# INDUSTRIAL OPTIMIZATION GROUP 


www.mit.jyu.fi/optgroup

## Overview

The Industrial Optimization Group developes theory, methodology and computer implementations for solving real-world decision-making problems. Most of the research concentrates on multiobjective optimization (MO) in which multiple conflicting objectives are optimized simultaneously and a decision maker (DM) is supported in finding a preferred compromise.

## Interactive Multiobjective Optimization

Interactive MO actively supports DMs in finding a preferred solution by continuously involving them in the solution processto guide the search. Continuous involvementenables DMs to learn about their preferences and the problem/phenomenon considered as well as interdependencies between the objectives. In addition to the NIMBUS method utilized in solving many practical MO problems, recent methods concentrate on computationally demanding problems (Pareto Navigator) and avoiding the anchoring effect often encountered in MO (Nautilus).


Approaching the solution set in the Nautilus method


Sofware implementation
The Group designs and implements MO software tools for DMs based on the methods developed. Interactive MO methods and hybrid EMO algorithms are of interest. The research addresses the most intuitive and efficient interaction techniques for the users, support for DMs in exploring multidimensional data, and reduction of user's cognitive burden. Usability plays an important role.

## Evolutionary Multiobjective Optimization (EMO)

EMO aims at finding a representation of the solution set for MO problems by utilizing evolutionary principles. Hybrid EMO algorithms with better convergence and computational efficiency have been developed. In addition, the Group is actively developing novel algorithms, e.g. with unrestricted population size, and evolutionary operators for improved performance.

## Applications

- Optimal control for continuous casting of steel
- Paper machine design
- Ultasonic transducer design
- Chemical process design for paper production
- Optimization of chemical separation processes
- Exhaust pipe design for two-stroke engines
- Intensity modulated radiotherapy treatment and brachytherapy planning
- Wastewater treatment plant design
- Heat exchanger network synthesis


## Collaboration e.g. with

Carnegie Mellon University, USA
Clemson University, USA
ETH, Switzerland
IIT Kanpur, India
Poznan University of Technology, Poland
Russian Academy of Sciences
University of Catania, Italy
University of Malaga, Spain
University of Manchester, UK
University of Wuppertal, Germany
Aalto University, Finland
Tampere University of Technology, Finland VTT Technical Research Centre of Finland

## Software

- WWW-NIMBUS
- IND-NIMBUS


## Approximation in Optimization

Approximation of objectives or solution sets in optimization is often utilized for computationally challenging problems. The use of meta-models as well as approximation and representation of solution sets of MO problems are being studied. The main research questions involve the quality of approximation and its usefulness and applicability for decision-making.


Meta-model approximation of an objective (CaCO3 fraction in a solid phase)

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## Contact

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"The essence of successful human actions is decision-making. The Industrial Optimization Group at the University of Jyväskylä uses mathematics, economics, and computer science to promote decision-making BY the people and FOR the people. Can sciences support our lives better?"

Prof. Margaret Wiecek, Clemson University, USA

