions of these 24 regular papers presented at the symposium are included in this volume. Overall, 52 talks (based on 24 regular papers and 28 short abstracts) of 25–30 minutes each, grouped into 16 sessions, were given at the conference.

We would like to thank all the authors who submitted their work to ISCO 2022, and the Program Committee members and external reviewers for their exceptional work. We would also like to thank our invited speakers as well as the speaker of the doctoral school for their excellent and inspiring lectures. They all contributed to the quality of the symposium. Finally, we would like to thank the members of the Organizing Committee for hosting the conference website, and for their remarkable technical assistance and support.

June 2022

Ivana Ljubić
Francisco Barahona
Santanu S. Dey
A. Ridha Mahjoub

Mourad Baïou
Bernard Gendron
Oktay Günlük
A. Ridha Mahjoub (Eds.)

LNCS 12176

Combinatorial Optimization

6th International Symposium, ISCO 2020
Montreal, QC, Canada, May 4–6, 2020
Revised Selected Papers

Preface

This volume contains the regular papers presented at ISCO 2020, the 6th International Symposium on Combinatorial Optimization, May 4–6, 2020. Originally, the conference was scheduled to take place in Montreal, Canada, but due to the COVID-19 pandemic, the conference was held online, attracting more than 250 registered participants. Past editions of ISCO (Hammamet, Tunisia, March 2010; Athens, Greece, April 2012; Lisboa, Portugal, March 2014; Vietri Sul Mare, Italy, May 2016; Marrakesh, Morocco, April 2018) all included invited talks, short papers, and a doctoral school. Unfortunately, due to the COVID-19 pandemic, these activities, originally scheduled to take place at HEC Montreal and at the University of Montreal, had to be canceled. Nonetheless, the online edition of the conference was a success, with 24 talks of 30 minutes each, grouped into 8 sessions, and every session attracting close to 100 participants from all around the world.

The ISCO series aims to bring together researchers from all communities related to combinatorial optimization, including algorithms and complexity, mathematical programming, operations research, stochastic optimization, graphs, and polyhedral combinatorics. It is intended to be a forum for presenting original research on all aspects of combinatorial optimization, ranging from mathematical foundations and theory of algorithms to computational studies and practical applications, and especially their intersections. In response to the call for papers, ISCO 2020 received 66 regular submissions. Each submission was reviewed by at least two Program Committee members. The submissions were judged on their originality and technical quality, and difficult decisions had to be made. As a result, 25 regular papers were selected to be presented at the symposium, giving an acceptance rate of 38%. One selected paper was withdrawn by the authors, but all other 24 papers were presented at the symposium. The revised versions of the 24 accepted regular papers presented at the conference are included in this volume.

We would like to thank all the authors who submitted their work to ISCO 2020, and the Program Committee members for their remarkable work. They all contributed to the quality of the symposium. Finally, we would like to thank the staff members of CIRRELT, the Interuniversity Research Centre on Enterprise Networks, Logistics and Transportation, which hosted the conference website, for their assistance and support.

May 2020

Mourad Baïou
Bernard Gendron
Oktay Günlük
A. Ridha Mahjoub

Jon Lee
Giovanni Rinaldi
A. Ridha Mahjoub (Eds.)

LNCS 10856

Combinatorial Optimization

5th International Symposium, ISCO 2018
Marrakesh, Morocco, April 11–13, 2018
Revised Selected Papers

Preface

This volume contains the regular papers presented at ISCO 2018, the 5th International Symposium on Combinatorial Optimization, held in Marrakesh, Morocco during April 11–13, 2018. ISCO 2018 was preceded during April 9–10 by the Spring School on "Advanced Mixed Integer Programming Formulation Techniques" given by Juan Pablo Vielma and Joye Huchette (MIT, USA). ISCO is a new biennial symposium. The first edition was held in Hammamet, Tunisia, in March 2010, the second in Athens, Greece, in April 2012, the third in Lisbon, Portugal, in March 2014, and the fourth in Vietri Sul Mare, Italy, in May 2016. The symposium aims to bring together researchers from all the communities related to combinatorial optimization, including algorithms and complexity, mathematical programming, operations research, stochastic optimization, multi-objective optimization, graphs, and combinatorics. It is intended to be a forum for presenting original research on all aspects of combinatorial optimization, ranging from mathematical foundations and theory of algorithms to computational studies and practical applications, and especially their intersections.

In response to the call for papers, ISCO 2018 received 75 regular submissions. Each submission was reviewed by at least three Program Committee (PC) members with the assistance of external reviewers. The submissions were judged on their originality and technical quality and the PC had to discuss in length the reviews and make tough decisions. As a result, the PC selected 35 regular papers to be presented in the symposium giving an acceptance rate of 46% (69 short papers were also selected from both regular and short submissions). Four eminent invited speakers, Friedrich Eisenbrand (EPFL, Lausanne, Switzerland), Marica Fampa (Federal University of Rio de Janeiro, Brazil), Bernard Gendron (University of Montreal, Canada), and Franz Rendl (University of Klagenfurt, Graz, Austria), also gave talks at the symposium. The revised versions of the accepted regular papers and extended abstracts of the invited talks are included in this volume.

We would like to thank all the authors who submitted their work to ISCO 2018, and the PC members and external reviewers for their excellent work. We would also like to thank our invited speakers as well as the speakers of the Spring School for their exciting lectures. They all much contributed to the quality of the symposium.

Finally, we would like to thank the Organizing Committee members for their dedicated work in preparing this conference, and we gratefully acknowledge our sponsoring institutions for their assistance and support.

May 2018

Jon Lee
A. Ridha Mahjoub
Giovanni Rinaldi

The original version of the book frontmatter was revised: The second editors' affiliations have been corrected. The correction to the book frontmatter is available at https://doi.org/10.1007/978-3-319-96151-4_36

Discrete Applied Mathematics 308 (2022) 1–3

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Preface: Combinatorial Optimization ISCO 2018

This special issue of *Discrete Applied Mathematics* is dedicated to the Fifth International Symposium on Combinatorial Optimization (ISCO 2018) that took place in Marrakesh, Morocco on April 11–13, 2018. ISCO 2018 was preceded by the Spring School that took place on April 9–10, 2018, on "Advanced Mixed Integer Programming Formulation Techniques" given by Juan Pablo Vielma and Joey Huchette from Massachusetts Institute of Technology (MIT), USA. This edition of ISCO was the fifth of a series of biennial conferences on combinatorial optimization with its first venue held in Hammamet, Tunisia in March 2010. ISCO is intended to be a forum for the exchange of recent scientific developments and for the discussion of new trends. The scope of the conference includes all aspects of combinatorial optimization ranging from mathematical foundations and theory of algorithms to computational studies and practical applications. Detailed information about ISCO 2018 is available at https://www.lamsade.dauphine.fr/~isco/ISCO2018/index4ea2.html?q=node/1.

In past years, combinatorial optimization has undergone rapid developments, major advances being obtained in different areas such as computational complexity, approximation algorithms, cutting-plane methods, and stochastic and robust optimization. Combinatorial optimization problems arise in different domains of production, telecommunication, economics, etc. Various exact, heuristic, and metaheuristic approaches have been devised for analysing and solving hard combinatorial optimization problems. Moreover, great development has been seen in graph theory and combinatorics that are central tools in combinatorial optimization. In this issue, several combinatorial optimization problems and resolution techniques as well as structural aspects of graphs and combinatorics are considered.

"Insight into the computation of Steiner minimal trees in Euclidean space of general dimension", by Marcia Fampa is an invited survey paper concerning state-of-the-art computational approaches for solving instances of the Euclidean Steiner tree problem in dimension greater than two.

"Matroid optimization problems with monotone monomials in the objective", by Anja Fischer, Frank Fischer, and S. Thomas McCormick investigates non-linear matroid optimization problems with polynomial objective functions, where the monomials satisfy certain monotonicity properties. These properties are exploited in a polyhedral approach to the problem.

"Computing the volume of the convex hull of the graph of a trilinear monomial using mixed volumes", by Emily Speakman, and Gennadiy Averkov gives new proof of a formula for the volume of the convex hull of the graph of a trilinear monomial, $y=x^1x^2x^3$, over a general box in the nonnegative orthant. The new shorter proof uses the deep theory of mixed volumes.

"A 2/3-approximation algorithm for vertex-weighted matching", by Ahmed Al-Herz, and Alex Pothen is a (computationally practical) 2/3-approximation algorithm for vertex-weighted matching on general graphs is devised. This extends what was known for bipartite graphs.

"A polyhedral model for enumeration and optimization over the set of circuits", by Steffen Borgwardt, and Charles Viss introduces a universal framework for enumerating the set of circuits and optimizing over sets of circuits of a polyhedron in an arbitrary representation (avoiding conversion to standard form that can cause the representation to explode). This leads to the efficient computation of a steepest-descent circuit that can be used in a theoretically efficient LP algorithm.

"Dual-feasible functions for integer programming and combinatorial optimization: Algorithms, characterizations, and approximations", by Matthias Köppe and Jiawei Wang studies two types of dual-feasible functions of a single real variable, in the context of the super-additive duality theory for integer programming. They also develop a software that automates testing piecewise-linear functions for maximality and extremality, providing a very useful tool for others working in this area.

https://doi.org/10.1016/j.dam.2021.12.012

"A PPA parity theorem about trees in a bipartite graph", by Kathie Cameron and Jack Edmonds presents a new PPA (Polynomial Parity Argument) theorem, concerning trees in bipartite graphs. This generalizes Berman's generalization of Thomason's generalization of Smith's Theorem.

"On some special classes of contact B_0-VPG graphs", by Flavia Bonomo-Braberman, María Pía Mazzoleni, Mariano Leonardo Rean, and Bernard Ries gives a forbidden induced subgraph characterization of contact B_0-VPG graphs within some special graph classes: chordal graphs, tree-cographs, P_4-tidy graphs, and P_5-free graphs. They also give a polynomial-time algorithm for recognizing chordal contact B_0-VPG graphs.

"Scaling matrices and counting the perfect matchings in graphs", by Fanny Dufosse, Kamer Kaya, Ioannis Panagiotas, and Bora Uçar investigates a randomized approach for approximating the number of perfect matchings in a bipartite graph (permanent of a 0–1 matrix) and in a general graph. An unbiased estimator is described for these quantities and a bound is provided on the critical ratio of this estimator. Theoretical results are supplemented with experimental results.

"Guessing fractions of online sequences", by Christian Konrad and Tigran Tonoyan addresses a typical issue in online computation, where in many situations it is necessary, or useful, to maintain an estimate of the amount of input that has been processed, or equivalently, of the amount of input that still has to be processed. This problem is formalized as one of guessing when an online algorithm finds itself at a given fraction of the input sequence length, without making any retroactive adjustments.

In "The Schrijver system of the flow cone in series–parallel graphs", by Michele Barbato, Roland Grappe, Mathieu Lacroix, Emiliano Lancini, and Roberto Wolfer Calvo the authors study when a graph has no K_5-minor, the corresponding flow cone can be described by the system $x(M) \geq 0$ for all multicuts M of the graph. The authors prove that this system is box-totally dual integral if and only if the underlying graph is series–parallel. Then, they refine this result to provide the Schrijver system describing the flow cone in series–parallel graphs.

"Structurally parameterized d-scattered set", by Ioannis Katsikarelis, Michael Lampis, and Vangelis Th. Paschos deals with the d-scattered set problem that consists, given a graph G and weights on the edges of G, in determining a set K of k nodes so that the distance (the shortest-path distance) between any pair of nodes in K is at least d. This problem generalizes the independent set problem ($d = 2$ and weights equal to 1). The authors provide upper and lower bounds on the complexity of this problem with respect to various standard graph parameters.

"Charging station optimization for balanced electric car sharing", by Antoine Deza, Kai Huang and Michael R. Metel focuses on finding optimal locations for charging stations for one-way electric car sharing programs. The objective is to limit the need for vehicle relocation by strategically locating charging stations given estimates of traffic flow. A mixed-integer linear programming formulation is presented with a large number of potential charging station locations. A column generation approach is used that finds an optimal set of locations for the continuous relaxation of the problem. Results of numerical experiments show that the proposed formulation significantly increases the balanced flow across the network.

"Network disconnection games: A game theoretic approach to checkpoint evaluation in networks", by Mourad Baïou and Francisco Barahona studies a network security question that consists of learning where are the most important checkpoints to intercept an adversary traveling from an origin to a destination. For that, they define a cooperative game where every player controls an arc and is able to place a checkpoint on it. The authors give a polynomial combinatorial algorithm for computing the nucleolus of this game. They also discuss the treatment of multiple adversaries.

"On the Lovász–Schrijver PSD-operator on graph classes defined by clique cutsets", by Annegret K. Wagler is devoted to the study of the Lovász–Schrijver PSD-operator LS_+ applied to the edge relaxation of the stable set polytope. The graphs for which the stable set polytope is achieved in one iteration of the LS_+ operator are called LS_+-perfect graphs. The author studies two graph classes. She completely describes the facets of the stable set polytope for such graphs that enables her to show that one class is a subclass of LS_+-perfect graphs, and to verify the so-called LS_+-Perfect Graph Conjecture for the other class.

"Student-project allocation with preferences over projects: Algorithmic and experimental results", by David Manlove, Duncan Milne, and Sofiat Olaosebikan studies the Student-Project Allocation problem with lecturer preferences over Projects (SPA-P). It is shown that MAX-SPA-P is polynomial-time solvable if there is only one lecturer involved, and NP-hard to approximate within some constant $c > 1$ if there are two lecturers involved. It is also shown that this problem remains NP-hard if each preference list is of length at most 3, with an arbitrary number of lecturers. The authors also describe an Integer Programming (IP) model for the MAX-SPA-P to be solved optimally in the general case. Following this, they present results arising from an empirical evaluation that investigates how the solutions produced by the approximation algorithms compare to optimal solutions obtained from the IP model.

"On convergence of scatter search and star paths with directional rounding for 0–1 mixed integer programs", by Raca Todosijević, Saïd Hanafia, and Fred Glover establishes several properties of directional rounding and show that it provides an extension of classical rounding and complementing operators. Also, they provide a Convergent Scatter Search algorithm for 0–1 Mixed Integer Programs.

In "Node-based Lagrangian relaxations for multicommodity capacitated fixed-charge network design", by Mohammad Rahim Akhavan Kazemzadeh, Tolga Bektaş, Teodor Gabriel Crainic, Antonio Frangioni, Bernard Gendron, and Enrico Gorgone node-based Lagrangian relaxations for the multicommodity capacitated fixed-charge network design problem, where the resulting Lagrangian subproblem decomposes by nodes, are introduced. It is shown that the Lagrangian dual bounds of these relaxations improve upon the linear programming relaxation bound. Also, the authors develop a Lagrangian matheuristic to compute upper bounds.

All the papers underwent the standard refereeing process of DAM. We would like to thank all the authors who submitted their work to this issue and the reviewers for their excellent work. Moreover, we would like to thank Professor Endre Boros, Editor–in-Chief of *Discrete Applied Mathematics*, for having accepted the publication of this special issue, and the editorial staff and publisher for their great cooperation and the high quality of the production.

Paris, September 15, 2021

Jon Lee
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PREFACE

Preface: The fourth International Symposium on Combinatorial Optimization (ISCO) 2016

Satoru Fujishige[1] · A. Ridha Mahjoub[2] · Franz Rendl[3]

Published online: 30 November 2018

This special issue of *Journal of Combinatorial Optimization* is dedicated to the fourth International Symposium on Combinatorial Optimization (ISCO 2016), which took place in Vietri Sul Mare, Italy, on May 16–18, 2016. ISCO 2016 was preceded by the Spring School on "Extended Formulations for Combinatorial Optimization" given by Samuel Fiorini and Volker Kaibel. This edition of ISCO was the fourth of a series of biennial conferences on combinatorial optimization with its first venue held in Hammamet, Tunisia in March 2010. ISCO is intended to be a forum for the exchange of recent scientific developments and for the discussion of new trends.The scope of the conference includes all aspects of combinatorial optimization ranging from mathematical foundations and theory of algorithms to computational studies and practical applications. Detailed information about ISCO 2016 is available in http://www.isco2016.it/.

In the past years, combinatorial optimization has undergone rapid developments, major advances being obtained in different areas such as computational complexity, approximation algorithms, cutting plane methods, and stochastic and robust optimization. Combinatorial optimization problems arise in different domains of production, telecommunication, economy, and the likes. Various exact, heuristic, and metaheuristic approaches have been devised for analysing and solving hard combinatorial optimization problems. Moreover, great development has been seen in graph theory and combinatorics, which are central tools in combinatorial optimization. In this issue, several combinatorial optimization problems and resolution techniques as well as structural aspects of graphs and combinatorics are considered.

- Base polyhedra and the linking property, by Tamàs Kiràly.

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Here it is proved that an integer polyhedron in the hyperplane $\Sigma_{j=1,\ldots,n}\, x_j = \beta$ is a base polyhedron if and only if it has the linking property, which implies that an integer polyhedron has the strong linking property if and only if it is a generalized polymatroid.

- On a general framework for network representability in discrete optimization, by Yuni Iwamasa.

In this paper, the author shows a complete characterization of network representable functions on $\{0,1\}^n$ in a general framework for the network representability of functions together with its implications to bi-submodular functions and k-submodular functions.

- A compact representation for minimizers of k-submodular functions, by Hiroshi Hirai and Taihei Oki.

A complete characterization of the class of a poset with inconsistent pairs (PIP) arising from k-submodular functions is given. Some algorithms to construct the elementary PIP of minimizers of a class of k-submodular functions are also discussed.

- An Algorithm for finding a representation of a subtree distance, by Kazutoshi Ando and Koki Sato.

In this paper, the authors give an $O(n^3)$ time algorithm for finding a representation of a given subtree distance. Using this, they also give an $O(n^3)$ time algorithm for deciding whether a given mapping is a subtree distance.

- Lot sizing with storage losses under demand uncertainty, by Stefano Coniglio, Arie M.C.A. Koster and Nils Spiekermann.

Here lot sizing with storages losses and demand uncertainty is modeled as a two-stage robust optimization problem. Computational experiments on heat production indicate that the two-stage approach with second-stage production and storage variables is preferable to having first-stage production variables. A hypbrid stochastic-robust approach is also investigated yielding the overall best performance.

- ILP Formulations of the degree-constrained minimum spanning hierarchy problem, by M. Merabet, M. Molnar and S. Durand.

In this paper, a hierarchy is interpreted as a homomorphism of a tree in a graph. An integer linear programming formulation for finding a degree-constrained minimum spanning hierarchy is discussed. Moreover A computational comparison of the degree-constrained minimum spanning tree problem to the new problem type shows a cost improvement when using the more general structure.

- Uniqueness of equilibria in atomic splittable polymatroid congestion games, by Tobias Harks and Veerle Timmermans.

The authors investigate here uniqueness of Nash equilibria in atomic splittable congestion games and derive a uniqueness result based on polymatroid theory.

- Sum-of-Squares rank upper bounds for matching problems, by Adam Kurpisz, Samuli Leppänen and Monaldo Mastrolilli.

In this paper the authors provide upper bounds for the rank of the sum-of-squares hierarchy for matching problems. In particular, they show that when the problem formulation is strengthened by incorporating the objective function in the constraints, the hierarchy requires at most k/2 ((k + 1)/2) levels to refute the existence of a perfect matching in an odd clique of size 2 k + 1, if k is even (odd).

- Robust trading mechanisms over 0/1 polytopes, by Mustafa Pinar.

The problem of designing a trade mechanism is considered in this paper. Using duality arguments, the author proposes a linear integer programming formulation for the problem. He also gives a full characterization of the convex hull of all the solutions of this formulation. Moreover, he introduces a further robustness concept, and gives a simple polynomial procedure to solve the associated design problem. Finally, he extends the results to the case where budget balance is relaxed to feasibility.

- Optimization problems with color-induced budget constraints, by Corinna Gottschalk, Hendrik Lüthen, Britta Peis, and Andreas Wierz.

Here the authors investigate extensions of the color-constrained matroid optimization problem, considered by Gabow and Tarjan (1984), to more general problems on poset matroids which take precedence constraints on the ground set into account.

- A compact representation for minimizers of k-submodular functions by Hiroshi Hirai and Taihei Oki.

A complete characterization of the class of a poset with inconsistent pairs (PIP) arising from k-submodular functions is given. Some algorithms to construct the elementary PIP of minimizers of a class of k-submodular functions are also discussed.

- Improved mixed-Integer programming models for the multiprocessor schedulung problem with communication delays, by Sven Mallach.

A mixed-integer programming model is introduced to describe the scheduling problem. Three modeling strategies are introduced, one ordering-based, one assignment-based, and finally a combination of the two. Extensive computations are given to demonstrate the efficiency of these approaches.

- Planning personnel retraining: column generation heuristics, by Oliver G. Czibula Hanyu Gu and Yakov Zinder.

This paper deals with the planning of personnel training. The authors show that the problem is NP-complete and dsicuss quadratic and linear programming formulations for the problem. Three column generation based algorithms and a neighbourhood search procedure are proposed.

- An exact approach for the balanced k-way partitioning problem with weight constraints and its application to sports team realignment, by Diego Recalde, Daniel Severín, Ramiro Torres and Polo Vaca.

This work is related to a balanced k-way partitioning problem with weight constraints to model the sports team realignment. Two integer programming formulations for the problem are introduced, and validity inequalities for the associated polytopes are identified. Using this together with a tabu search procedure for computing an upper bound, a branch-and-cut for the problem is devised.

- Subset sum problems with digraph constraints, by Laurent Gourvès, Jérôme Monnot and Lydia Tlilane.

The authors introduce and study some optimization problems related to the subset sum problem. Each problem is modelled as a node-weighted digraph problem, and one has to determine a node subset whose total weight does not exceed a given budget. Some additional constraints need to be satisfied. Some complexity and approximation results are discussed.

- The QAP polytope and the graph isomorphism problem, by P. Aurora and S.K. Mehta.

Graph isomorphism is investigated in terms of faces of the QAP polytope. Using an integer linear programming formulation of graph isomorphism, the authors provide a first set of certificates for a pair of graphs to be nonisomorphic. In addition, they introduce new facets of the QAP polytope.

- The weakly connected independent set polytope in corona and join of graphs, by Fatiha Bendali and Jean Mailfert.

In this paper, the authors introduce the weakly connected independent set problem, and discuss some compositions in the associated polytope. It is shown that if a graph is obtained from two graphs by either the corona or the join operation, then a complete description of the polytope can be obtained from the polytopes related to the pieces. Also some algorithmic consequences are discussed.

- The min-up/min-down unit commitment polytope, by Pascale Bendotti, Pierre Fouilhoux and Cécile Rottner.

This paper deals with the min-up/min-down unit commitment problem, which consists in finding.

Minimum-cost production plan on a discrete time horizon for a set of fossil-fuel units for electricity production. A polyhedral study of the problem is provided as well as a branch-and-cut algorithm.

- Approximability and exact resolution of the multidimensional binary vector assignment problem, by Marin Bougeret, Guillerme Duvillié and Rodolphe Giroudeau.

This paper discusses some approximation results for the multidimensional binary vector assignment problem.

- On the m-clique free interval subgraphs polytope: polyhedral analysis and applications, by Mohammed-Albarra Hassan, Imed Kacem, Sébastien Martin and Izzeldin M. Osman.

The m-clique free interval subgraphs polytope is studied. Several facet-defining inequalities for this polytope are introduced. The authors also discuss applications to the open-shop problem with disjunctive constraints. Using the polyhedral results, they propose a branch-and-cut algorithm for this problem.

All the submitted papers have gone through the strict reviewing process of this journal. We would like to thank all the authors who submitted their work to this issue and the reviewers for their excellent work. Moreover, we would like to thank Professor

Ding-Zhu Du, Editor–in-Chief of *Journal of Combinatorial Optimization*, for having accepted the publication of this special issue and the editorial assistants of the journal for their great effort and cooperation.