

Optimointiryhmä

Research Group in Industrial Optimization



<http://www.mit.jyu.fi/optgroup/>

University of Jyväskylä
Dept. of Mathematical Information Technology

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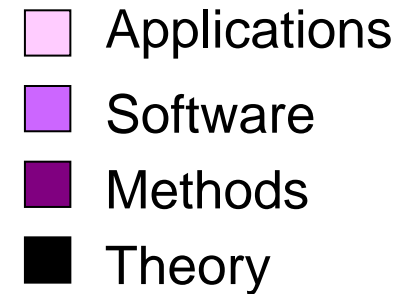
People

- Kaisa Miettinen, PhD
- Jussi Hakanen, PhD
- Petri Eskelinen, PhD
- Timo Aittokoski, PhD
- Prof. Margaret Wiecek (visiting from Clemson Univ, USA)
- External members:
 - Jari Toivanen (Stanford),
 - Iryna Yevseyeva (INESC, Porto)
- Tomi Haanpää, MSc
- Markus Hartikainen, PhLic
- Vesa Ojalehto, MSc
- Sauli Ruuska, MSc
- Karthik Sindhya, MSc
- Suvi Tarkkanen, MSc (on maternity leave)

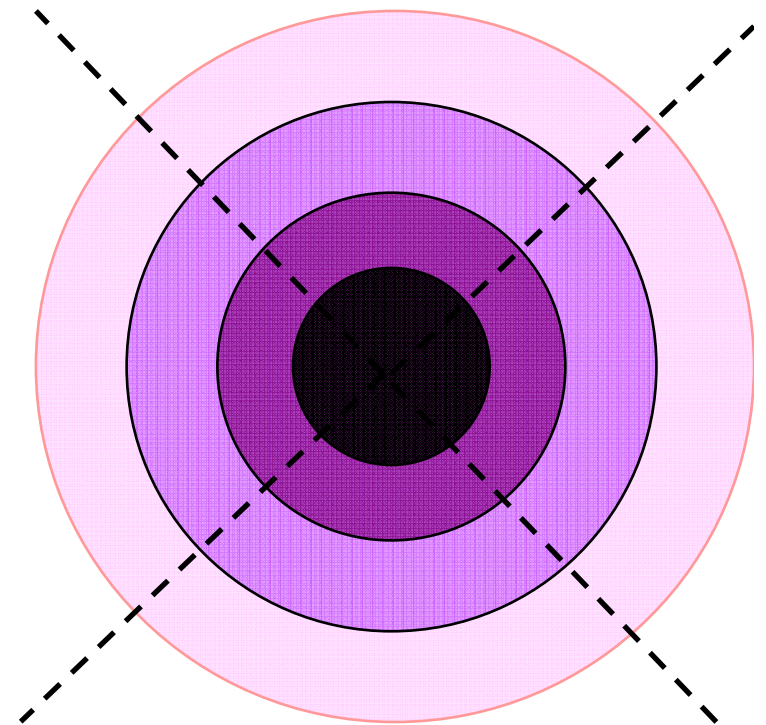
Primary areas of interest

- Nonlinear multiobjective optimization
- Multiple criteria decision making
- Mathematical programming
- Global optimization and evolutionary algorithms
- Hybrid approaches
- Software development incl. usability
- Industrial applications

Our Research



- Solving complex problems – supporting decision making
 - Computational efficiency
 - Cognitive validity
- Typically multiple objectives
 - Interactive methods
- Method development
 - Methods generic, i.e., application independent
- Many different approaches
 - Mathematical programming with strong theoretical background
 - Evolutionary approaches with other metaheuristics and heuristics, hybrids
 - Application-specific tailoring also needed



Application fields

Working Principles

- Regular individual advisory meetings
- Weekly seminars
- Active national and international networks
– many visitors every year
- Cross-refereeing and active discussions



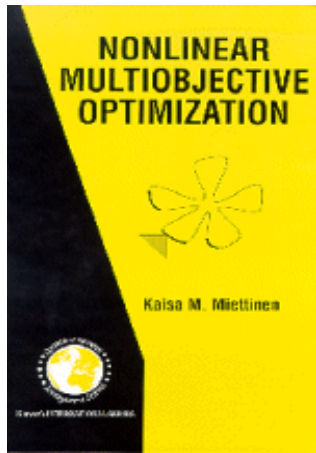
Some Outcomes



- NIMBUS method + software (2 versions)
 - WWW-NIMBUS; first multiobjective optimization method operating via Internet since 1995
 - <http://nimbus.it.jyu.fi/>
 - **IND-NIMBUS for industrial problems**
- Other methods
 - Interactive (e.g. Pareto Navigator, Nautilus)
 - Hybrids (e.g. interactive and a posteriori methods, utilizing reference point information)
- 9 PhD theses
- Books, journal articles, conference articles, working papers/reports

Some Books

- Miettinen, K., Nonlinear Multiobjective Optimization, Kluwer Academic Publishers, Boston, 1999.
- Miettinen, K., Mäkelä, M.M., Neittaanmäki, P. and Periaux, J. (eds), Evolutionary Algorithms in Engineering and Computer Science, John Wiley & Sons, Chichester, 1999.
- Branke J., Deb, K., Miettinen, K., Slowinski, R. (eds), Multiobjective Optimization: Interactive and Evolutionary Approaches, Springer, 2008.

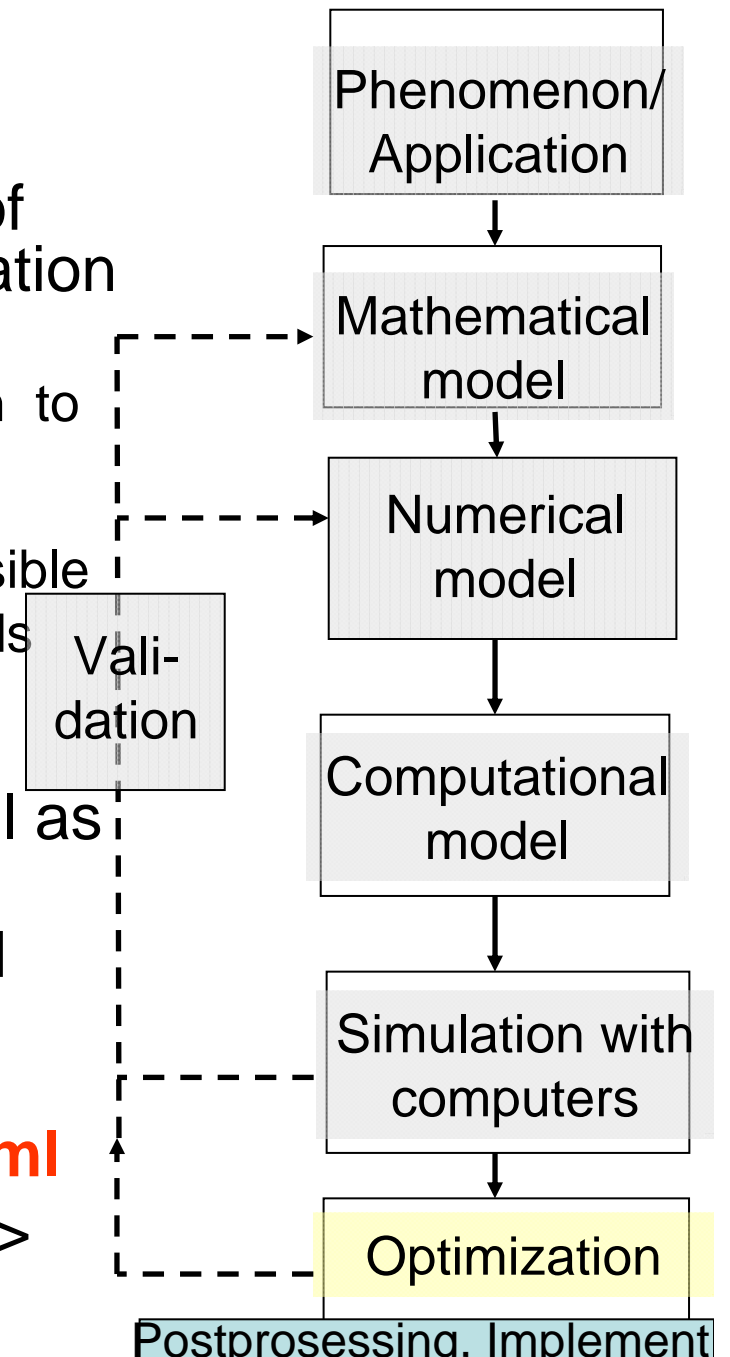


Some Applications

- Optimal control in continuous casting of steel
- Chemical process design (paper making and simulated moving bed process)
- Design of paper machines
- Optimal shape of ultrasonic transducers, exhaust pipes of 2-stroke engines
- Waste water treatment planning
- Heat exchanger network synthesis
- Radiotherapy treatment planning: IMRT and brachytherapy (see 9.3.2010 YLE TV 1, *Prisma studio at 18.30*)

Mission

- Spread understanding about potential of optimization and multiobjective optimization
 - Modelling + simulation not enough alone!
 - Operations research is a scientific approach to decision making
 - Beauty of computational science and optimization often remains **hidden** and invisible
 - Meaning of application-independent methods and approaches
- Get inspiration from real applications to method and theory development as well as software design
- Foster collaboration between users and researchers
- Active publishing, see e.g. <http://www.mit.jyu.fi/miettine/publ.html>
- New approaches -> new perspectives -> new kinds of solutions



Funding

- EU projects e.g. INGENET (1997-2001)
 - Thematic network: 22 partners (industry & academy)
- Various projects funded by the Academy of Finland during the years
- Projects funded by Tekes and companies
 - E.g. in Technology Programs MASI, BioRefine
 - POJo funded by Forest Cluster and Tekes
- Projects e.g. with Pöyry Environment
- Graduate schools COMAS, FICS and GS on systems analysis, decision making and risk management
- JyU
- Foundations

Collaboration e.g. with

- FiDiPro project at HSE with Kalyanmoy Deb (nowadays IIT Kanpur, India)
- Univ. of Malaga (Spain), Univ. of Erlangen, Univ. of Wuppertal and Univ. of Karlsruhe (Germany), Poznan Univ. of Tech., National Inst. of Telecomm., Warsaw (Poland), ETH Zurich (Switzerland), Univ. of Georgia, Carnegie-Mellon Univ. (USA), Univ. of Catania (Italy)
- Researcher exchange with Russian and Bulgarian Academies of Sciences
- Co-operation with Aalto Univ., Univ. of Eastern Finland, Tampere Univ. of Tech., Helsinki Univ. of Tech., Univ. of Turku, VTT
- PhD student visitors from Univ. of Wuppertal, Univ. of Malaga

Networks



- Active national and international collaboration
- International Society on Multiple Criteria Decision Making; www.mcdmsociety.org
 - President 2011-2015
- EUROPT, EURO Working Group on Continuous Optimization, www.iam.metu.edu.tr/EUROPT/
 - Chair 2010-2012
- Finnish Operations Research Society (Suomen operaatiotutkimusseura); www.operaatiotutkimus.fi
- Finnish Society on Computational Sciences (Suomen laskennallisten tieteiden seura); www.sulatis.fi
- Member of the Steering Committee of EMO (Evolutionary Multiobjective Optimization) 2008-

Acknowledgements

- ★ Thanks to projects, collaborators and industrial partners

- ★ Further information:

<http://www.mit.jyu.fi/miettine>

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