Newsletter 17 of EUROPT

EUROPT - The Continuous Optimization Working Group of EURO

http://www.iam.metu.edu.tr/EUROPT/

October 2009

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Words from the chair

Dear Members of EUROPT, dear Friends,

It is a great pleasure to address you these salutation words when we have already started the new academic year 2009-2010, in which a huge number of European universities are facing the so-called "Bologna Reforms".

The Bologna Declaration on the European space for higher education includes the following statement: "It is **a commitment freely taken** by each signatory country to reform its own higher education system or systems in order to create overall convergence at European level. The Bologna Declaration is not a reform imposed upon national governments or higher education institutions."

It is also stated that "The **action programme** set out in the Declaration is based on a clearly defined common goal, a deadline, and a set of specified objectives:

- a clearly defined common goal: to create a European space for higher education in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education;
- a deadline: the European space for higher education should be completed in 2010;
- a set of specified objectives: the adoption of a **common framework of readable and comparable degrees** , the introduction of **undergraduate and postgraduate levels in all countries**, with first degrees no shorter than 3 years and relevant to the labour market; **ECTS-compatible credit systems** also covering lifelong learning activities, a **European dimension in quality assurance**, with comparable criteria and methods; the **elimination of remaining obstacles to the free mobility** of students and teachers."

I would like to emphasize the sentence describing what seems to be one of the most relevant objectives of this reform: "in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education". To increase the international competitiveness of European higher education entails the need of a big effort in improving the quality of our undergraduate and postgraduate studies, and this is a very hard task in times of a big economical crisis, when governments are introducing severe cuts in their budgets, including the expenditures in education and research (about a 15% of reduction in Spain).

This situation is especially critical in those countries, like Spain, where academic authorities decided to go further in the Bologna Reform and to introduce important changes in the education system, which intends now to be mainly based on self-learning processes and tutorial teaching systems. These deep changes are not specifically considered in the Bologna Declaration, but the politicians in these countries try to avoid the high failing rates in the university studies, as well as to increase the motivation degree of the students.

These objectives are correct (in principle!), but they cannot be achieved without big investments in the universities, and they are not conceivable in this scenario of strong economical crisis.

So, my conclusion is that this is time for **optimization**, in the sense that universities must assign scarce resources to an increasing number of objectives (as contracting more assistants, splitting the students in smaller groups, introducing modern teaching technologies, etc.). I hope that our authorities will finally apply **optimal solutions** to the serious problem that we have to face in the next years, but perhaps we should limit our expectations and to hope that they will find at least **feasible solutions**.

With my best wishes, Yours sincerely, *Marco A. Lopez,* Chair of EUROPT

Forthcoming Events

- ## 3rd Global Conference on Power Control and Optimization
  ### Gold Coast, Australia
  ### February 2-4, 2010

  http://www.engedu2.net/index.htm

  (LAST ANNOUNCEMENT: submission of papers still possible until October 31, 2009)

  Scope and aims. The Conference is technically sponsored by AIP, WSEAS and Springer-link, and organized by School of Engineering, Curtin University, Malaysia, and the Middle East Technical University, the Institute of Applied Mathematics.

  Topics. Contemporary and original research and educational development in the area of electrical power engineering, control systems and methods of optimization. The scope includes, but not limited to, the following topics: Hybrid renewable energy and energy saving; Power systems, protection and reliability; Controllers, drives and machine design; Smart system and dynamic robust system; Mechatronics and nano physics; NEMS and MEMS; Simulators and software engineering; Soft computing and computational intelligent; Fuzzy and hybrid optimization; Bioinformatics and body sensors; Inventory, queuing game theory; Artificial immune systems; Evolutionary algorithms; Ant colony, genetic and swarm optimization; Probabilistic possibilistic optimization; Production design and rough set; Line, pattern searches and decision making; Micro transportation; Network communication and wireless sensor; Scheduling and assignment problems; Condition monitoring and instruments; Graph theory supply chain management; Financial mathematics and risk management.

  Papers. Prospective authors from universities or institutes and industries are invited to submit the full paper by email before the deadline. Paper should be submitted electronically, formatted in MS-Word, as per PCO guideline. All papers will be peer reviewed by independent specialists as per IEEE guide. PCO-10 proceeding will be published online by AIP. Selected papers will be published in Elsevier, Springer, Inderscience, Professional Engineering, and other Journals.

  Proposals for holding special Sessions, Stream, Tutorials and Workshops are invited from prospective authors, industrial bodies and academicians, and should be addressed to the Chair.

- ## 4th Australia-China Workshop on Optimization
  ### Ballarat, Australia
  ### December 9-11, 2009
  www.ballarat.edu.au/ard/itms/CIAO/Workshops/ACOW/

  The workshop aims to bring together experts from around the world in the area of optimization theory, methods and applications. It will provide an opportunity for meeting and exchanging recent research findings and discussions on possible collaboration and joint projects.

Keynote speakers: Professor Marco Lopez from University of Alicante, Professor Liansheng Zhang from Shanghai University and Professor Tamas Terlaky from Lehigh University.

- ## MOPGP10 – Multi-Objective Programming and Goal Programming
  ### Sousse, Tunisia
  ### May 24-26, 2010
  http://mopgp10.logiq-isgis.org/

Scope. MOPGP is an international conference series devoted to multi-objective programming and goal programming. It disseminates recent theoretical and methodological developments, algorithmic developments, survey results and significant technical applications in the field of MOP and GP.

Target topics (but not limited to): Planning and scheduling; Logistic and routing problems; Time tabling; Cutting problem; Knapsack problem; Portfolio optimization; Set covering / clustering / packing; Data mining; Health and environment; Bioinformatics; Business applications (Finance, management, marketing).

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IMPORTANT DAYS
Deadline for submission: January 31st, 2010
Notification of acceptance: March 1st, 2010
Early Registration: April 10th, 2010

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- ## 24th MEC-EurOPT-2010
  ## XXIV MINI EURO CONFERENCE "Continuous Optimization and Information-Based Technologies in the Financial Sector"
  ### Izmir, Turkey
  ### June 23-26, 2010

http://www.ieu.edu.tr/Europt-2010

Main topics: Computational and Mathematical Finance, Continuous Optimization and Control, and Information-Based Technologies, with a special emphasis on their fruitful interactions in theory, methods and applications.

Invited Speakers: Ralph Tyrell Rockafellar, University of Washington, USA; Roger J.-B. Wets, Mathematics, University of California, Davis, USA; Panos M. Pardalos, University of Florida, USA; Juan Enrique Martinez Legaz, Universitat Autonoma de Barcelona, Spain; Ulrich Horst, Humboldt University Berlin, Germany; Suleyman Ozekici, Koc University, Turkey.

Publications:

- A special issue of Journal of Global Optimization: Global Optim. Appl.;

- A Special Issue of Optimization: Advances in Cont. Optim. with Appl.in Fin.;

- A Special Issue of TOR - Transactions on Operational Research;

- Conference Proceedings Book.

Programme Committee Chair: Roger Wets, University of California at Davis, USA.

Organizing Committee Chair: Cemali Dincer, Izmir Univ. of Econ. Turkey.

Co-Chairs: Refail Kasimbeyli, Izmir Univ. of Econ, Turkey, Gerhard-Wilhelm Weber, Middle East Tech. Univ., Turkey.

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IMPORTANT DAYS
Abstract submission: January 18, 2010
Notification of acceptance: February 26, 2010
Early Registration: April 12, 2010

• **EURO XXIV**
24th European Conference on Operational Research
Lisbon, Portugal
July 11th - 14th, 2010

http://www.euro2010lisbon.org
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Aims and scope. This large conference is organized by EURO (The Association of European O.R. Societies) and APDIO (The Portuguese O.R. Society), with the support of FCUL (Faculty of Sciences, Universidade de Lisboa, Portugal) and CIO (Operational Research Centre, Portugal).

All researchers, academicians, practitioners, as well as students interested in any branch of operational research, mathematical modelling or economic analysis are invited to participate in the conference and to present their papers. Invited and contributed papers will be organized in parallel sessions. In general, sessions will be a part of conference streams, and streams are grouped by areas. Researchers who want to organize an invited session or contribute a paper within an invited session should contact the Stream organizer, Area organizer or a corresponding member of the Program Committee with their proposals. Abstract submission and registration are done online, via the Conference web page.

Contacts.

Programme: prog@euro2010lisbon.org

Registration, travel accommodation: registration@euro2010lisbon.org

General inquiries: info@euro2010lisbon.org

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IMPORTANT DAYS
Deadline for abstract submission: February 28, 2010
Notification of acceptance: March 15, 2010
Deadline for early registration: March 31, 2010

Deadline for author registration (for inclusion in the programme): April 30, 2010
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• 8th EUROPT Workshop on
ADVANCES IN CONTINUOUS OPTIMIZATION
Aveiro, Portugal
July 9 - 10, 2010

Programme Committee: Marco Lopez (Chair, Universidad de Alicante); Domingos M. Cardoso (Universidade de Aveiro); Emilio Carrizosa (Universidad de Sevilla); Joaquim J. Júdice (Universidade de Coimbra); Diethard Klatte (Universitat Zurich); Olga Kostyukova (Belarusian Academy of Sciences); Marco Locatelli (Universita' di Torino); Florian Potra (University of Maryland Baltimore County); Franz Rendl (Universitat Klagenfurt); Claudia Sagastizabal (CEPEL - Research Center for Electric Energy); Oliver Stein (Karlsruhe Institute of Technology); Georg Still (University of Twente).

Organizing Committee: Domingos M Cardoso (Chair, Universidade de Aveiro); Tatiana Tchemisova (co-Chair, Universidade de Aveiro); Miguel Anjos (University of Waterloo); Mirjam Duer (University of Groningen); Edite Fernandes (Universidade do Minho); Vicente Novo (Spanish Open University); Juan Parra (Universidad de Elche); Gerhard-Wilhelm Weber (Middle East Technical University).

More detailed information to appear in the next issue ow EUROPT Newsletters

• 52th Workshop "Nonlinear Optimization, Variational Inequalities and Equilibrium Problems"
Erice, Italy
July 2 - 10, 2010
www.dis.uniroma1.it/ erice2010

Organization. Ettore Majorana Centre for Scientific Culture International School of Mathematics "G. Stampacchia" Erice, Italy

Aims. To review and discuss recent advances in the development of analytical and computational tools for Nonlinear Optimization, Variational Inequalities and Equilibrium Problems, and to provide a forum for interactions in strictly related fields of research.

Topics. Topics include constrained and unconstrained nonlinear optimization, global optimization, derivative-free methods, nonsmooth optimization, nonlinear

complementarity problems, variational inequalities, equilibrium problems, game theory, bilevel optimization, neural networks and support vector machines training, applications in engineering, economics, biology and other sciences.

The Workshop will include keynote lectures (1 hour) and contributed lectures (30 min.). Members of the international scientific community are invited to contribute a lecture describing their current research and applications. Acceptance will be decided by the Advisory Committee of the School.

Invited lecturers who have confirmed the participation are: Ernesto G. Birgin, Francisco Facchinei, Christodoulos A. Floudas, David Gao, Diethard Klatte, Eva K. Lee,

Marco Locatelli, Jacqueline Morgan, Evgeni A. Nurminski, Jong-Shi Pang, Mike J. D. Powell, Franz Rendl, Nikolaos V. Sahinidis, Katya Scheinberg, Marco Sciandrone, Valeria Simoncini, Henry Wolkowicz, Ya-xiang Yuan.

Special issue. A special issue of Computational Optimization and Applications will be dedicated to the Workshop, including a selection of invited and contributed lectures.

Scientific and Organizing Committee: Gianni Di Pillo, SAPIENZA – Universita' di Roma, Italy; Franco Giannessi, Universita' di Pisa, Italy; Massimo Roma, SAPIENZA – Universita' di Roma, Italy

Contact: erice2010@dis.uniroma1.it

- ## 10th International Conference on PARAMETRIC OPTIMIZATION AND RELATED TOPICS (paraoptX)
  ### Karlsruhe, Germany
  ### September 20 - 24, 2010

  www.ior.kit.edu/paraoptX.php

The international conference series "Parametric Optimization and Related Topics" was founded in 1985 and, since then, took place each 2-3 years in different places: the latter six conferences were held in Enschede (1995), Tokyo (1997), Dubrovnik (1999), Puebla (2002), Cairo (2005), and Cienfuegos (2007). From September 20 to 24, 2010, the Karlsruhe Institute of Technology will host the conference paraoptX.

Parametric optimization is a part of mathematical programming and has emerged as an exciting research area in theory, numerics and applications. It investigates the properties of solutions to optimization problems under data perturbations or uncertainty. Many relations to other disciplines of operations research, like stochastic programming, complementarity problems, mixed-integer problems, model-building, numerical methods, multi-objective optimization and optimal control, originate from these properties.

paraoptX welcomes papers as well as proposals for special sessions on any area in parametric optimization or related topics. We hope that the conference will continue to help link researchers and practitioners from different areas of mathematical programming from around the world.

Invited speakers: Christodoulos A. Floudas (Princeton University, Princeton, USA); Sven Leyffer (Argonne National Laboratory, Argonne IL, USA); Boris Mordukhovich (Wayne State University, Detroit MI, USA); Jiri Outrata (Charles University, Prague, Czech Republic); Teemu Pennanen (Helsinki University of Technology, Helsinki, Finland); Andreas Waechter (IBM Watson Research Center, Yorktown Heights NY, USA)

Programm committee:

Chairs: Jan-J. Rueckmann (University of Birmingham, United Kingdom), Oliver Stein (Karlsruhe Institute of Technology, Germany)
*Members:*Wolfgang Achtziger (Technische Universitaet Dortmund, Germany), Roberto Cominetti (Universidad de Chile, Santiago, Chile), Asen Dontchev (National Science

Foundation, Ann Arbor, USA), Miguel Goberna (Universidad de Alicante, Spain), Andreas Griewank (Humboldt-Universitaet zu Berlin, Germany), Juergen Guddat (Humboldt-Universitaet zu Berlin, Germany), Francisco Guerra (Universidad de las Americas, Puebla, Mexico), Alfredo Iusem (IMPA, Rio de Janeiro, Brazil), Florian Jarre (Heinrich-Heine-Universitaet Duesseldorf, Germany), Hubertus Th. Jongen (RWTH Aachen, Germany), Christian Kanzow (Universitaet Wuerzburg, Germany), Diethard Klatte (Universtiaet Zuerich, Switzerland), Michal Kocvara (University of Birmingham, United Kingdom), Marco Lopez (Universidad de Alicante, Spain), Juan Enrique Martinez Legaz (Universitat de Barcelona, Spain), Diethard Pallaschke (Karlsruhe Institute of Technology, Germany), Panos Pardalos (University of Florida, Gainesville FL, USA), Werner Roemisch (Humboldt-Universitaet zu Berlin, Germany), Ruediger Schultz (Universitaet Duisburg-Essen, Germany), Alexander Shapiro (Georgia Tech, Atlanta, USA), Georg Still (Universiteit Twente, The Netherlands), Jie Sun (National University of Singapore, Republic of Singapore), Kok Lay Teo (Curtin University of Technology, Perth, Australia), Tamas Terlaky (Lehigh University, Bethlehem PA, USA), Michel Thera (Universite de Limoges, France), Jane Ye (University of Victoria, Canada)

Organizing committee:

Chair: Oliver Stein (Karlsruhe Institute of Technology, Germany)
Members: Stefan Nickel (Karlsruhe Institute of Technology, Germany), Jan-J. Rueckmann (University of Birmingham, United Kingdom), Marcel Sinske (Karlsruhe Institute of Technology, Germany), Paul Steuermann (Karlsruhe Institute of Technology, Germany), Karl-Heinz Waldmann (Karlsruhe Institute of Technology, Germany)

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IMPORTANT DAYS
Abstract submission: May 21, 2010
Notification of acceptance: June 4, 2010
Early Registration: June 18, 2010

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- ## 25 th Mini-EURO Conference on Uncertainty and Robustness in Planning and Decision Making
  ### Coimbra, Portugal
  ### April 15-17, 2010
  www.inescc.pt/urpdm2010

Organization. University of Coimbra, Portugal with the support of the COST Action IC0602 on Algorithmic Decision Theory and EURO (The European Association of Operational Research Societies)

Scope and objectives. Uncertainty and risk are pervasive issues in planning and decision making tasks. With a wide range of causes and types of uncertainty, there are correspondingly many approaches to their treatment in decision analysis and optimization models. Some are tackled through discussion and creativity techniques to help decision makers set the boundaries of their problem; others are tackled through modelling techniques, e.g. probability, to reflect the randomness in the external world; yet others are approached through the use of sensitivity and robustness studies to explore the possible consequences of lack of precision in data estimates and judgments. Different research

communities address uncertainty issues in planning and decision making using different approaches, which often present similarities although being developed under distinct perspectives. There is a clear need for more work in the interfaces between these approaches for dealing creatively and effectively with different types of uncertainty in different contexts, also having in mind real-world applications. This Conference is aimed at bringing together the specific expertise in aspects of handling uncertainty within decision support models to build a more comprehensive overview and integrated methodologies to tackle the various sources and types of uncertainties at stake in optimization and decision problems. The Conference will provide a forum in which researchers coming from different scientific disciplines and areas can discuss and share their experience regarding methodological approaches to tackle uncertainty for obtaining robust conclusions in decision support models and their applications. Contributions from decision theory, Bayesian analysis, fuzzy sets, rough sets, risk analysis, stochastic programming, sensitivity analysis, robustness analysis, interval programming, inexact programming, constraint programming, evolutionary algorithms and meta-heuristics, multi-criteria analysis and multi-objective optimization, among others, are expected both from methodological and application perspectives, thus paving the way for a cross-fertilization between distinct ways to incorporate the treatment of uncertainty in optimization and decision support models. This event follows up the successful conference on "Managing Uncertainty in Decision Support Models" that was held in 2004.

Submissions and publication. Contributions must be submitted under the form of short papers (4-6 pages) in the template provided at the Conference web site. Two types of submissions are welcome: - Proposal for a session of three papers devoted to a given topic. After acceptance, the promoter will be responsible for his/her session and will chair it. - Free submission of short papers. The accepted papers will be published in the Conference Proceedings. We are also arranging special issues of scientific journals for fully refereed versions of selected papers.

Venue. The conference will be hosted by the University of Coimbra. Dating from 1290, the University of Coimbra is one of the oldest higher education institutions in Europe. Coimbra is located in the centre region of Portugal, easily accessible by car, bus or train from Lisbon (200 Km) or Oporto (130 Km) international airports.

Organizing Committee. Carlos Henggeler Antunes, Luís Cândido Dias, Maria João Alves, Ana Rosa Borges, Carla Oliveira

International Programme Committee.

Chairs: Carlos Henggeler Antunes (Portugal) and David Rios Insua (Spain)

Members: Ahti Salo (Finland), Alexis Tsoukiàs (France), Amparo Marmol (Spain), Barry O'Sullivan (Ireland),Bernard Roy (France),Carlos Fonseca (Portugal), Daniel Vanderpooten (France), Eleni Pratsini (Switzerland), Enrique Miranda (Spain), Fabrizio Ruggeri (Italy),Jacinto Gonzalez-Pachon (Spain), János Fodor (Hungary), João Clímaco (Portugal),José Figueira (Portugal), Kaisa Miettinen (Finland), Laureano Escudero (Spain), Love Ekenberg (Sweden), Luís Dias (Portugal), Manfred Jaeger (Denmark), Manuel Matos (Portugal), Marc Sevaux (France), Mashahiro Inuiguchi (Japan), Melvyn Sim (Singapore), Pedro Larrañaga (Spain), Raymond Bisdorff (Luxembourg, Robin Keller (USA), Roman Slowinski (Poland), Salvatore Greco (Italy), Simon French (UK), Thomas Nielsen (Denmark), Ulrich Junker (France), Vincent Mousseau (France), Wlodzimierz Ogryczak

(Poland)

Secretariat. URPDM 2010, INESC Coimbra, Rua Antero de Quental 199, 3000-033 Coimbra, Portugal

Contact. E.mail: urpdm2010@inescc.pt

- **3rd Conference on Nonlinear Science and Complexity NSC'10**
Ankara, Turkey
July 28-31, 2010
nsc10.cankaya.edu.tr/index.php

Organization. Cankaya University, Ankara, Turkey

Aims and scope. This conference will provide a place to exchange recent developments, discoveries and progresses on Nonlinear Science and Complexity. The aims of the conference are to present the fundamental and frontier theories and techniques for modern science and technology, and to stimulate more research interest for exploration of nonlinear science and complexity. The conference will focus on fundamental theories and principles, analytical and symbolic approaches, computational techniques in nonlinear physical science and nonlinear mathematics.

Contacts. E.mail: nsc10@cankaya.edu.tr or dumitru@cankaya.edu.tr

Contact in EUROPT: Gerhard-Wilhelm Weber (gweber@metu.edu.tr)

- **ICOTA 8**
8th International Conference on Optimization: Techniques and Applications
Shanghai, China
December 10-13, 2010
http://www.fdsm.fudan.edu.cn/icota8

Scope: It is a continuation of the ICOTA series, which has been held in Singapore (1989 and 1992), Chengdu, China (1995), Perth, Australia (1998), Hong Kong (2001), Ballarat,

Australia (2004) and Kobe, Japan (2007). More information about ICOTA 8 can be found on the conference website.

International Programme Committee: *Co-chairs:* Masao Fukushima (Kyoto University), Kok Lay Teo (Curtin University of Technology)

Invitation to organize special sessions and special streams: Special sessions and streams are to complement the regular technical programme with emerging topics of interest and will constitute very important parts of the programme of ICOTA 8. . Each special session will consist of 4 talks, 20 minutes each. You are also welcome to organize a special stream which could include more than one session.

The proposal should be send to ICOTA8@fudan.edu.cn by February 1, 2010, and include the following information:
(1) Title of the proposed special session (stream)
(2) Name(s)/affiliation(s) of organizer(s), and contact email address
(3) List of potential contributors and tentative paper titles (if available)
(4) Aim of the proposed special session (stream)

Proposals will be evaluated on the basis of their relevance, timeliness, interest and significance, as well as the quality of potential papers to be included in the proposed session (stream). Notification of acceptance of special sessions (streams) will be sent via email by February 20, 2010. Special session (stream) organizers would be responsible for managing the review of the papers submitted to their proposed special sessions (streams).

Contact: ICOTA8@fudan.edu.cn

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IMPORTANT DAYS

Submission Deadline: February 1, 2010
Notification of acceptance of special sessions (streams): February 20, 2010
Acceptance Notification: February 20, 2010
Conference: December 10-13, 2010

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- **ALIO/INFORMS Joint International Meeting**
June 6-9, 2010
Buenos Aires, Argentina
http://meetings.informs.org/BuenosAires2010/ meetings@informs.org

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SECOND ANNOUNCEMENT

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All the information can be found in the conference web site and in EUROPT Newsletter N.16:

http://www.iam.metu.edu.tr/EUROPT/Newsletter16-EUROPT.pdf

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IMPORTANT DAYS
Abstract Submission opens: August 15, 2009
Abstract Submission deadline: February 1, 2010
Authors Deadline for Final Abstract Changes: April 26, 2010
Registration Deadline: May 7, 2010

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• ORP3 - EURO Conference for young OR researchers
Cádiz, Spain
September 13 - 16, 2011

Aims and scope. ORP3 is the EURO peripatetic conference, each edition of which is hosted by a renowned European centre in Operations Research. It is organised biannually and is devoted to the Operational Research field in its broadest sense. Previous conferences have been held in Paris (2001), Lambrecht (2003), Valencia (2005) and Guimarães (2007).

ORP3 aims at being a forum promoting scientific and social exchanges between the members of the future generation of Operations Research in academic research and industry.

Topics. The conference is open to the whole scope of Operations Research, but the following topics are mostly welcome: Integer Programming and Combinatorial Optimization; Discrete Optimization; Graphs Networks; Location Theory; Transportation and Logistics; Game Theory; Network Optimization; Multicriteria Optimization; Production Management; Supply Chain Management; Routing Problems

Sessions. The conference is composed only of plenary sessions and each participant will act as the chair and discussant of another session. In addition at least two tutorial sessions are planned with 1 hour and 30 minutes each.

Submission. The conference is based on a full paper submission.

Conference venue. The conference will be held in the Department of Statistics and Operation Research from Cádiz University, Spain.

Scientific and organizing committee. The scientific committee is formed by well established researchers in the field of Operations Research

Chair: Antonio M. Rodríguez-Chía, Universidad de Cádiz, Spain.

Co-Chair: Justo Puerto, Universidad de Sevilla, Spain.

Members: Francisco Barahona, IBM Watson Research Center, New York; Ángel Corberán, Universidad de Valencia, Spain; Elena Fernández, Universidad Politécnica de Cataluña, Spain; Xavier Gandibleux, Universite de Nantes, France; Horst Hamacher, Kairserslautern University, Germany; Eligius M.T. Hendrix, Wageningen University, Netherlands; Martine Labbé, Université Libre de Bruxelles, Belgium; Mercedes Landete, Universidad Miguel Hernández, Spain; Alfredo Marín, Universidad de Murcia, Spain; Stefan Nickel, Universität des Saarlandes, Germany; Arie Tamir, Tel Aviv University, Israel; Francisco Saldanha-da-Gama, University of Lisbon, Portugal; Bruno Simeone, Universita La Sapienza, Rome

Local organizing committee.

Chair: Antonia Castaño Martínez.

Co-Chairs: Inmaculada Espejo Miranda, and Concepción Valero Franco.

Members: Juan Ignacio García García, Juan Antonio García Ramos, Bartolomé López Jiménez, Juan Luis Peralta Sáez, Carmen Dolores Ramos González, Miguel Ángel Sordo Díaz, Alfonso Suárez Llorens.

Participation. Participation is limited to a group of about 35 students. In order to attend ORP3 as a participant you must satisfy one of the following conditions:

- A young PhD student

- A young post doctoral OR researcher (maximum two years after completing your doctoral thesis at the deadline for submission)

- A young OR analyst (maximum two years of professional experience at the deadline for submission)

The selection of participants is made by the scientific committee on the basis of full paper submissions of publishable quality in an international OR journal.

Co-authored papers are acceptable as long as they are presented by a participant satisfying the aforementioned requirements.

Submission of papers. The conference is based on a full paper submission. The paper submission may be in a PDF or Postscript format sent through the conference web site. After being accepted the participants are requested to send the source files of the paper in a LaTeX. The LaTeX style file will be available for download from the conference web site.

Contacts. E.mail: antonio.rodriguezchia@uca.es

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IMPORTANT DAYS

Deadline for submission: January 31, 2011
Notification of acceptance: June 15, 2011
Deadline for registration: July 15, 2011

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Awards and Nominations

- **EEPA 2010 – EURO Excellence in Practice Award 2010**

This is an invitation for Authors to submit work which they propose to present at the EURO Conference 2010 for the above award.

PURPOSE. The purposes of the competition are to:

- recognise outstanding accomplishments in the practice of Operational Research,
- attract more application-oriented papers to EURO Conferences,
- promote the practice of Operational Research in general.

GUIDELINES. All interested authors are invited to submit a detailed description of an application of Operational Research which has original features, whether in methodology, application or implementation. This may be in the form of a paper written for publication (although not necessarily published at the time of submission), a client report, or other appropriate documentation. The documentation must describe the work in a way which

illustrates how it meets the criteria outlined below. The age limit for published papers is four years. The work must not have been submitted concurrently to another competition. The application is open to Operational Research specialists from any part of the world.

EVALUATION CRITERIA. The criteria for the evaluation of the work are:

- scientific quality,

- relevance to Operational Research,

- originality in methodology, implementations and/ or field of application,

- a real impact to practice,

- appreciation by the organisation involved with the application.

Letters of appreciation are important.

THE PROCESS. The jury selects a short-list of finalists who will present their work in a special session of the EURO Conference 2010 in Lisbon. There is no registration fee for one author of each of the finalist presentations. The winner will be determined by the jury at the end of the special session and will be announced by the chairman of the jury during the closing session of the EURO Conference.

THE PRIZE. The prize for the winners is a distinct honour that in material terms consists of:

- a certificate of excellence in OR practice for each author of the paper and for the concerned organization,

- an amount of 3,000 EUR for the authors.

THE JURY.

CHAIR: Prof. Dr. M.Grazia Speranza, University of Brescia, Italy, speranza@eco.unibs.it

OTHER MEMBERS: Prof. Dr. Michel Bierlaire, EPFL, Lausanne, Switzerland,

michel.bierlaire@epfl.ch; Prof. Dr. Edmund Burke, University of Nottingham, UK, ekb@cs.nott.ac.uk; Prof. Richard Eglese, Lancaster University, UK, R.Eglese@Lancaster.ac.uk; Prof. Dr. Oli B.G. Madsen, Technical University of Denmark, ogm@transport.dtu.dk

SUBMISSION. Please send the material of your submission to the chair of the jury by email. The deadline for the submission of applications is: JANUARY 31, 2010

• EURO Doctoral Dissertation Award - EDDA 2010

The EDDA (EURO Doctoral Dissertation Award) is a EURO instrument. It consists of a prize that is awarded at each EURO-K conference. The purpose of the prize is to distinguish an outstanding PhD thesis in Operational Research defended in the countries having an OR society that is member of EURO. It will be awarded for the fifth time at the closing session of the EURO-2010 conference (Lisbon, July 11 - 14, 2010).

Eligibility of applications. The EDDA 2010 jury will only consider PhD theses in Operational Research defended between 15 January 2009 (i.e., the deadline for the preceding edition of the prize) and 15 January 2010 (the deadline for the present edition). The dissertation should have been defended in a University located in a member country of EURO. The author of the dissertation should be a member of a member society of

EURO. To be considered, a dissertation should be nominated by the supervisor of the thesis (one of them in case of multiple supervisors). The supervisor of the dissertation is asked to provide the jury with the following information:

1. the text of the dissertation,

2. an extended abstract (up to 5 pages) of the dissertation; this abstract should be written in English and should include precise keywords,

3. if the dissertation is not written in English, a paper in English authored (or co-authored) by the author of the dissertation and describing the core ideas of the thesis. This paper should preferably have been published in or submitted to an international journal.

4. nomination letters (or reports) from two referees selected by the dissertation supervisor, supporting the submission and stating their assessment of why the thesis should win the award.

5. an up-to-date CV of the candidate, including a list of publications.

No nomination will be considered without these items.

Additional information. All information should be sent in electronic form to the chairman of the jury, Mikael Rönnqvist (mikael.ronnqvist@nhh.no), using a compressed format (e.g. zip) to save space and bandwidth.

Since many PhD theses in OR are defended each year, the jury would like to remind supervisors that only outstanding pieces of work have a reasonable chance of winning the award.

Jury:

1. Mikael Rönnqvist (Chairman),

2. Jacques Teghem (Chairman of the 2012 edition of the EDDA),

3. Silvano Martello (Chairman of the 2013 edition of the EDDA),

4. Hartmut Stadtler,

5. Ahti Salo.

Selection process. The selection process consists in two phases.

Phase 1: Each application is studied by several members of the jury. The jury selects a short list of three finalists. The jury evaluates the applications taking the following points into account:

- Originality and novelty of the subject,
- Pertinence of the subject for OR;
- Depth and breadth of the results,
- Contributions of the dissertation to the theory and practice of OR,
- Applications and/or potential applicability of the results,
- Impact on related fields,
- Quality of the related publications.

Phase 2: These 3 finalists are invited to present their contribution in front of the jury and any other interested participant during a special EDDA session scheduled at the EURO 2010 conference. The jury selects the final laureate after the session.

Award. The prize consists in an ad hoc certificate and reward of 1,000 .

The three finalists will have to register for the EURO 2010 conference (they will only pay the early registration fees). EURO will contribute, if necessary, to their travel and journey expenses.

Deadlines.

The deadline for submitting applications is 15 January 2010.

The nomination of the three finalists will be made public before 15 April 2010.

Contact. Mikael Rönnqvist, Department of Finance and Management Science, Norwegian School of Economics and Business Administration, Helleveien 30, NO-5045 Bergen, Norway

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• EDSM 2010 – EURO Distinguished Service Medal 2010

Eligibility. The EDSM 2010 will be given to an individual who has served the European OR community and the profession effectively for many years. No currently active officer of EURO (Executive Committee member, EDSM 2010 jury member, Organising and Programme Committees Chairpersons of the EURO 2010 Conference) is eligible.

Award. The laureate will receive a "medal", a diploma and will be invited to all future EURO Conferences without payment of the registration fees.

Selection process: The national member societies of EURO, the EURO Working Groups, the previous EURO Distinguished Service Medal laureate and previous EDSM jury chair are kindly invited to send nominations for possible award recipients to the EDSM jury by the deadline indicated below. Please enclose, if possible, a CV or an equivalent document. Nominations must be made in confidence (i.e. the nominee should not be informed). The jury will evaluate the proposed candidates essentially on basis of their distinguished services to EURO and to the profession of OR.

Jury. Tuula Kinnunen (Chairperson), Alexis Tsoukias, Zilla Sinuany-Stern, Rainer Burkard, Jan Weglarz

Deadlines.

The deadline for submitting nominations is January 31, 2010.
The decision of the jury will be communicated to the EDSM laureate by March 5, 2010.
The decision of the jury will be publicly announced at the 2010 EURO Conference.

Contact. Tuula Kinnunen, HAAGA-HELIA, University of Applied Sciences Hietakummuntie 1 A FI-00700 Helsinki, Finland

Tel: +358 9 2296 6536 or +358 40 500 7473 Email: tuula.kinnunen@haaga-helia.fi or euro@tuulakinnunen.fi

Job opportunities

FACULTY POSITION: The MIT Sloan School invites applications for a tenure-track faculty position in the area of Operations Management beginning July 2010. Strong applicants will demonstrate the potential for research and teaching excellence in Operations Management. We are especially interested in candidates who can build a strong methodological research base, contribute to application areas of high impact, and be a successful teacher for the undergraduate, MBA, and Ph.D. programs. Applicants should possess or be close to the completion of a Ph.D. in a relevant field by the date of appointment. We especially want to identify qualified female and minority candidates for consideration in these positions. Applicants must submit their 1) up-to-date curriculum vitae, 2) relevant information about teaching as well as research experience and performance, and 3) three letters of recommendation by November 1, 2009. If papers are available, please provide electronic copies. Please send electronic applications to: om-search@mit.edu Operations Management Faculty Search Committee c/o Ms. Shiba Nemat-Nasser MIT Sloan School of Management MIT is an equal opportunity employer committed to building a culturally diverse intellectual community and strongly encourages applications from women and minorities.

Problems and Teaching Activities

The material of this section is proposed by professor Miguel F. Anjos, Department of Management Sciences, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada and Universität zu Köln, Institut für Informatik, Pohligstrasse 1, 50969 Köln, Germany.

<div align="center">

"Proofs of Via Semidefinite Programming"
by Miguel F. Anjos
E-mail: anjos@stanfordalumni.org

</div>

The Boolean satisfiability (SAT) problem has attracted researchers from various disciplines. This has resulted in extraordinary theoretical breakthroughs in the last few decades, and in a dramatic increase in the ability of software to solve SAT instances in recent years [6]. It remains nevertheless very challenging to detect and certify that a SAT instance is unsatisfiable, i.e., that none of the exponentially-many possible truth assignments will satisfy the given logic formula. The focus of this note is on the application of semidefinite programming (SDP) to prove unsatisfiability.

An instance of SAT in conjunctive normal form is specified by a set of Boolean variables $x_1, \ldots, x_n$ and a propositional formula $\Phi = \bigwedge_{j=1}^{m} C_j$, with each clause C_j having the form $C_j = \bigvee_{i \in I_j} x_i \vee \bigvee_{k \in \bar{I}_j} \bar{x}_k$ where $I_j, \bar{I}_j \subseteq \{1, \ldots, n\}$, $I_j \cap \bar{I}_j = \emptyset$, and $\bar{x}_i$ denotes the negation of x_i. The SAT problem asks whether Φ is satisfiable, that is, whether there is a truth assignment to the variables $x_1, \ldots, x_n$ such that Φ evaluates to TRUE.

If TRUE is denoted by 1 and FALSE by -1, and for clause j and $i \in I_j \cup \bar{I}_j$ we define

$$s_{j,i} := \left\{ \begin{array}{rcl} 1, & \text{if} & i \in I_j \\ -1, & \text{if} & i \in \bar{I}_j \end{array} \right.$$

then SAT can be formulated as an binary optimization feasibility problem:

$$\begin{array}{ll} \text{find} & x \in \{\pm 1\}^n \\ \text{s.t.} & \sum_{i \in I_j \cup \bar{I}_j} s_{j,i} x_i \geq 2 - l(C_j), \quad j = 1, \ldots, m \end{array}$$

where $l(C_j) = |I_j \cup \bar{I}_j|$ denotes the number of literals in clause C_j. SAT is in general NP-complete, though some special cases such as 2-SAT can be solved in polynomial time. (For $k \geq 2$, k-SAT refers to the instances of SAT for which all the clauses have length at most k.)

The impact of SDP in approximation algorithms for maximum-satisfiability problems, starting with the well-known breakthrough of Goemans and Williamson [9], is already well known. This is one of the latest developments in the long history of interplay between optimization and logical inference; the book of Chandru and Hooker [7] contains an excellent presentation of the role of linear and nonlinear programming until the 1990s, and the survey paper [3] summarizes the role of SDP in recent years.

The first SDP-based approach to SAT was the Gap relaxation of de Klerk, van Maaren, and Warners [8] based on the concept of elliptic approximations for SAT instances. The idea is to reformulate a SAT formula as the problem of finding a ± 1 (hence binary) n-vector in an intersection of ellipsoids in $\Re^n$. Although working directly with intersections of ellipsoids is difficult, this can be relaxed to an SDP problem, called the Gap relaxation. The Gap relaxation for 3-SAT may be expressed as follows:

find $X \in \mathcal{S}^{n+1}$
s.t.

$$s_{j,i_1} s_{j,i_2} X_{i_1,i_2} - s_{j,i_1} X_{0,i_1} - s_{j,i_2} X_{0,i_2} + 1 = 0, \text{ where } \{i_1, i_2\} = I_j \cup \bar{I}_j, \text{ if } l(C_j) = 2$$

$$s_{j,i_1} s_{j,i_2} X_{i_1,i_2} + s_{j,i_1} s_{j,i_3} X_{i_1,i_3} + s_{j,i_2} s_{j,i_3} X_{i_2,i_3} - s_{j,i_1} X_{0,i_1} - s_{j,i_2} X_{0,i_2} - s_{j,i_3} X_{0,i_3} \leq 0,$$
$$\text{where } \{i_1, i_2, i_3\} = I_j \cup \bar{I}_j, \text{ if } l(C_j) = 3$$

$$\mathrm{d}\,(X) = e$$

$$X \succeq 0$$

where $\mathcal{S}^n$ denotes the space of $n \times n$ square symmetric matrices, $\mathrm{d}\,(X)$ represents a vector containing the diagonal elements of the matrix X, e denotes the vector of all ones, and $X \succeq 0$ denotes that X is positive semidefinite. This relaxation characterizes unsatisfiability for 2-SAT problems and for some classes of covering problems, including mutilated chessboard and pigeonhole instances.

An elliptic approximation uses a quadratic representation of SAT formulas. More powerful relaxations can be obtained by considering higher-degree polynomial representation of SAT formulas. The starting point is to define for each clause a polynomial in ± 1 variables that equals 0 if and only if the clause is satisfied by the truth assignment represented by the values of the binary variables. Thus, testing satisfiability of a SAT formula is reduced to testing whether there are values $x_1, \ldots, x_n \in \{-1, 1\}$ such that for every clause in the instance, the corresponding polynomial evaluated at these values equals zero. We present two approaches for using SDP to answer this question.

The first approach, proposed by van Maaren, van Norden and Heule [14], is based on considering the aggregate polynomial obtained by summing all the polynomials arising from clauses. This polynomial is non-negative on $\{-1, 1\}^n$, and its value equals the number of unsatisfied clauses. A result of Putinar [12] shows that each polynomial that is non-negative on $\{-1, 1\}^n$ can be expressed as a sum-of-squares (SOS) modulo the ideal generated by the polynomials $x_k^2 - 1, k =$

$1, \ldots, n$. An SDP problem is now obtained as follows. Parrilo [11] showed that given a column vector β of monomials in the variables $x_1, \ldots, x_n$ and a polynomial $p(x)$, then $p(x)$ can be written as a SOS in terms of the elements of β if and only if there exists a matrix $S \succeq 0$ such that $\beta^T S \beta = p$. If S is symmetric positive semidefinite, then $S = W^T W$ for some matrix W, and hence we have an explicit decomposition of p as an SOS: $\beta^T S \beta = p \Rightarrow \|W\beta\|_2^2 = p$. The resulting SDP problem is

$$
\begin{aligned}
\max \quad & g \\
\text{s.t.} \quad & F_\Phi^{\mathcal{B}}(x) - g \equiv \beta^T S \beta \text{ modulo } I_{\mathcal{B}} \\
& S \succeq 0
\end{aligned}
$$

where $I_{\mathcal{B}}$ denotes the ideal generated by $x_k^2 - 1, k = 1, \ldots, n$. Note that since β is fixed, the equation $F(x) - g = \beta^T S \beta$ is linear in S and g, and hence this is an SDP problem.

van Maaren, van Norden and Heule show many interesting results of the SOS approach for maximum-satisfiability. For reasons of brevety, we only note here that the SOS approach can be applied to obtain proofs of unsatisfiability. For instance, it is straightforward to prove that if there exists a monomial basis β and an $\epsilon > 0$ such that $F^{\mathcal{B}}(x) - \epsilon$ is a SOS modulo $I_{\mathcal{B}}$, then the underlying SAT formula is unsatisfiable.

The second approach was proposed by this author and yields improved SDP relaxations by applying ideas from the Lasserre hierarchy of SDP relaxations for binary optimization problems [10]. The general construction and analysis of these relaxations are presented in [1, 2, 4, 5]. We outline here how these relaxations are constructed.

By construction of the coefficients $s_{j,i}$, clause j is satisfied if and only if $s_{j,i}x_i$ equals 1 for at least one $i \in I_j \cup \bar{I}_j$, or equivalently $\prod_{i \in I_j \cup \bar{I}_j} (1 - s_{j,i}x_i) = 0$. Expanding this product, we can formulate SAT as follows:

$$
\begin{aligned}
\text{find} \quad & x_1 \ldots, x_n \\
\text{s.t.} \quad & \\
& \sum_{t=1}^{l(C_j)} (-1)^{t-1} \left[\sum_{T \subseteq I_j \cup \bar{I}_j, |T| = t} \left(\prod_{i \in T} s_{j,i} \right) \left(\prod_{i \in T} x_i \right) \right] = 1, \quad j = 1, \ldots, m \\
& x_i^2 = 1, \quad i = 1, \ldots, n
\end{aligned}
$$

The next step is to formulate the problem in symmetric matrix space. Let $\mathcal{P}$ denote the set of nonempty sets $T \subseteq \{1, \ldots, n\}$ such that the term $\prod_{i \in T} x_i$ appears in the above formulation. Also introduce new variables

$$
x_T := \prod_{i \in T} x_i,
$$

for each $T \in \mathcal{P}$, and thus define the rank-one matrix

$$
Y := \begin{pmatrix} 1 \\ x_{T_1} \\ \vdots \\ x_{T_{|\mathcal{P}|}} \end{pmatrix} \begin{pmatrix} 1 \\ x_{T_1} \\ \vdots \\ x_{T_{|\mathcal{P}|}} \end{pmatrix}^T,
$$

whose $|\mathcal{P}| + 1$ rows and columns are indexed by $\{\emptyset\} \cup \mathcal{P}$. By construction of Y, we have that $Y_{\emptyset, T} = x_T$ for all $T \in \mathcal{P}$. Using these new variables, and the observation that for every triple

T_1, T_2, T_3 of subsets in $\mathcal{P}$ such that the symmetric difference of any two equals the third, the following three equations hold for every rank-one matrix Y:

$$Y_{\emptyset,T_1} = Y_{T_2,T_3}, \quad Y_{\emptyset,T_2} = Y_{T_1,T_3}, \quad \text{and} \quad Y_{\emptyset,T_3} = Y_{T_1,T_2}. \tag{1}$$

Since this is not necessarily true for the SDP relaxation (i.e., after the rank constraint is removed), we add some of these constraints explicitly to the SDP relaxation for the purpose of strengthening it. We choose to add the equations of the form (1) for all the triples $\{T_1, T_2, T_3\} \subseteq \mathcal{P}$ satisfying the symmetric difference condition and such that $(T_1 \cup T_2 \cup T_3) \subseteq (I_j \cup \bar{I}_j)$ for some clause j, we obtain the SDP relaxation:

$$
\begin{aligned}
&\text{find} \quad Y \in \mathcal{S}^{1+|\mathcal{P}|} \\
&\text{s.t.} \\
&\quad \sum_{t=1}^{l(C_j)} (-1)^{t-1} \left[\sum_{T \subseteq I_j \cup \bar{I}_j, |T|=t} \left(\prod_{i \in T} s_{j,i} \right) Y_{\emptyset,T} \right] = 1, \quad j = 1, \ldots, m \\
&\quad Y_{\emptyset,T_1} = Y_{T_2,T_3}, \quad Y_{\emptyset,T_2} = Y_{T_1,T_3}, \text{ and } Y_{\emptyset,T_3} = Y_{T_1,T_2}, \ \forall \{T_1, T_2, T_3\} \subseteq \mathcal{P} \\
&\qquad \text{such that } T_1 \Delta T_2 = T_3 \text{ and } (T_1 \cup T_2 \cup T_3) \subseteq (I_j \cup \bar{I}_j) \text{ for some } j \\
&\quad \mathrm{d}(Y) = e \\
&\quad Y \succeq 0
\end{aligned}
\tag{2}
$$

where $T_i \Delta T_j$ denotes the symmetric difference of T_i and T_j. As is also true for the Gap relaxation, if (2) is infeasible then the SAT formula is unsatisfiable. Since some SDP solvers can provide a certificate of infeasibility of the SDP problem (à la Farkas), the SDP-based approach can provide explicit certificates of unsatisfiability (to within a given precision ϵ) in polynomial-time.

Note that (2) has one linear contraint per clause, and the connections between the clauses are solely provided by the structure and positive semidefiniteness of the matrix Y of linearized terms. To improve the quality of the SDP relaxation, one can create more connections between the clauses by creating additional rows and columns. However, this should be done in a controlled manner to bound the size of the resulting relaxation. First, we choose one representative term for each clause j, namely $x_{I_j \cup \bar{I}_j}$. Let $\tilde{m}$ denote the number of such terms. (Since two or more clauses may be formed using exactly the same variables, $\tilde{m} < m$ is possible.) We augment $\mathcal{P}$ by adding sets of variables representing pairwise products of these $\tilde{m}$ terms, so as to better capture the interactions between clauses. Specifically, let $\mathcal{C}_0 = \{S | S = I_j \cup \bar{I}_j \text{ for some } j\}$; clearly $\mathcal{C}_0 \subset \mathcal{P}$ and $|\mathcal{C}_0| = \tilde{m}$. We wish to consider arbitrary pairings of the $\tilde{m}$ elements of $\mathcal{C}_0$, therefore we fix an ordering of the elements of $\mathcal{C}_0$, say: $S_0^{(1)}, S_0^{(2)}, \ldots, S_0^{(\tilde{m})}$. We denote the pairing using a permutation π_0 of $\{1, \ldots, \tilde{m}\}$ with the interpretation that the first two elements in the permutation are paired, then the next two, and so on (with a non-paired element at the end of the permutation if $\tilde{m}$ is odd).

Let π_0 thus represent a given pairing of the elements of $\mathcal{C}_0$. Using π_0, we define

$$\mathcal{C}_1 = \left\{ S_1^{(\lambda)} = S_0^{(\pi_0(2\lambda-1))} \Delta S_0^{(\pi_0(2\lambda))} | \lambda = 1, 2, \ldots, \lfloor \frac{\tilde{m}}{2} \rfloor \right\} \cup \left\{ S_0^{(\pi_0(\tilde{m}))} | \tilde{m} \text{ is odd} \right\}.$$

Clearly $|\mathcal{C}_1| = \lceil \frac{\tilde{m}}{2} \rceil$. Define $\mathcal{C}_2$ in a similar way using an arbitrary pairing of the elements of $\mathcal{C}_1$, and so on, until reaching $\mathcal{C}_L$ with only one set. It follows that $L \leq \log_2 \tilde{m} \leq \log_2 m$ and $3 \leq |\mathcal{C}_{L-1}| \leq 4$.

Using the set of column indices $\mathcal{C} := \mathcal{P} \cup \bigcup_{\sigma=1}^{L} \mathcal{C}_\sigma$, we formulate the problem in symmetric matrix space by proceeding as above, and we tighten the resulting SDP relaxation by adding the equations of the form (1) as in (2) plus all those from triples $\{S_\mu^{(\pi(2\lambda-1))}, S_\mu^{(\pi(2\lambda))}, S_{\mu+1}^{(\lambda)}, \} \subseteq \bigcup_{\sigma=1}^{L} \mathcal{C}_\sigma$ such that $S_{\mu+1}^{(\lambda)} = S_\mu^{(\pi(2\lambda-1))} \Delta S_\mu^{(\pi(2\lambda))}$ for some μ and λ. The resulting SDP relaxation is:

$$
\begin{aligned}
\text{find} \quad & Z \in \mathcal{S}^{1+|\mathcal{C}|} \\
\text{s.t.} \quad & \\
& \sum_{t=1}^{l(C_j)} (-1)^{t-1} \left[\sum_{T \subseteq I_j \cup \bar{I}_j, |T|=t} \left(\prod_{i \in T} s_{j,i} \right) Z_{\emptyset,T} \right] = 1, \quad j = 1, \dots, m \\
& Z_{\emptyset,T_1} = Z_{T_2,T_3}, \quad Z_{\emptyset,T_2} = Z_{T_1,T_3}, \text{ and } Z_{\emptyset,T_3} = Z_{T_1,T_2}, \forall \{T_1,T_2,T_3\} \subseteq \mathcal{P} \\
& \quad \text{such that } T_1 \Delta T_2 = T_3 \text{ and } (T_1 \cup T_2 \cup T_3) \subseteq (I_j \cup \bar{I}_j) \text{ for some clause } j \\
& Z_{\emptyset,S_\mu^{(\pi_\mu(2\lambda-1))}} = Z_{S_\mu^{(\pi_\mu(2\lambda))},S_{\mu+1}^{(\lambda)}}, \quad Z_{\emptyset,S_\mu^{(\pi_\mu(2\lambda))}} = Z_{S_\mu^{(\pi_\mu(2\lambda-1))},S_{\mu+1}^{(\lambda)}}, \\
& \quad \text{and } Z_{\emptyset,S_{\mu+1}^{(\lambda)}} = Z_{S_\mu^{(\pi_\mu(2\lambda-1))},S_\mu^{(\pi_\mu(2\lambda))}}, \forall \{S_\mu^{(\pi_\mu(2\lambda-1))}, S_\mu^{(\pi_\mu(2\lambda))}, S_{\mu+1}^{(\lambda)}\} \subseteq \mathcal{P} \\
& \quad \text{such that } S_{\mu+1}^{(\lambda)} = S_\mu^{(\pi_\mu(2\lambda-1))} \Delta S_\mu^{(\pi_\mu(2\lambda))} \text{ for some } \mu \text{ and } \lambda \\
& \mathrm{d}(Z) = e \\
& Z \succeq 0.
\end{aligned}
\tag{3}
$$

We note that different choices of permutations π_μ may lead to different relaxations for the same instance of SAT. Nonetheless, for any such choice, the relaxation (3) fully characterizes unsatisfiability for the Tseitin class of SAT instances [13]:

Theorem 1. *[5] A Tseitin instance of SAT is unsatisfiable if and only if the corresponding SDP relaxation (3) is infeasible for any choice of permutations π_μ.*

To construct a Tseitin instance, we begin with a parity problem, i.e., a collection of statements about the parity of a given set of Boolean variables. Each parity statement has the form $x_1 \oplus x_2 \oplus \dots \oplus x_p = r$, where $\oplus$ denotes exclusive or. Therefore, $r = 0$ denotes that an even number of the variables involved is TRUE, while $r = 1$ denotes that an odd number of them is TRUE. The problem is to determine if all the statements can be satisfied simultaneously.

Each parity statement is equivalent to a SAT instance composed of 2^{p-1} clauses. The structure of the clauses depends on the value of r:

- if $r = 0$ then the conjunction consists of all possible clauses on the p variables with an odd number of negated variables; and

- if $r = 1$ then the conjunction consists of all possible clauses on the p variables with an even number of negated variables.

To build a Tseitin instance of SAT, we fix a connected graph $G = (V, E)$ with each vertex $v_i \in V$ labelled with a value $t(v_i) \in \{0, 1\}$. Then we introduce a Boolean variable $x_{i,j}$ for each $(i, j) \in E$, and let each $v_i \in V$ give rise to the conjunction of $2^{\deg(v_i)-1}$ clauses corresponding to the parity statement

$$
\bigoplus_{\nu \in N(v_i)} x_{v_i,\nu} = t(v_i),
$$

where $N(v_i) \subset V$ denotes the vertices connected to v_i by an edge. It is straightforward to check that the SAT instance obtained from the conjunction of all these clauses is unsatisfiable if and only if $\sum_{v_i \in V} t(v_i)$ is odd. By Theorem 1, this is equivalent to feasibility of (3).

A number of interesting open questions remain in this area. One question is to study how particular choices of the permutation π_μ may affect the effectiveness of (3). Another open question is how to extract the combinatorial information contained in a certificate of infeasibility from an SDP solver. This would be a significant step in bridging from the numerical proof of infeasibility provided by an SDP solver to a proof of unsatisfiability in the language of logic.

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Editor's personal comments

Dear colleagues, dear members of EUROPT and dear readers.

We continue to receive information from many friends and colleagues to whom we are very in debt. I would like to emphasize the precious collaboration of Gerhard Wilhelm Weber (Willy), Kaisa Mittenen, Oliver Stein, and others who have send us the most part of the enclosed information. I would like also to express my gratitude to Professor Marco Lopez, Chair of EUROPT, whose deep reflection about the Bologna Reforms invites to think seriously about pros and cons of this process that affects almost all of us, and to Professor Miguel Anjos, from Department of Management Sciences, University of Waterloo, by his very attractive introduction to Boolean satisfiability problems via semidefinite programming.

Finally, I would like to mention that the 8th EUROPT Workshop on Advances in Continuous Optimization will be held in Aveiro, Portugal, between 9 and 10 of July (before EURO XXIV, Lisbon, 11-14 July, 2010). It will be a very special Workshop, celebrating the 10th birthday of EUROPT (founded in July 2000, in Budapest, during the 17th European Conference on Operation Research, with Professor Tamas Terlaky as the first Chair).

On behalf of the Editorial Board of EUROPT Newsletter,
Domingos M Cardoso

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Editorial Board: Domingos M Cardoso, Tatiana Tchemisova
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