



# BULLETIN

## INTERNATIONAL CENTER FOR MATHEMATICS

JUNE 2005

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### COMING EVENTS

#### THEMATIC TERM ON OPTIMIZATION

##### COORDINATOR

Luís Nunes Vicente (University of Coimbra)

Optimization (mathematical programming) is a well established discipline of mathematics which has been remarkably capable of finding new applications to science, engineering, and economics.

##### DATES

July 2005

Two areas where optimization is playing an increasingly important role are finance and medicine. The 2005 CIM Thematic Term includes a workshop and a short-course

on Optimization in Finance and a workshop on Optimization in Medicine.

One of the main events of this Thematic Term is the Workshop on PDE Constrained Optimization, where a short course is also planned. Optimization problems governed by PDEs is at the core of simulation-based optimization, an area of high demand and pivotal importance in multi-disciplinary engineering.

A Summer School on Integer Programming is also scheduled, focused on the newest recent developments obtained by geometric and algebraic approaches to combinatorial optimization problems.

The programme of events is the following:

### **July 5-8: Workshop on Optimization in Finance**

#### ORGANIZERS

A. M. Monteiro (University of Coimbra), R. H. Tütüncü (Carnegie Mellon University, Pittsburgh, USA) and L. N. Vicente (University of Coimbra).

#### AIMS

Optimization models and methods play an increasingly important role in financial decision making. Many problems in quantitative finance, originated from asset allocation, risk management, derivative pricing, and model fitting, are now routinely and efficiently solved using modern optimization techniques. This workshop will bring together researchers in the rapidly growing field of financial optimization and intends to provide a forum for innovative models and methods on new topics, novel approaches to well-known problems, success stories, and computational studies in this exciting field. Participants are encouraged to present and discuss their recent work and new, possibly controversial, approaches are particularly welcome.

The targeted audience for this workshop includes graduate students and faculty members working in applied mathematics, operations research, and economics, who have been interested in mathematical finance or plan to do so. The workshop will also be attractive for those doing quantitative modelling in the financial market.

A one-day short-course, intended for optimization researchers interested in quantitative finance as well as finance researchers and practitioners interested in optimization models and methods, will precede the scientific programme of the workshop. Invited and contributed presentations will be scheduled during the remaining three days.

The event will be held at the Faculty of Economics - University of Coimbra.

#### SHORT COURSE

It will be delivered by

R. H. Tütüncü (Carnegie Mellon University, USA)

S. Uryasev (University of Florida, USA)

#### INVITED SPEAKERS

J. R. Birge (University of Chicago, USA)

T. F. Coleman (Cornell University, USA)

H. Konno (Chuo University, Japan)

J. M. Mulvey (Princeton University, USA)

R. T. Rockafellar (University of Washington, USA)

N. Touzi (CREST, France)

S. A. Zenios (University of Cyprus, Cyprus)

For more information about the event, see

<http://www.mat.uc.pt/tt2005/of/>

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### **July 11-15: Summer School on Geometric and Algebraic Approaches for Integer Programming**

#### ORGANIZERS

M. Constantino (University of Lisbon), L. Gouveia (University of Lisbon) and R. Weismantel (Otto-von-Guericke-University of Magdeburg, Germany).

#### AIMS

The School is composed by five set of lectures, designed to introduce young researchers to the more recent advances on geometric and algebraic approaches for integer programming. Each set of lectures will be about six hours long. They will provide the background, introduce the theme, describe the state-of-the-art, and suggest practical exercises. The organizers will try to provide a relaxed atmosphere with enough time for discussion.

Integer programming is a field of optimization with recognized scientific and economical relevance. The

usual approach to solve integer programming problems is to use linear programming within a branch-and-bound or branch-and-cut framework, using whenever possible polyhedral results about the set of feasible solutions. Alternative algebraic and geometric approaches have recently emerged that show great promise. In particular, polynomial algorithms for solving integer programs in fixed dimension have recently been developed. This is a hot topic of international research, and the School will be an opportunity to bring up-to-date knowledge to young researchers.

The school will be held at the Faculty of Sciences, Bloco C6 - located in the main campus of the University of Lisbon.

#### LECTURES

*Generating Functions for Lattice Points*

A. Barvinok (University of Michigan, USA)

*Geometric Approaches to Cutting Plane Theory*

G. Cornuéjols (Carnegie Mellon University, USA)

*Fast Algorithms for Integer Programming in Fixed Dimension*

F. Eisenbrand (Max-Planck-Institut, Germany)

*I. Experimenting and Applying the Rational Function Method: A LattE Tutorial*

*II. Transportation Polytopes: Structure, Algorithms, and Applications to Optimization and Statistics*

J. de Loera (University of California, Davis, USA)

*The Integral Basis Method and Extensions*

R. Weismantel (Otto-von-Guericke Univ. Magdeburg, Germany)

For more information about the event, see

<http://www.mat.uc.pt/tt2005/ss/>

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#### **July 20-22: Workshop on Optimization in Medicine**

#### ORGANIZERS

C. Alves (Technical University of Lisbon), P. M. Pardalos (University of Florida, Gainesville, USA) and L. N. Vicente (University of Coimbra).

#### AIMS

The study of computing in medical applications has opened many challenging issues and problems for both the medical computing and mathematical communities. This workshop is intended to foster communication and collaboration between researchers in the medical computing community and researchers working in applied mathematics and optimization.

Mathematical techniques (continuous and discrete) are playing a key role with increasingly importance in understanding several fundamental problems in medicine.

For instance, mathematical theory of nonlinear dynamics and discrete optimization has been used to predict epileptic seizures. Next to stroke, epilepsy is among the most common disorders of the nervous system. Measures derived from the theory of nonlinear dynamics and discrete optimization techniques are used for prediction of impending epileptic seizures from analysis of multielectrode electroencephalographic (EEG) data.

Several examples of the use of mathematics in medicine can be found in recent cancer research. Sophisticated mathematical models and algorithms have been used for generating treatment plans for radionuclide implant and external beam radiation therapy. With Gamma Knife treatment, for example, optimization techniques have been used to automate the treatment planning process.

Optimization has been used to address a variety of medical image registration problems. In particular, specialized mathematical programming techniques have been used in a variety of domains including the rigid alignment of primate autoradiographs and the non-rigid registration of cortical anatomical structures as seen in MRI.

The invited presentations will be complemented by sessions of contributed talks.

The event will take place at the Institute of Biomedical Research in Light and Image (IBILI), Faculty of Medicine - University of Coimbra

#### INVITED PRESENTATIONS

*Optimization of Gamma Knife Radiosurgery*

M. C. Ferris (University of Wisconsin, USA)

*Multicriteria Optimization in Radiation Therapy*

H. W. Hamacher (Univ. of Kaiserslautern, Germany)

*Optimization in Epilepsy*

L. D. Iasemidis (Arizona State University, USA)

*Optimal Reconstruction Kernels in Medical Imaging*

A. K. Louis (University of Saarbrücken, Germany)

*Optimization and Optimal Control in High Intensity Ultrasound Surgery*

J. P. Kaipio (University of Kuopio, Finland)

*Integer Programming in Radiation Therapy*

E. K. Lee (Georgia Institute of Technology, USA)

*Optimization in Medical Imaging Registration*

A. Rangarajan (University of Florida, USA)

For more information about the event, see

<http://www.mat.uc.pt/tt2005/om/>

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## July 26-29: Workshop on PDE Constrained Optimization

### ORGANIZERS

L. M. Fernandes (Polytechnical Institute of Tomar), M. Heinkenschloss (Rice University, Houston, USA) and L. N. Vicente (University of Coimbra).

### AIMS

Optimization problems governed by partial differential equation (PDE) constraints arise in many important applications. Progress in computational and applied mathematics combined with the availability of rapidly increasing computer power steadily enlarges the range of applications that can be simulated numerically and for which optimization tasks, such as optimal design, parameter identification, and control are being considered. For most of these optimization problems, simple approaches combining off-the-shelf PDE solvers and optimization algorithms often lack robustness or can be very inefficient.

Successful solution approaches have to overcome challenges arising from, e.g., the increasing complexity of applications and their mathematical models, the influence of the underlying infinite dimensional problem structure on optimization algorithms, and the interaction of PDE discretization and optimization.

This workshop will combine a wide range of topics important to PDE constrained optimization in an integrated approach, fusing techniques from a number of

mathematical disciplines including functional analysis, optimal control theory, numerical optimization, numerical PDEs, and numerical analysis and application specific structures.

A short course will be offered on the first day of the workshop.

Invited and contributed presentations will be scheduled during the remaining three days.

The event will take place at the Escola Superior de Tecnologia de Tomar and Hotel dos Templários, Tomar.

### SHORT COURSE

*Theoretical background on characterization and properties of solutions to PDE constrained optimization problems*

F. Tröltzsch (Technical University of Berlin, Germany)

*Numerical solution of PDE constrained optimization problems*

M. Heinkenschloss (Rice University, USA)

### INVITED PRESENTATIONS

*Flow Control*

M. D. Gunzburger (Florida State University, USA)

*Multiphysics Problems*

R. H. W. Hoppe (University of Augsburg, Germany)

*State Constraints*

K. Kunisch (University of Graz, Austria)

*Time Dependent Problems*

G. Leugering (Univ. Erlangen-Nürnberg, Germany)

*Model Reduction*

A. T. Patera (MIT, USA)

*Adaptive Solution of PDE Constrained Problems*

R. Rannacher (University of Heidelberg, Germany)

*Preconditioning of KKT Systems*

E. W. Sachs (University of Trier, Germany)

For more information about the event, see

<http://www.mat.uc.pt/tt2005/pde/>

OTHER CIM EVENTS IN 2005:

INTERNATIONAL CONFERENCE ON  
SEMIGROUPS AND LANGUAGES

University of Lisbon, July 12-15

Organizers:

Jorge M. André, New Univ. of Lisbon  
Mário Branco, Univ. of Lisbon  
Vitor Hugo Fernandes, New Univ. of Lisbon  
John Fountain, Univ. of York, UK  
Gracinda M. S. Gomes, Univ. of Lisbon  
John Meakin, Univ. of Nebraska, USA

CONFIRMED INVITED LECTURERS

J. Almeida, Univ. of Porto, Portugal  
R. Gilman, Stevens Institute of Technology, USA  
M. Lawson, Heriot-Watt Univ., UK  
S. Margolis, Bar-Ilan Univ., Israel  
D. McAlister, Northern Illinois Univ., USA  
D. Munn, Univ. of Glasgow, UK  
F. Otto, Univ. of Kassel, Germany  
J.-E. Pin, Univ. Paris 7, France  
P. Silva, Univ. of Porto, Portugal  
B. Steinberg, Carleton Univ., Canada  
M. Szendrei, Univ. of Szeged, Hungary  
D. Therien, McGill Univ., Canada  
M. Volkov, Ural State Univ., Russia  
P. Weil, Univ. of Bordeaux, France

For more information about this event, see

<http://caul.cii.fc.ul.pt/cs12005/>

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WORKSHOP ON STATISTICS IN GENOMICS  
AND PROTEOMICS

Hotel Estoril Eden, Monte Estoril, October 6-8

Organizers:

M. Antónia A. Turkman, Univ. of Lisbon  
Kamil Feridun Turkman, Univ. of Lisbon  
Lisete Sousa, Univ. of Lisbon  
Luzia Gonçalves, New Univ. of Lisbon

AIMS

The workshop will aim to bring together the leading researchers in the areas of statistics in genomics and proteomics, to describe the state of the art and also to present problems that will change the next generation of Biostatistics and Bioinformatics researchers.

The workshop will have 7 Keynote speakers and 5 Invited speakers (from Portugal) on topics which are at the forefront of research. The main areas of the workshop are:

- Analysis of Gene Expression Data
- Regulatory Networks
- Statistical Proteomics
- Physical Mapping
- Phylogenetics and Evolutionary Genomics

PRELIMINARY LIST OF KEYNOTE SPEAKERS

Terry Speed, Department of Statistics, University of California, USA

Dirk Husmeier, Biomathematics & Statistics Scotland SCRI, UK

Ruedi Aebersold, Institute for Systems Biology, Seattle, USA

Sophie Schbath, Institut National de la Recherche Agronomique, Unité Mathématique, Informatique & Génome, France

Korbinian Strimmer, Department of Statistics, University of Munique, Germany

Chris Cannings, Division of Genomic Medicine, University of Sheffield, UK

Simon Tavaré, Department of Biological Sciences, University of South California, USA

## PRELIMINARY LIST OF INVITED SPEAKERS

Margarida Amaral, Department of Chemistry and Biochemistry, University of Lisbon and National Institute of Health, Lisbon

Líbia Zé-Zé, Sequencing Unit, ICAT, University of Lisbon

Pedro Fernandes, Gulbenkian Institute of Science, Lisbon

Rogério Tenreiro, Department of Plant Biology, University of Lisbon

Mário Silva, Department of Informatics, University of Lisbon

For more information about this event, see

<http://wsgp.deio.fc.ul.pt/>

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## WORKING AFTERNOONS SPM/CIM

CIM, Coimbra

A joint initiative of the Portuguese Mathematical Society (SPM) and the International Center for Mathematics (CIM).

Programme for 2005/06:

- 3 September 2005 - Geometry - Organizer: Rui Loja Fernandes (IST, Lisbon)
- 5 November 2005 - Partial Differential Equations - Organizer: José Miguel Urbano (Univ. Coimbra)

- 7 January 2006 - Dynamical Systems - Organizer: José Ferreira Alves (Univ. Porto)
- 4 March 2006 - Statistics - Organizer: Paulo Teles (Univ. Porto)
- 6 May 2006 - Optimization - Organizer: Domingos Cardoso (Univ. Aveiro)

For more information, see

<http://www.spm.pt/investigacao/spmcim/spmcim.phtml>

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## SUMMER SCHOOL ON MATHEMATICS “ESCOLA DIAGONAL”

IST, Lisbon, September 5-9

An organization of the *Fundação Calouste Gulbenkian*, in the framework of the *Programa Gulbenkian Novos Talentos em Matemática*.

Also supported by *Fundação para a Ciência e a Tecnologia* (FCT), International Center for Mathematics (CIM), Portuguese Mathematical Society (SPM) and Center for Mathematical Analysis, Geometry, and Dynamical Systems of IST.

For more information, see

<http://www.math.ist.utl.pt/escola/>

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## CIM EVENTS FOR 2006

The CIM Scientific Committee, in a meeting held in Coimbra on February 12, approved the CIM scientific programme for 2006.

The list of events is the following:

GRAPH SPECTRA

10-12 April 2006

Chairman of Organizing Committee:

D. Cardoso, Univ. Aveiro

Chairman of Scientific Committee:

D. Cvetkovic, Univ. Belgrado, Serbia-Montenegro

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LIE ALGEBRAS AND QUANTIC GROUPS

28-30 June 2006

Organizing Committee:

H. Albuquerque, Univ. Coimbra

S. Lopes, Univ. Porto

J. Teles, Univ. Coimbra

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MATHEMATICS IN CHEMISTRY

19-21 July 2006

Chairman of Organizing Committee:

J. C. Zambrini, Univ. Lisbon

Chairman of Scientific Committee:

J. A. Martinho Simões, Univ. Lisbon

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SUMMER SCHOOL ON STATISTICAL TOOLS IN  
KNOWLEDGE BUILDING

23-29 July 2006

For updated information on these events, see

<http://www.cim.pt/?q=events>.

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Scientific Coordinators:

D. Pestana, Univ. Lisbon

C. W. Andersen, Univ. Sheffield, England

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MATHEMATICAL PROBLEMS IN  
TELECOMMUNICATIONS

4-8 September 2006

Organizing Committee:

C. Salema, Telecommunications Institute and IST, Lisbon

C. Rocha, Mathematics Department, IST, Lisbon

A. Navarro, Telecommunications Institute and Univ. Aveiro

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MATHEMATICS IN BIOLOGY AND MEDICINE

11-15 September 2006

Organizing Committee:

J. Carneiro, F. Dionísio, G. Gomes and I. Gordo, Gulbenkian Institute of Science, Oeiras

## CIM NEWS

### SEMINAR OF THE 2005 ANNUAL SCIENTIFIC COUNCIL MEETING

Held in Coimbra in February 12, 2005, the files of the talks

Geodesic flows on flat surfaces

(by Marcelo Viana, IMPA, Brasil)

A market-induced mechanism for stock pinning

(by Marco Avellaneda, Courant Institute of Mathematical Sciences, USA)

are available at <http://www.cim.pt/?q=cscam>

### MEETING OF THE GENERAL ASSEMBLY OF CIM

During the morning of May 21, 2005, the General Assembly of CIM met in the CIM premises at the Astronomical Observatory of the University of Coimbra. In the afternoon of the same day, the members of the General Assembly had the opportunity to attend a talk by Eng. António Segadães Tavares (one of the recipients of the 2004 IABSE Outstanding Structures Award) on the extension of the Funchal Airport, and another one by Prof. Manuel Castellet (the Chairman of ERCOM - European Research Centres on Mathematics) about ERCOM and the *Centre de Recerca Matemàtica* (Barcelona, Spain).

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## RESEARCH IN PAIRS AT CIM

CIM has facilities for research work in pairs and welcomes applications for their use for limited periods.

These facilities are located at Complexo do Observatório Astronómico in Coimbra and include:

- office space, computing facilities, and some secretarial support;
- access to the library of the Department of Mathematics of the Univ. of Coimbra (30 minutes away by bus);
- lodging: a two room flat.

At least one of the researchers should be affiliated with an associate of CIM, or a participant in a CIM event.

Applicants should fill in the electronic application form in

<http://www.cim.pt/?q=research>

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## CIM ON THE WEB

For updated information about CIM and its activities, see <http://www.cim.pt>

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