

Doctoral Studies in Systems and Operations Research

Ahti Salo

Systems Analysis Laboratory

Dept of Mathematics and Systems Analysis

<http://sal.aalto.fi/>



Aalto-yliopisto
Aalto-universitetet
Aalto University

1.10.2024



See also

- [Bachelor Major in Mathematics and Systems Sciences](#)
- [Master's Programme in Mathematics and Operations Research](#)
- [Doctoral Education Network in Systems Analysis, Decision Making and Risk Management](#)
- [Finnish Operations Research Society](#)
- [Aalto Centre for Operations Research = ACOR](#)
- [Aalto Systems Forum](#)
- [Behavioural Operational Research](#)

News and Events



Key faculty members



Prof. Fabricio Oliveira
Optimization under
uncertainty



Prof. Ahti Salo
Decision & risk analysis



Prof. Philine Schiewe
Public transport optimization



Prof. Kai Virtanen
Defence and military operations



Prof. Risto Lahdelma
Energy systems analysis



Prof. Afzal Siddiqui
Power markets &
economics

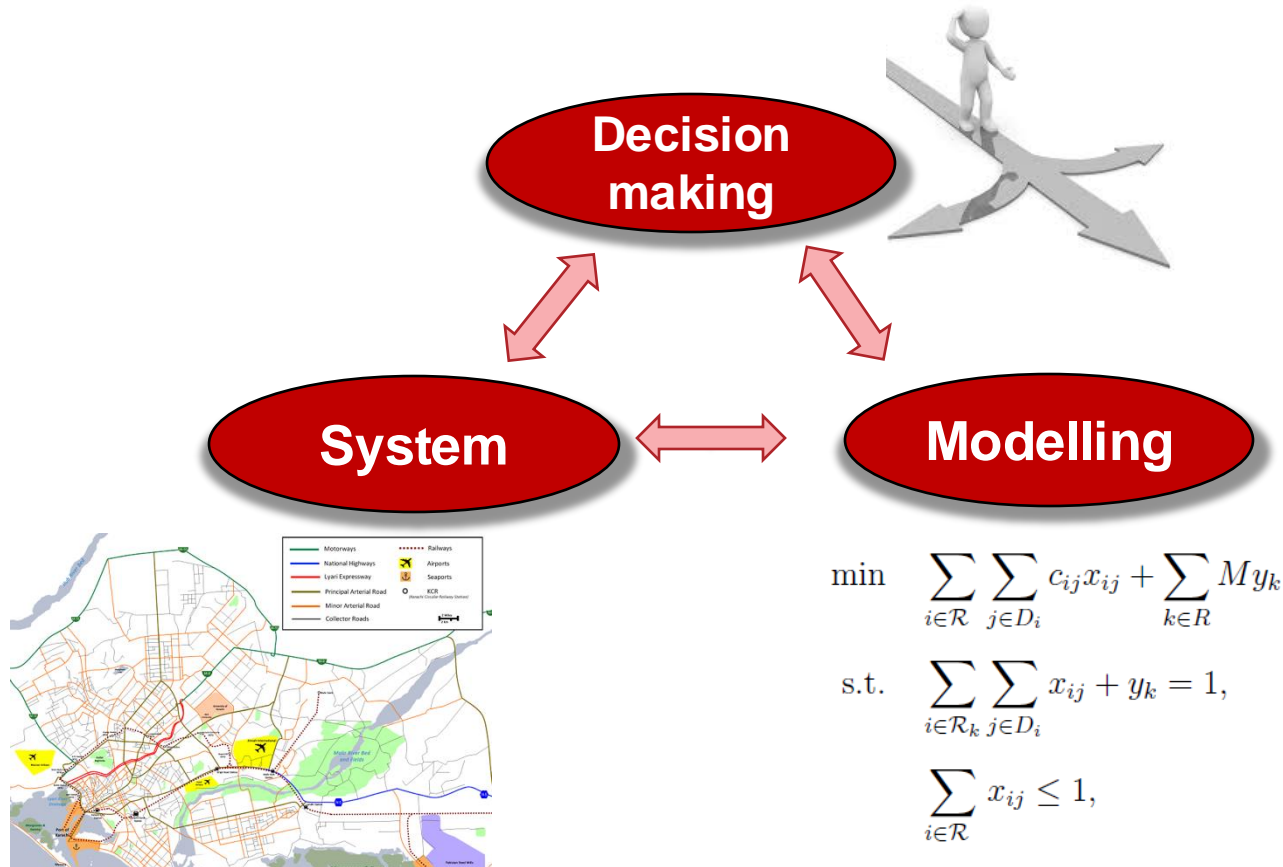


Dr. Fernando Dias
Bioinformatics &
optimization



Dr. Tuomas Raivio
Critical infrastructure
resilience

Pillars of Operations Research



Research fields and supervising professors (School of Science)

Research field is an area of academic research in which the school has agreed to provide doctoral education. The Aalto Doctoral Programme in Science offers doctoral education in 6 research fields, which are based on the strong research traditions of the departments. The programme is a joint effort of the Department of Neuroscience and Biomedical Engineering, Department of Mathematics and Systems Analysis, Department of Applied Physics, Department of Computer Science, and Department of Industrial Engineering and Management.

The doctoral student chooses a research field when applying to the programme. The professor supervising the doctoral studies is agreed upon at the same time.

| | | | |
|-------|---|--|--|
| F017Z | Systeemi- ja operaatiotutkimus Systems and Operations Research System- och operationsanalys | <u>Oliveira, Fabricio</u> <u>Salo, Ahti</u> <u>Schiewe, Philine</u> <u>Virtanen, Kai</u> <u>Lahdelma, Risto</u> (until 31.12.2025) | Systems Analysis Laboratory: http://sal.aalto.fi/en/ |
|-------|---|--|--|

Aalto Doctoral Programme in Science

Information for applicants

[What are doctoral studies like?](#)

[How to apply?](#)

[Open positions](#)

[Research fields and supervising professors \(School of Science\).](#)

Planning your studies

[Doctoral student study guide](#)

[Doctoral personal study plan \(DPSP\).](#)

[MyStudies instructions](#)

[Doctoral courses and curriculum \(SCI\).](#)

Thesis and research work

[Doctoral thesis at Aalto University.](#)

[Supervision of doctoral studies](#)

[Researcher skills for doctoral students](#)

[Pre-examination, defence and graduation](#)

Other useful links

[Annual enrolment](#)

[Doctoral student forms](#)




[Change of supervising professor, thesis advisor, research field, thesis topic o...](#)

[Doctoral Programme Committee \(School of Science\).](#)

[Doctoral page index](#)

Aalto Doctoral Programme in Science

The Doctoral Programme in Science is a multidisciplinary programme with a unique combination of science, technology and business. The research done is committed to high standards of international excellence and the aim is to educate doctoral students in different research fields to tackle increasingly complex societal challenges in areas such as energy, environment, health and well-being. The doctoral programme offers a four-year doctoral programme in physics, mathematics, biomedical engineering, computer science or industrial engineering and management.

| | | |
|---|---|--|
|  Degree: Doctor of Science (Technology) |  Application period: 8 Jun 2024 – 5 Dec 2024 |  Language of instruction: Finnish English Swedish |
|  Duration: 4 years, full-time |  Eligibility: Relevant master's degree awarded by a Finnish university or a Finnish university of applied sciences, or a corresponding degree completed abroad |  Field of study: Technology and Engineering |
|  Credits: |  Organising school: School of Science | |

Full-time or part-time studies

All doctoral students are defined as either full-time or part-time students. Doctoral students may not change their study mode by themselves, but it can be changed by application if necessary.

Research @ SAL

The Systems Analysis Lab employs researchers (doctoral students)

A career path for those interested in scientific training

D.Sc. (Tech.) opens doors for research and academic position

Summer job opportunities as research assistants

Key research areas

1. Optimization under uncertainty
2. Risk-informed decision making
3. Public transportation optimization
4. Operations research in defense
5. Energy and climate change policies



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Getting Your D.Sc. (Tech.) @SAL

➤ There is **a long and strong tradition**

- 84 Dissertations since SAL was founded in 1984
- 35 since Aalto was established in 2010
- Presently ~30 enrolled doctoral students (incl. part-time)

➤ Presently **40 ECTS** credits of **course work**

➤ **Doctoral Dissertation**

- Almost always a collection of articles (= submitted manuscripts or published papers)
- Number of articles depends on length and the candidate's contribution

<https://sal.aalto.fi/en/publications/theses/doc/>

Participatory Approaches to Foresight and Priority-Setting in Innovation Networks

Ville Brummer

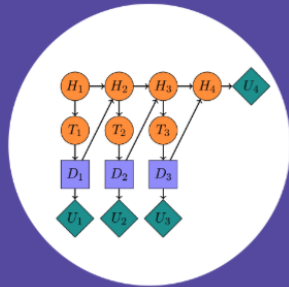
Doctoral dissertation for the degree of Doctor of Science in Technology to be presented with due permission of the Faculty of Information and Natural Sciences for public examination and debate in Auditorium E at the Aalto University School of Science and Technology (Espoo, Finland) on the 23rd of June 2010 at 12 noon.



1. Totti Könnölä, Ville Brummer, and Ahti Salo. 2007. [Diversity in foresight: Insights from the fostering of innovation ideas](#). Technological Forecasting and Social Change, volume 74, number 5, pages 608-626. © 2006 Elsevier Science. By permission.
2. Totti Könnölä, Ahti Salo, and Ville Brummer. [Foresight for European coordination: developing national priorities for the Forest-Based Sector Technology Platform](#). International Journal of Technology Management, forthcoming. © 2010 Inderscience Enterprises. By permission.
3. Ville Brummer, Totti Könnölä, and Ahti Salo. 2008. [Foresight within ERA-NETs: Experiences from the preparation of an international research program](#). Technological Forecasting and Social Change, volume 75, number 4, pages 483-495. © 2008 Elsevier Science. By permission.
4. Ville Brummer, Ahti Salo, Juuso Nissinen, and Juuso Liesiö. [A methodology for the identification of prospective collaboration networks in international R&D programmes](#). International Journal of Technology Management, forthcoming. © 2010 Inderscience Enterprises. By permission.
5. Ahti Salo, Ville Brummer, and Totti Könnölä. 2009. [Axes of balance in foresight – reflections from FinnSight 2015](#). [Technology Analysis & Strategic Management](#), volume 21, number 8, pages 987-1001. © 2009 Taylor & Francis. By permission.
6. Ville Brummer, Ahti Salo, and Margareetta Ollila. 2009. [Balancing incentives in thematic priority-setting for collaborative innovation networks](#). In: Proceedings of the 4th European Conference on Management of Technology: "Closing the Innovation Gap: Theory and Practice" (EuroMOT 2009). Glasgow, Scotland. 6-8 September 2009. © 2009 by authors.

Mixed-integer formulations for large-scale energy-environmental optimization

Olli Herrala



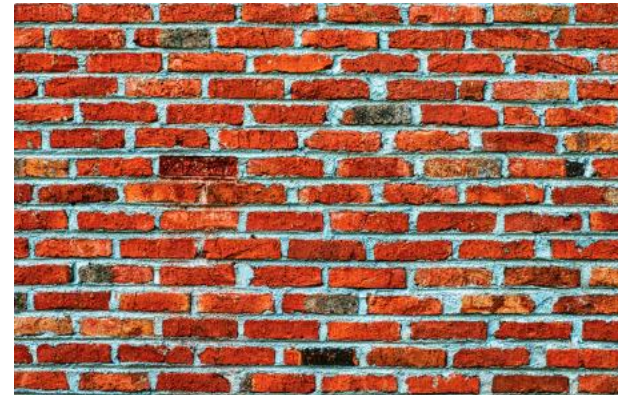
- I. [Publication 1]: Helmi Hankimaa, Olli Herrala, Fabricio Oliveira and Jaan Tollander de Balsch. Solving influence diagrams via efficient mixed-integer programming formulations and heuristics. Submitted to INFORMS Journal on Computing, December 2023. DOI: 10.48550/arXiv.2307.13299 [View at publisher](#)
- II. [Publication 2]: Olli Herrala, Topias Terho, Fabricio Oliveira. Risk-averse decision strategies for influence diagrams using rooted junction trees. Submitted to Operations Research Letters, December 2023. DOI: 10.48550/arXiv.2401.03734 [View at publisher](#)
- III. [Publication 3]: Olli Herrala, Tommi Ekhholm, Fabricio Oliveira. Solving decision problems with endogenous uncertainty and conditional information revelation using influence diagrams. Submitted to Omega, February 2024. DOI: 10.48550/arXiv.2304.02338 [View at publisher](#)
- IV. [Publication 4]: Olli Herrala, Steven A. Gabriel, Fabricio Oliveira, Tommi Ekhholm. A novel strong duality -based reformulation for trilevel infrastructure models in energy systems development. Journal of the Operational Research Society, July 2024. DOI: 10.1080/01605682.2024.2365807 [View at publisher](#)

Why might you wish to pursue a doctorate?

- Receiving the fancy title of **Doctor of Science in Technology** (\approx PhD)?
- Obtaining a “**driver’s licence**” for an academic career?
- Taking the chance to **explore your full potential**?
- Developing the knowledge, capabilities and networks that allow you to become successful as an **independent professional**?

Making a contribution that matters

- You are expected to produce **new scientific knowledge**
 - New theories & methods?
 - New empirical data sets?
 - New research questions?
- Yet trying to make a difference **on all fronts** entails risks
 - Lack of comparability with earlier contributions?
 - Overwhelming breadth of earlier work to be mastered?
 - A Dissertation is not a display of general knowledge or accumulated wisdom!
- Why should others care about the problem you have solved?



Top 6 knowledge and skills doctorates developed during their studies*

- Analytical and systematic thinking
- Knowledge and skills related to methodology and research methods
- Problem-solving skills
- Knowledge and skills related to the research area
- Ability to learn and adopt new information
- Information acquisition skills

AAAA-Rating of Success Factors

Abilities

- Relevant educational background
- Supportive working conditions that enable doctoral studies
- Access to adequate supervision

Appetite

- Passion for learning coupled with an analytical and questioning mindset
- Keeness on composing, elaborating and presenting arguments

Aptitude

- An inclination for mathematical thinking
- A liking for tackling hard (rather than easy) challenges

Attitude

- Proactiveness, curiosity, perseverance, patience and humility
- Passion for quality, even (but not unbridled!) perfectionism

Examples of Doctoral Careers



Anna Repo
Natural Resources
Institute Finland
(Luke)



Juuso Liesiö
Aalto BIZ



Tuomas Lahtinen
Data & AI Consulting,
Loihde



Vilma Virasjoki
Fingrid



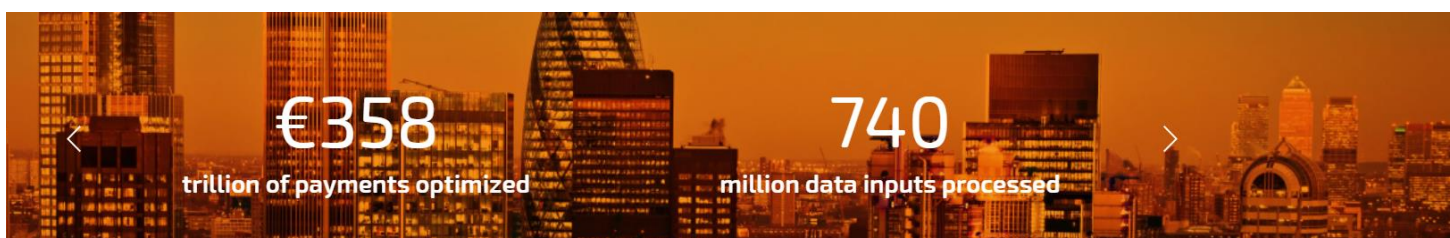
Dr Kimmo Soramäki

Founder and CEO

Network Topology, System Mechanics
and Behavioral Dynamics in Interbank
Payment Systems

Aalto University publication series

DOCTORAL DISSERTATIONS 75/2012



€358

trillion of payments optimized

740

million data inputs processed

FNA's technology enables decision makers and business analysts to easily uncover hidden connections, access and understand complex networks and create dashboards & simulations.

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Optimize

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<https://www.fna.fi/>



PRESIDENT OF THE REPUBLIC OF FINLAND

Director of Peace Mediation

Ville Brummer

Doctor of Science (Tech), Aalto University, 2010

Master of Science (Tech), University of Helsinki, 2005

Director of Peace Mediation and Member of the Cabinet of the President of the Republic of Finland, 2024–

Programme Director, CMI – Martti Ahtisaari Peace Foundation (formerly Crisis Management Initiative ry), 2013–2024

Head R&D, Crisis Management Initiative ry, 2010–2013

Project assistant, advisor and project manager, Crisis Management Initiative ry, 2008–2010

Researcher, Aalto University, 2005–2008



At best, it's a great part of a lifelong journey

- You will contribute to the advancement of science, which can be very **satisfying**
- There is a good chance that you won't be just as **free** later during your later career
- It's an opportunity to test and push your limits thereby **expanding your horizons**
- The friendships and professional contacts you develop may **enrich your life** for decades

