

CENTER OF EXCELLENCE IN OPTIMIZATION AND SYSTEMS ENGINEERING



PHOTO: MIKAEL NYBERG

The annual seminar in Optimization and Systems Engineering arranged by the OSE group took place at Åbo Akademi University in November 2012. The plenary speaker was professor Stratos Pistikopoulos from Imperial College London.

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2012

THE YEAR IN REVIEW – SOME HIGHLIGHTS

MID-TERM PROJECT REPORT

The Optimization and Systems Engineering group was appointed an internal Center of Excellence for the time-period 2010–14. In October 2012, a mid-term project report was finalized and an evaluation was performed by the university using an external reviewer.

The report described the progress in the individual work-packages including all publications and other results obtained during the reporting period. Eight PhD students have fully or partly been funded by the project. In addition, thirteen professors and other post doctoral researchers have been involved in the project.

From January 2010 to May 2012, a total of 90 publications were published: one monograph, four book chapters, 70 peer-reviewed journal papers as well as a large number of conference papers. According to the guidelines, the 10 most valued publications were also included in the report.

“At 2.5 years into the program, the CoE has produced considerable research output and made significant breakthrough contributions in its thematic areas.”

EVALUATOR'S COMMENTS IN THE OSE MID-TERM REVIEW

Below some additional quotes from the evaluator's report in November 2012:

“From the included 10 representative publications, it is quite clear that the quality of these publications is very high. The 10 publications represent the strengths of the CoE and demonstrate the world-class nature of the CoE's research.”

“The CoE has engaged in strong scientific activities that promote excellent research productivity. The senior researchers of the CoE are highly visible at an international level. They are active in conference participation and organization and perform exemplary editorial and advisory roles in the scientific community. Moreover, there is an excellent plan to integrate CoE researchers with international collaborators. In particular, with an annual OSE seminar from an international panelist and research exchanges and extended visits of CoE researchers with the panelists, the CoE has ensured an exposure to leading international research and an essential cross-fertilization for the CoE's activities. As a result of these activities, the CoE has made links to the strongest groups in MINLP and global optimization around the world. The CoE international scientific panel in this area is second to none.”

VOLVO OCEAN RACE GAME 2012

Aided by one-hundred year old weather maps and his knowledge in optimization, PhD student Mikael Nyberg recently won a leg in one of the world's largest virtual regattas, Volvo Ocean Race Game, with over 178 000 registered boats and about 90 000 participants. Nyberg was awarded a trip to Auckland, New Zealand to visit the real Volvo Ocean Race when it visited the city.

When interviewed for the Åbo Akademi University news bulletin, Nyberg says “How the boats sail is easy to formulate mathematically. The problem is, however, that the combinatorial complexity is huge, since it grows exponentially with regards to the number of points.”

Nyberg used optimization software developed for the previous race by a Croatian programmer. In the software, where Nyberg helped with the optimization part, tree



PHOTO: MARC BOW

Thomas Johanson (to the left), helmsman on Puma Ocean Racing, and Mikael Nyberg in Auckland, New Zealand

structures containing all alternatives from the starting and end points are used. These tree structures are then combined, and as the game progresses, bad branches can be removed from the trees.

SOME SELECTED OSE NEWS ITEMS

- JANUARY 4** Professor Tapio Westerlund joined the editorial board of Journal of Global Optimization, a Springer journal dealing with theoretical and computational aspects on global optimization and its applications in science, management and engineering. It was the seventh highest ranked journal 2011 in the subarea control and optimization of mathematics by SCImago Journal Rank.
- AUGUST 31** Peter Lindberg defended his thesis “The knapsack problem approach in solving partial hedging problems of options”. The opponent was professor Wolfgang Runggaldier, Università degli Studi di Padova, Italy, and the custos was professor Paavo Salminen.
- NOVEMBER 29** The annual seminar in Optimization and Systems Engineering took place in Turku.

RESEARCH VISIT TO CARNEGIE MELLON UNIVERSITY



PHOTO: CMU

Group portrait from the poster session at the CAPD annual review meeting in March 2012

FACTS ABOUT CMU

- CMU is a private university founded in 1900 in Pittsburgh, Pennsylvania, USA. The metropolitan area of Pittsburgh has about 2.4 million inhabitants.
- The university campus is located about 5 km from the center of Pittsburgh, and in close proximity to the University of Pittsburgh.
- Has about 6 000 undergraduate and 6 000 post-graduate students in seven colleges and independent schools, including the Carnegie Institute of Technology and the Tepper School of Business.
- Academic Ranking of World Universities (ARWU) ranks CMU 2012 as the 9th best university world-wide in engineering, technology and computer sciences.



PITTSBURGH ■

CMU campus in Pittsburgh



PHOTO: WIKIMEDIA COMMONS

Downtown Pittsburgh



PHOTO: AXEL NYBERG

In the spring of 2012 I was at Carnegie Mellon University (CMU) in Pittsburgh, Pennsylvania, USA, as a visiting researcher for six months. I worked in professor Ignacio Grossmann's group together with PhD students from CMU and other visitors. While at CMU, I attended courses in optimization both at the Chemical Engineering Department as well as Tepper School of Business.

To my surprise, the university itself was not that much different from ÅAU. CMU has about 12 000 students (6 000 undergraduates) and the classes are relatively small with a nice atmosphere. In some of the courses I attended, there were only a handful of students.

Professor Grossmann is also the director for the Center of Advanced Process Decision-making (CAPD). The CAPD has a close collaboration with the industry, resulting for example in seminars with industry representatives as well as many joint research projects.

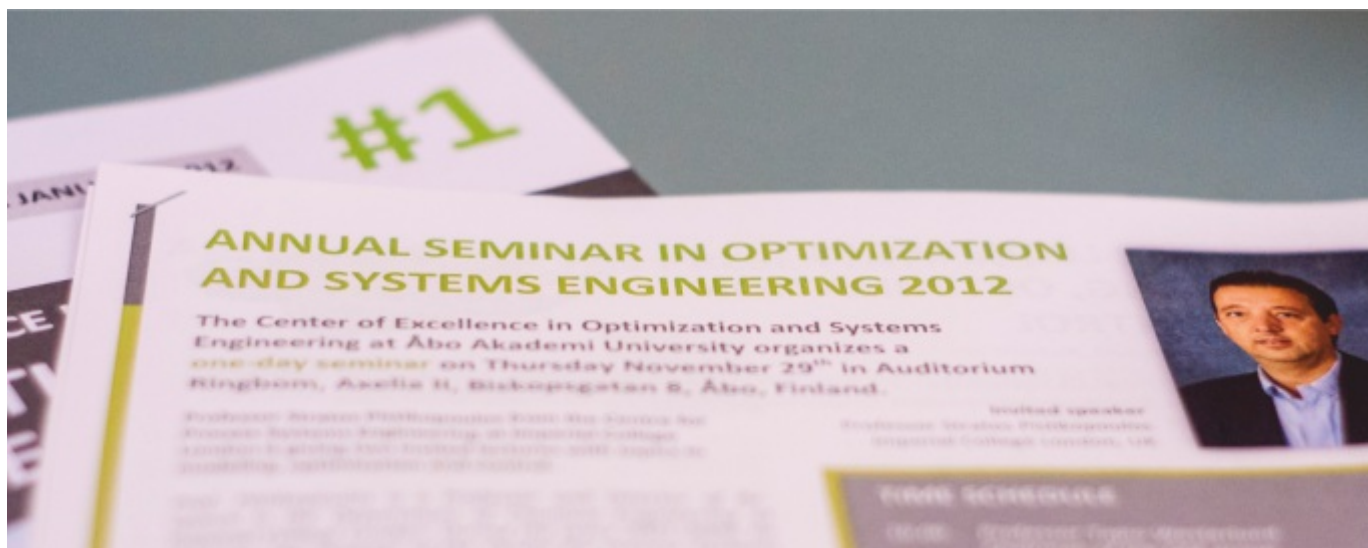
All in all, I had a wonderful time both at CMU and in Pittsburgh and I am very grateful to professor Grossmann for inviting me.

AXEL NYBERG

PhD student in the OSE group



ANNUAL OSE SEMINAR 2012



Modeling, optimization and control were the topics of the plenary lectures at the annual seminar in Optimization and Systems Engineering 2012 taking place at Åbo Akademi University in Turku on November 29. Keynote speaker was professor Stratos Pistikopoulos from Imperial College London, UK, one of the members of the International Scientific Panel of the OSE group.

At the seminar, professor Pistikopoulos held the following two presentations:

- Multi-parametric programming and explicit model predictive control – a progress report
- Modeling, optimization and advanced control of biomedical systems.

In addition to theoretical advances, he also illustrated some interesting applications in anesthesia and chemotherapy.

Professor Pistikopoulos is one of the most cited researchers in process systems engineering. In total, he is the author of eight books and over 250 scientific research papers.

In addition, he has been the recipient of several awards and recognitions; the latest was the Computing in Chemical Engineering Award of the Computing and Systems Technology (CAST) Division of the American Institute of Chemical Engineers (AIChE).

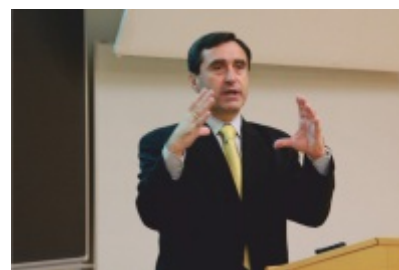
After the plenary talks, the seminar continued with presentations of current research performed in the OSE group. All presentations given at the seminar are available on the OSE group's website www.abo.fi/ose.

This seminar is the third in its series. The goal is to invite a member of the International Scientific Panel (see the last page) as the plenary speaker at the annual seminar.

The previous two years, researchers from American universities were invited: In 2011 professor Ignacio Grossmann from Carnegie Mellon University was the plenary speaker, while professor Christodoulos Floudas from Princeton University participated the year before.

An interesting fact is that both professor Pistikopoulos and professor Floudas have been post graduate students of professor Grossmann.

Professors Floudas and Grossmann



PRESENTATIONS AT THE SEMINAR

MORNING SESSION

CHAIRMAN: PROFESSOR TAPIO WESTERLUND

PROFESSOR STRATOS PISTIKOPOULOS

- Multi-parametric programming and explicit model predictive control – a progress report
- Modeling, optimization and advanced control of biomedical systems

AFTERNOON SESSION

CHAIRMAN: DR ANDREAS LUNDELL

AXEL NYBERG, PHD STUDENT

- The quadratic assignment problem

OTTO NISSFOLK, PHD STUDENT

- A metaheuristic optimization algorithm for binary quadratic problems

ANDERS SKJÄL, PHD STUDENT

- Two approaches to underestimating quadratic functions

JOHAN PENSAR, PHD STUDENT

- A Bayesian score for LDAGs

AMIR SHIRDEL, PHD STUDENT

- System identification in the presence of trends and outliers

MIKAEL NYBERG, PHD STUDENT

- State splitting in continuous time STN-models



Professor Pistikopoulos during his lecture



Prof. Pistikopoulos, dr Stefan Emet and prof. Westerlund

Pictures from the seminar. From the upper left: Axel Nyberg, Anders Skjäl, Amir Shirdel, Otto Nissfolk, Mikael Nyberg, Johan Pensar and Andreas Lundell





PHOTO: ANDREAS LUNDELL

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ABOUT THE OSE RESEARCH GROUP

FOR MORE INFORMATION, VISIT THE OSE
GROUP'S WEB SITE AT WWW.ABO.FI/OSE

The Optimization and Systems Engineering (OSE) group at Åbo Akademi University is an interdisciplinary research group focusing on theory, methods and algorithms in systems engineering, optimization and statistics, and their applications in science and engineering.

OSE bridges the systems engineering, systems theory and mathematical disciplines at Åbo Akademi University and the OSE group represents the kernel of expertise in this field at the University. The group was appointed a Center of Excellence within research at the university for the time-period 2010–14.

INTERNATIONAL SCIENTIFIC PANEL

Forming a basis for the international collaboration, the OSE group has an international scientific panel consisting of top researchers in the field. The members are:

PROFESSOR IGNACIO GROSSMANN
Department of Chemical Engineering,
Carnegie Mellon University, Pittsburgh, USA

PROFESSOR CHRISTODOULOS FLOUDAS
Department of Chemical and Biological Engineering,
Princeton University, USA

PROFESSOR STRATOS PISTIKOPOULOS
Department of Chemical Engineering,
Imperial College London, UK

PROFESSOR LEO LIBERTI
Laboratoire d'informatique,
École Polytechnique, Paris, France

PROFESSOR MONTAZ ALI
School of Computational and Applied Mathematics,
University of the Witwatersrand,
Johannesburg, South-Africa

KEY FIGURES 2010–2012

PERSONNEL

- 7 professors
- 6 post doc researchers
- 19 PhD students (8 directly funded)

PUBLICATIONS

- 1 monograph
- 4 book chapters
- 70 peer-reviewed journal articles
- 16 articles in conference proceedings

NEW PHD STUDENT



Johan Pensar was accepted as a PhD student in the OSE group starting from July 2013. His thesis has the topic "Context specific graphical models and their applications" and is supervised by professor Jukka Corander at the Department of Mathematics.

GROUP LEADERS



OPTIMIZATION

PROFESSOR TAPIO WESTERLUND
Chairman of the OSE group
Process Design and Systems Engineering
Department of Chemical Engineering



SYSTEMS ENGINEERING

PROFESSOR HANNU TOIVONEN
Industrial Systems Engineering
Department of Information Technologies



SYSTEMS THEORY

PROFESSOR GÖRAN HÖGNÄS
Mathematics and Statistics
Department of Natural Sciences



MATHEMATICAL STATISTICS

PROFESSOR JUKKA CORANDER
Mathematics and Statistics
Department of Natural Sciences

ABOUT THIS ISSUE

LAYOUT: Andreas Lundell

TEXT: Andreas Lundell and Tapio Westerlund

OPTIMIZATION AND SYSTEMS ENGINEERING

Åbo Akademi University, Biskopsgatan 8, FIN-20500 ÅBO, Finland

Phone: +358 (0)2 215 4460, Internet: www.abo.fi/ose, e-mail: ose@abo.fi