

OPTIMIZATION AND SYSTEMS THEORY

Karen Aardal & Jacob van der Woude

People

Optimization:

Faculty:

- Karen Aardal
- Frank Vallentin
- To Be Hired

Postdoc:

- Edward Kim

PhD students:

- Evan DeCorte
- Frederik von Heymann
- Shanfei Li
- Henk Post

Systems Theory:

Faculty:

- Dimitri Jeltsema
- Johannes Maks
- Jan van Schuppen
- Niek Tholen
- Jacob van der Woude

PhD students:

- Adolfo Chavez Jimenez
- Shah Muhammad

Optimization

The research area of optimization deals with:

- Developing and analyzing models of real-life problems as well as problems occurring in other scientific disciplines (mathematics, physics, computer science...)
- Design and analysis of algorithms for solving optimization models either exactly or approximately.

Courses

- Optimization, BSc Applied Math
- Optimization, BSc Computer Science
- Convex Optimization and Systems Theory, MSc TU Delft
- Transport, Routing and Scheduling, MSc TU Delft
- Continuous Optimization, MSc MasterMath
- Discrete Optimization, MSc MasterMath
- Heuristic Methods in Operations Research, MSc MasterMath
- Advanced Linear Programming, MSc MasterMath
- Scheduling, MSc MasterMath

PhD courses can be followed through:

LNMB (Dutch Network on the Mathematics of Operations Research)

(www.lnmb.nl)

Examples of MSc Thesis Projects

- Optimal trading strategy for energy storage systems
- Approximation algorithms for facility location
- Time-dependent network flows
- Simulation tool for ambulance planning
- Hub location and network design
- Minimum Manhattan networks
- Gate assignment: models and methods

Research topics

Frank Vallentin:

Combinatorial optimization in a continuous setting:
convex analysis and harmonic analysis

Examples of results:

- New upper bounds for the kissing number (=the maximum number of non-overlapping unit balls that can simultaneously touch a central unit ball)
- Generalization of the theta function (Lovász)

Geometry of numbers and computational geometry

Examples of results:

- New algorithms for various packing and covering problems
- Perfect forms and polyhedra with symmetries

Karen Aardal:

Integer optimization and the geometry of numbers

Examples of results:

- Reformulation techniques for linear Diophantine equations
- Extended reformulations for integer programs

Approximation algorithms for facility location

Examples of results:

- First constant approximation algorithm for uncapacitated facility location
- Currently best performance guarantee for uncapacitated facility location and general k -level uncapacitated facility location

Systems Theory

The research area of systems theory deals with:

- mathematical models
 - of dynamic systems
 - with inputs and outputs
 - their realization
 - system identification
- their control based on
 - stability requirements
 - optimality criteria (e.g. minimal energy)
 - taking into account noise and uncertainty

Courses offered by the group:

- Systems theory for BSc students AM
- Systems theory for MSc students Aerospace
- Modeling and control for BSc+MSc students EE
- Systems and control (3TU, Mastermath, MSc AM)
- Nonlinear systems theory (Mastermath, MSc AM)
- Control of discrete-time stoch. systems (MSc AM)
- Convex optimization and systems theory (MSc AM)

AM = Applied Mathematics,

EE = Electrical Engineering

Topics of master level projects, examples (old and new):

- Kites and their control, adaptive tracking
- Coordination control of distributed Gaussian systems
- Control of distributed automata with state tree structures
- Bird migration detection from radar images
- Optimal thruster allocation and control for DP
- Time table design using max-plus algebra
- Game theory and control
- Optimal control of mechanical systems

Research topics of staff:

- System theory of electromechanical systems (Dimitri Jeltsema)
- Clifford algebras for mechanical systems (Johannes Maks)
- Control of distributed systems (Jan H. van Schuppen)
- Modeling and systems with constraints (Jacob van der Woude)