EURO Summer Institute 2006

Optimization Challenges in Engineering: Methods, Software, and Applications

Lutherstadt Wittenberg

18 August – 2 September, 2006

Final Report

Contents

1 Scientific Committee

- Mirjam Dür (Darmstadt, Germany)
- Horst Hamacher (Kaiserslautern, Germany)
- Petra Huhn (Clausthal, Germany)
- Florian Jarre (Düsseldorf, Germany)
- Kathrin Klamroth (Erlangen, Germany)
- Michal Kočvara (Prague, Czech Republic)
- Claude Lemaréchal (INRIA, France)
- Yurii Nesterov (Louvain, Belgium)
- Tamás Terlaky (Hamilton, Canada)

2 Organizing Committee

Local:

- Mirjam Dür (Darmstadt, Germany)
- Petra Huhn (Clausthal, Germany)
- Kathrin Klamroth (Erlangen, Germany)
- Christiane Tammer (Halle, Germany)

External:

- Ulrike Leopold-Wildburger (Graz, Austria)
- Bülent Karasözen (Ankara, Turkey)
- Günter Leugering (Erlangen, Germany)
- Gerhard Wilhelm Weber (Ankara, Turkey)

3 Sponsors

We would like to thank the following sponsors whose support made possible this Summer Institute:

EURO
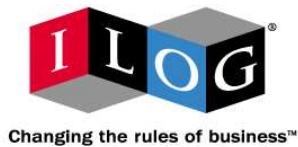**The Association of European Operational Research Societies**

GOR
The German Operations Research Society

EUROPT
The Continuous Optimization Working Group of EURO

The Leucorea Foundation

ILOG

Siemens

The State of Saxony-Anhalt

Vereinigung der Freunde der Technischen Universität Darmstadt

4 Summary

EURO institutes are organized on an annual basis by EURO, the Association of European Operational Research Societies. They take place in different countries and focus on varying topics. For two weeks, they bring together 20 to 30 carefully selected junior scientists and give them the opportunity of joint discussions, of forming networks with international colleagues, and of meeting renowned researchers in their field. This is accomplished by a combination of an inspiring scientific program with interesting social activities.

ESI2006 was carried out by the German Operations Research Society (GOR) and the EURO Working Group on Continuous Optimization (EUROPT). It was organized by Mirjam Dür, Petra Huhn, Kathrin Klamroth and Christiane Tammer. It was initiated, however, by Gerhard-Wilhelm Weber, the chair of EUROPT, and Tamás Terlaky, whom we wish to thank for their continuing support. Additional valuable support was provided by Gerhard Wäscher, the head of the GOR, which we appreciated very much.

The topic of ESI2006 was modern optimization methods and their applications in engineering science. This is reflected by the composition of the Scientific Committee which had the following members: Mirjam Dür (Darmstadt, Germany), Horst Hamacher (Kaiserslautern, Germany), Petra Huhn (Clausthal, Germany), Florian Jarre (Düsseldorf, Germany), Kathrin Klamroth (Erlangen, Germany), Michal Kočvara (Prague, Czech Republic), Claude Lemarechal (INRIA, France), Yurii Nesterov (Louvain, Belgium), and Tamás Terlaky (Hamilton, Canada).

Location

ESI took place in the buildings of the LEUCOREA foundation in the city of Wittenberg in the former eastern part of Germany. Founded in the year 1994, the LEUCOREA foundation aims at bringing new international scientific and cultural life to Wittenberg, at the same place where 500 years ago one of the most renowned universities of Germany was established. The old university, the LEUCOREA, was founded in 1502, and only a few years later it was proud to have Martin Luther and Philipp Melanchthon among its professors. During the following centuries the university moved to Halle, but the buildings remained and now accommodate nicely renovated lecture rooms, computer labs, a cafeteria and several guest rooms. The pleasant atmosphere, the excellent working conditions and the hospitality and enthusiasm of the employees of the LEUCOREA foundation were highly appreciated by all participants of ESI and contributed to its success.

Participants

The participants of ESI were doctoral and post-doctoral students from EURO-countries and from associated organizations. They had to apply for participation by submitting an original and unpublished paper to their national OR-societies, and the selection process was based on the quality of this work. Cooperations with IFORS (International Federation of Operational Research Societies) and ALIO (Asociación Latinoamericana de Investigación Operativa) broadened the national variety of the participants, and in the end all five continents were represented at this years ESI: We had participants from Austria, Belgium, Brazil, Canada, Germany, Hungary, India, Iran, Ireland, Israel, Italy, Lithuania, New Zealand, South Africa, Spain, Switzerland and Turkey. The international atmosphere of ESI added to its success and was positively mentioned by all of its participants. Seven out of 25 participants were women.

Scientific Program

The scientific program combined short courses by nine invited, internationally renowned scientists in the field with contributions by the participating students who presented their work in 30 minute talks.

Annick Sartenaer (FUNDP Namur, Belgium) made the start and gave the first of the nine lectures of approximately five hours each. She gave an introduction to trust region methods in nonlinear optimization. Andrew Conn (IBM, USA) continued the following day with an introduction to derivative free optimization. After that, Andrea Walther (TU Dresden, Germany) and Andreas Griewank (HU Berlin, Germany) jointly taught automatic differentiation. Their presentations were accompanied by practical computer exercises. The second week began with an introduction to semidefinite programming and interior point methods given by Tamás Terlaky (McMaster University, Canada). Conic quadratic and convex optimization were the topic of Erling Andersen (MOSEK, Denmark). The practical applications of convex optimization were discussed in detail by Lieven Vandenberghe (UCLA, USA), who focussed,

among others, on modelling issues and engineering applications. Michal Kočvara (Academy of Sciences of the Czech Republic) presented recent developments in structural optimization and the relations to semidefinite programming. The final talk of the week and of the ESI was given by Hans-Georg Bock (University of Heidelberg, Germany) on dynamical processes and optimal control problems and their applications.

The short courses of the invited speakers were complemented by 30 minute presentations of the participating students. Each of them had the opportunity to present his/her research and to discuss it with the other participants and with the invited speakers. The research topics were relatively widespread and ranged from theoretically oriented topics as, for example, nonsmooth Newton methods, to multicriteria optimization, and to various applications, for example, in engineering design, data mining, telecommunication, routing problems and structural optimization. The presentations initiated many interesting discussions, ideas were exchanged, and some of the participants even started to work on joint projects and papers.

Social Program

To emphasize also the social and cultural aspects of the summer institute and to show the participants some of Germany's beauty, the scientific program was complemented by an extensive social program. This included a guided tour through Wittenberg and the participation in the "Wittenberg Festival Night" (music, theater, expositions and much more in the city center of Wittenberg), trips to Dresden (with a city tour and visits of the Semper Opera and the reconstructed Church of our Lady) and to Berlin (with a city tour and visits of the parliament building (Reichstag) and the "Night of Open Museums"), as well as a local trip to the renaturated coal mining area Goitzsche near Bitterfeld. Joint barbecues, visits to the local bars in Wittenberg and a party evening organized by the participants completed the program. For the organisation of the excursions, for the local support in Wittenberg and also preceding the ESI, a special thank is given to the "ESI Crew" consisting of Stefan Bundfuss, Jochen Gorski, Andreas Löhne, Sylke Sauter and Alexander Thekale from Darmstadt, Erlangen and Halle.

Special Journal Issue

As explained in the *Guidelines for EURO Institutes*, it is the intention of EURO to have a special issue of their journal EJOR devoted to the Institute. This is the reason behind the rather complicated application procedure (applicants were expected to submit an unpublished paper in order to be considered). Although all previous EURO Institutes had their special issue, it turned out that this was not possible for our ESI2006 (and presumably the same will be true for future Institutes). The reason is that EJOR has a huge backlog of papers, and has therefore stopped to accept proposals for special issues. As our participants had already run through the application procedure, we were still planning to bring out a special issue, and we are happy that the journal Mathematical Methods of Operations Research (MMOR) has accepted to publish it. All participants were highly interested in having this option, and this is also evidenced by the fact that 15 of them have submitted their work to our special issue and another three have announced to do so.

For future Institutes, we strongly encourage EURO to change the guidelines for the application procedure and to develop a concept for EURO Institutes without a possibility to publish the results thereof. In our understanding, introducing young people to the process of writing papers and brushing the papers up such that they can be published has always been a central element of these schools and has definitely been an important incentive in the past for young researchers to apply and attend. If this possibility is not given any more, suitable alternatives should be provided.

Conclusion

For all participants of the ESI, the summer school was an excellent opportunity to get a broader knowledge of their own field of research, to learn about new methodologies, techniques, and software, and to build up a network of connections with young researchers from all parts of the world, as well as renowned professionals. Because of the relatively long duration of 15 days, the atmosphere was relaxed and there was plenty of time for extensive discussions and scientific exchange. Several participants used the opportunity to continue on to the annual meeting of the German OR Society which took place in the week right after ESI in Karlsruhe, Germany.

5 Scientific Program

5.1 Titles of the Lectures

- Erling D. Andersen, MOSEK, Denmark: *Conic Quadratic Optimization*

- Hans-Georg Bock, University of Heidelberg, Germany: *Dynamical Processes and Optimal Control*

- Andrew R. Conn, IBM Watson Research Center, USA: *Derivative Free Optimization*

- Andreas Griewank, Humboldt University Berlin, Germany: *Automatic Differentiation*

- Michal Kočvara, Academy of Sciences of the Czech Republic: *Structural Optimization via Semidefinite Programming*

- Annick Sartenaer, University of Namur, Belgium: *On Trust-Region Methods in Nonlinear Optimization*

- Tamás Terlaky, McMaster University, Canada: *SDP and Interior Point Methods*

- Lieven Vandenberghe, UCLA, USA: *Modeling and Solving Engineering Problems*

- Andrea Walther, University of Dresden, Germany: *Automatic Differentiation and ADOL-C*

5.2 Titles of the Participants' Presentations

- Jalal Akbari (Iran): *A Software for Shape Optimization of Concrete Arch Dams*

- Marina Andretta (Brazil): *Augmented Lagrangian Method with Lower-Level Linear Constraints*

- Jolita Bernatavičienė (Lithuania): *Optimization of the Diagnosis Decisions by Integration of Data Mining Methods*

- Odellia Boni (Israel): *Adjustable Approach to Robust Optimization*

- Stephan Bütikofer (Switzerland): *Globalization of a Nonsmooth Newton Method via Path-Search*

- Paula Carroll (Ireland): *Polyhedral Approach to Telecommunications Networks Design Problems*

- Robert Chares (Belgium): *Computation of the Universal Barrier for a Class of Non-Symmetric Convex Cones*

- David Gideon Conradie (South Africa): *Scheduling at Coal Handling Facilities with Multiple Objectives and Stochastic Elements using Metaheuristics*

- Zsolt Csizmadia (Hungary): *Large Scale Bilinear Optimization in Practice: A Case Study*

- Sergio Delgado-Quintero (Spain): *A Mathematical Programming Approach for Categorical Data Editing*

- Armin Fügenschuh (Germany): *Mixed-Integer Programming for Topology Optimization in Sheet Metal Design*

- Jochen Gorski (Germany): *An Enhanced Alternate Convex Search Strategy for Biconvex Minimization Problems*

- Johannes Wilhelm Joubert (South Africa): *Time-dependent Travel Times in Constrained Vehicle Routing Problems: An Evolutionary Approach*

- Ugur Kaplan (Turkey): *Modeling and Optimization of Complex Supply Chain Systems using Hybrid System Approach*

- Valeria Leggieri (Italy): *A Set Covering Formulation for the Minimum Power Multicasting Problem in Wireless Ad-Hoc Networks*

- Andreas Löhne (Germany): *A New Approach to Duality in Vector Optimization and its Consequences for Multi-Objective Linear Programming*

- Nataliya Metla (Austria): *Lipschitz Stability for Elliptic Mixed Constrained Optimal Problems*

- Guido Perboli (Italy): *EVE-OPT: a Hybrid Algorithm for the Capability Vehicle Routing Problem*

- Federico Perea (Spain): *Greedy-Based Approaches to Solve the Multidimensional Assignment Problem*

- Koduvayur Muthuswamy Rajesh (India): *On a Local Search Based Method for a Class of Global Optimization Problems*

- Sleman Saliba (Germany): *Approximation Algorithms for a Vehicle Dispatching Problem*

- Lizhen Shao (New Zealand): *Multiple Objective Linear Programming in Radiotherapy Treatment Planning*

- Alexander Thekale (Germany): *Optimization with Expensive Function Evaluations*

- Cheng (Marshal) Wang (Canada): *A Dynamic Dual Decomposition Method for Stochastic Uncapacitated Facility Location Problems*

- Julius Žilinskas (Lithuania): *On Three-Dimensional Visualization of Multidimensional Data Using Multidimensional Scaling with City Block Metric*

5.3   Time Table Program

Monday 21 August	
8:30 – 9:00	Opening
9:00 – 10:30	*Lecture:* **Annick Sartenaer**
10:30 – 11:00	Coffee Break
11:00 – 12:30	*Lecture:* **Annick Sartenaer**
12:30 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Annick Sartenaer**
16:00 – 16:30	Coffee Break

Tuesday 22 August	
8:30 – 10:00	*Lecture:* **Andrew Conn**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Andrew Conn**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Andrew Conn**
16:00 – 16:30	Coffee Break
16:30 – 17:00	*Presentation:* **Alexander Thekale**
17:00 – 17:30	*Presentation:* **Julius Žilinskas**

Wednesday 23 August	
8:30 – 10:00	*Lecture:* **Andrea Walther**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Andrea Walther**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Andrea Walther**
16:00 – 16:30	Coffee Break
16:30 – 17:00	*Presentation:* **Jolita Bernatavičienė**
17:00 – 17:30	*Presentation:* **Sergio Delgado-Quintero**

Thursday 24 August	
8:30 – 10:00	*Lecture:* **Andreas Griewank**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Andreas Griewank**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Andreas Griewank**
16:00 – 16:30	Coffee Break
16:30 – 17:00	*Presentation:* **Koduvayur Muthuswamy Rajesh**
17:00 – 17:30	*Presentation:* **Ugur Kaplan**

Friday 25 August	
8:30 – 9:00	*Presentation:* **Johan Joubert**
9:00 – 9:30	*Presentation:* **Guido Perboli**
9:30 – 10:00	*Presentation:* **Sleman Saliba**
10:00 – 10:30	Coffee Break
10:30 – 11:00	*Presentation:* **Paula Caroll**
11:00 – 11:30	*Presentation:* **Valeria Leggieri**
11:30 – 12:00	*Presentation:* **Federico Perea**
12:00 – 14:00	Lunch
14:00 – 14:30	*Presentation:* **Lizhen Shao**
14:30 – 15:00	*Presentation:* **David Gideon Conradie**
15:00 – 15:30	*Presentation:* **Andreas Löhne**

Monday 28 August	
8:30 – 10:00	*Lecture:* **Tamás Terlaky**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Tamás Terlaky**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Tamás Terlaky**
16:00 – 16:30	Coffee Break
16:30 – 17:00	*Presentation:* **Odellia Boni**
17:00 – 17:30	*Presentation:* **Armin Fügenschuh**

Tuesday 29 August	
8:30 – 10:00	*Lecture:* **Erling Andersen**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Erling Andersen**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Erling Andersen**
16:00 – 16:30	Coffee Break
16:30 – 17:00	*Presentation:* **Robert Chares**
17:00 – 17:30	*Presentation:* **Zsolt Csizmadia**

Wednesday 30 August	
8:30 – 10:00	*Lecture:* **Lieven Vandenberghe**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Lieven Vandenberghe**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Lieven Vandenberghe**
16:00 – 16:30	Coffee Break
16:30 – 16:45	*Address to the ESI participants:* **Gerhard Wäscher**, President of the German OR Society
16:45 – 17:15	*Presentation:* **Jalal Akbari**
17:15 – 17:45	*Presentation:* **Stephan Bütikofer**

Thursday 31 August	
8:30 – 10:00	*Lecture:* **Michal Kočvara**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Michal Kočvara**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Michal Kočvara**
16:00 – 16:30	Coffee Break
16:30 – 17:00	*Presentation:* **Marina Andretta**
17:00 – 17:30	*Presentation:* **Jochen Gorski**

Friday 1 September	
8:30 – 10:00	*Lecture:* **Hans-Georg Bock**
10:00 – 10:30	Coffee Break
10:30 – 12:00	*Lecture:* **Hans-Georg Bock**
12:00 – 14:00	Lunch
14:00 – 16:00	*Lecture:* **Hans-Georg Bock**
16:00 – 16:30	Coffee Break
16:30 – 17:00	*Presentation:* **Nataliya Metla**
17:00 – 17:30	*Presentation:* **Cheng (Marshal) Wang**

6   Social Program

Friday 18 August	
approx. 19:00	Welcome Dinner

Saturday 19 August	
14:00 – 16:00	Guided tour through Wittenberg
from 19:00	”Wittenberger Erlebnisnacht”: Music, theater, expositions and much more in the city center of Wittenberg

Sunday 20 August: Trip to Dresden	
7:00	Departure from Leucorea
11:00 – 13:00	Guided tour through Dresden
13:00 – 14:10	Time at own disposal. *Recommendation: Picnic next to the river Elbe*
14:10 – 15:15	Guided tour through the **Semper Opera House**
15:15 – 18:45	Time at own disposal. *Recommendation:* **Mathematisch-Physikalischer Salon**, *a museum on mathematics and physics in the Zwinger*
18:50 – 20:00	Guided Tour to the cupola of the **Dresdner Frauenkirche**
20:00 – 21:00	Time at own disposal. *Recommendation: Discover the interior of the Frauenkirche*
21:00	Departure of the bus back to Wittenberg. **Meeting Point: Zwinger**

Saturday 26 August: Trip to Berlin	
7:30	Departure from Leucorea
10:00 – 12:00	Guided tour through the **Reichstag** (parliament building)
12:00 – 14:15	Time at own disposal. *Recommendation: Open day in all German Federal Ministries*
14:15 – 17:30	Guided bus tour through Berlin. Starts: Reichstag, Ends: Potsdamer Platz
17:30 – 23:00	Time at own disposal. *Recommendation:* **Lange Nacht der Museen:** *Open day at all Berlin museums starting at 18:00*
23:00	Departure of the bus back to Wittenberg. **Meeting Point: Rotes Rathaus**

Sunday 27 August	
	Relaxing and walk to the **Hundertwasserschule** in Wittenberg
14:00 – 15:00	Guided tour through the Hundertwasserschule
15:00 – 18:00	Tour to the renaturated coal mining area Goitzsche near Bitterfeld
18:00	Joint Dinner in an italian restaurant

7 Financial Report

7.1 Income

We received the following exact amounts:

EURO	14000 €
GOR	3000 €
Leucorea Foundation	4000 €
ILOG	2000 €
Siemens	1500 €
Friends of TU Darmstadt	500 €
University of Halle-Wittenberg	2000 €
Friends of Univ. Halle	1130 €
State of Saxony-Anhalt	2000 €
Sum	30130 €

7.2 Expenditure

The expenditures were as follows:

Travel expenses of Invited Speakers	4642.86 €
Accomodation	9070.— €
Food and meals	9303.67 €
Social acitvities	3217.68 €
Course materials	484.42 €
Organizers' expenses	3411.37 €
Sum	30130.— €

Darmstadt, 14. Januray 2007　　　　　　　Mirjam Dür

(ESI-Chair)