Sensor informatics and Decision-making for the DIgital Transformation (SEDDIT)

-

A Vinnova Competence Center

Workshop 2024

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Center Director

Linköping University

SEDDIT

Sensor informatics and Decision-making for the Digital Transformation

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Program

9.30 – 9.45 Coffee

9.45 - 10.00 Welcome & Introduction

10.00 – 10.45 *Data-driven and distributed optimization for addressing complexity in contemporary applications,* Maria Prandini, Politecnico di Milano

10.45 – 11.10 SEDDIT in a sustainability perspective

11.10 – 12.00 Project overview and poster teaser

12.00 – 13.45 Lunch and poster session

13.45 – 14.30 *Controlling a Pandemic: An account of successfully applying control theory to the covid-19 pandemic in Denmark*, Jakob Stoustrup, Aalborg University

14.30 – 15.00 Coffee

15.00 – 16.00 Think tanks

16.00 – 16.15 Sum up and closing

16.30 – 17.30 Board meeting

19.00 Dinner at Stångs Magasin

Introduction

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Background

- Competence centers have existed in various shapes for almost three decades
- An initiative from NUTEK/Vinnova during the mid nineties
- The divisions of Automatic Control and Vehicular Systems have been part of competence centers (or similar) in different stages (ISIS, LINK-SIC)
- Purposes of a competence center:
  - Carry out research of high academic quality and of importance for the industrial partners
  - Contribute to networking and exchange of knowledge between the partners
  - Support innovation and competitiveness of the industrial partners.





Center partners

Linköping University
Uppsala University
Saab Aeronautics
Saab Dynamics
Scania
Volvo Cars
Atlas Copco Industrial Technique
Väderstad
Actia Nordic
SafeLine
UMS Skeldar
Sensorbee





Background

- An exciting range from large to smaller companies
- The industrial partners act in different areas, i.e. non-competing
- The core competences of SEDDIT are of importance for the industrial partners

Core competences

- Sensor fusion and sensor systems
- Data-driven modeling and diagnostics
- Learning methods for control
- Control-oriented physics-based modeling
- Optimization and planning for control and autonomy

Background

- SEDDIT started Jan 1 2024
- Funding for five years, with possible extension
- Funding:
  - Vinnova - Cash
  - Linköping and Uppsala Universities – Cash and in-kind
  - Companies – Cash and in-kind
  - Roughly 1/3 each
- Web site will be released soon
- SEDDIT is part of the Vinnova program Avancerad Digitalisering

Roles

- Board
- Management team, including director, co-director, coordinator, and researchers
- International Scientific Advisory Board (ISAB)
- PhD students, postdocs, supervisors, students, etc.

Strategy

1. To contribute to new products and processes via the development of high-quality research results in industry-relevant areas, as well as fast knowledge transfer from academia to industry.
2. To produce highly qualified human resources (PhD and MSc degrees) with solid knowledge within sensor informatics and decision-making to the industry, and to impact the relevance of engineering education at Linköping University (LiU) and Uppsala University (UU) with up-to-date course content based on recent research results, as well as industrial and societal needs.
3. To positively influence the gender balance within the education and research connected to the center.
4. To ensure an international perspective through collaboration on industry-oriented research with a selected set of international partners

Keywords

- **People** – PhDs and MScs with the required knowledge and skills for the field.
- **Processes** – Tools and methods for an improved and more efficient product development process.
- **Products** – E.g. algorithms for improved performance of the product of the company.

SEDDIT in a sustainability perspective

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Challenges

- Climate change
- Global stability and security
- Competitiveness of the Swedish system-building industry

Focus areas

- Zero carbon emission and resilient transportation systems
- Societal security and environmental monitoring

Core competences

- Sensor fusion and sensor systems
- Data-driven modeling and diagnostics
- Learning methods for control
- Control-oriented physics-based modeling
- Optimization and planning for control and autonomy

Focus areas and core competences in a sustainability perspective

SDGs

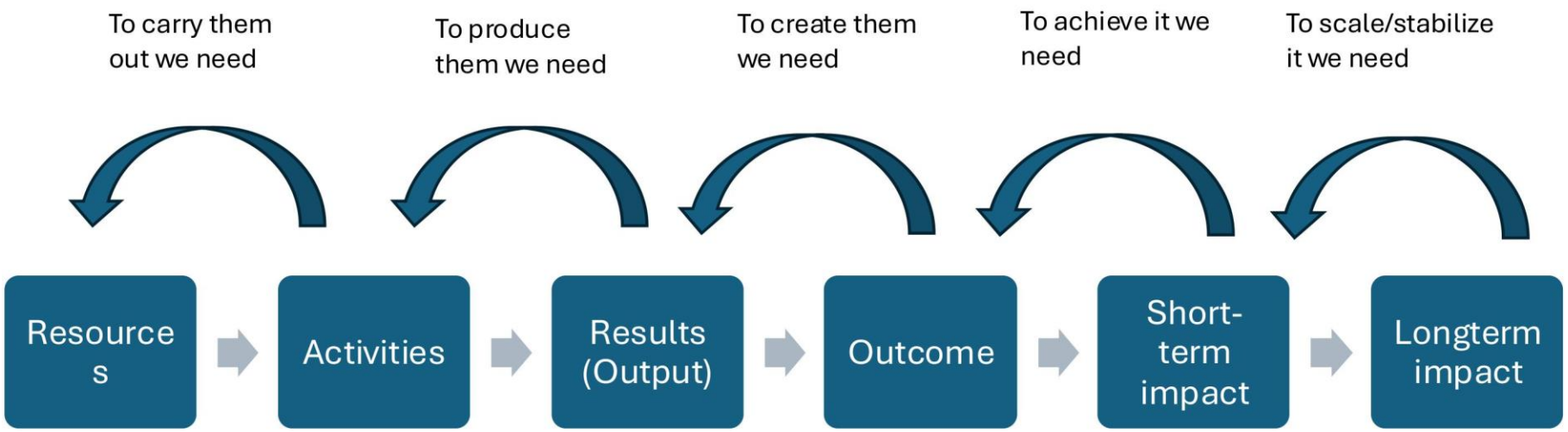

13
CLIMATE ACTION
11
SUSTAINABLE CITIES AND COMMUNITIES
9
INDUSTRY, INNOVATION AND INFRASTRUCTURE
17
PARTNERSHIPS FOR THE GOALS

Activities

- Sustainability workshop in Gothenburg in February 2024 arranged by Vinnova/AFRY
- As preparation we collected information about the sustainability policies of the partners
- Sustainability is one point in the template when formulation project proposals
- Internal workshop about sustainability and impact
- Instructions for sustainability plan Vinnova will come for review in December
- Kick-off for all competence centers in January
- Homework
- Sustainability workshop with presentations of sustainability plans in April

A way of thinking

Change logic for impact implementation



Competence centres and sustainability plan

- Information meeting with sustainability consultants – background and phase 1 plan
- Phase 1 – look for sustainability competence within the participant organisations
- Workshop 7th March: Hands-on, try the process to make a sustainability plan, consultancy support.
- Outcomes:
  - ✓ A single template for the sustainability plan for new competence centres
  - ✓ More consultancy support to work with the sustainability plan
- Sustainability plan and sustainability management will be included in the midterm review will be part of the 5 years evaluation.

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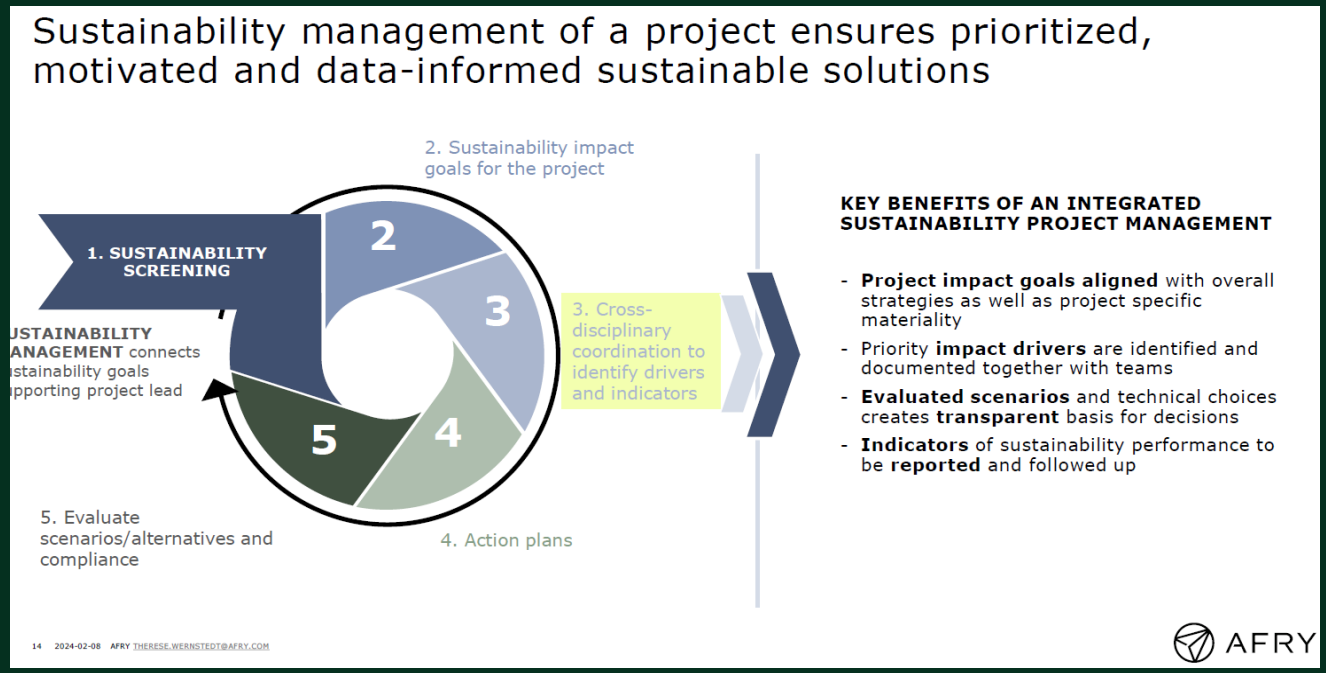
Sustainability plan phase 2

- Open process to choose consultancy company to lead phase 2 completed. AFRY is selected.
- Vinnova can now offer individual sustainability consultancy support to the competence centres.
- Participation of centre's partners from academy and private sector
- Important aspect for international competitiveness, SME and LE sustainability work and reporting
- The sustainability plans are going to be in line with international frameworks for sustainability reporting such as CSRD and ESRS



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Sustainability plan phase 2

Preliminary time plan:

- November-December 2024: AFRY produces a template for a sustainability plan with associated routines for management.
- December 2024: Discussion on the sustainability template with two selected groupings from two competence centres (SEDDIT and CoDig).
- End of December 2024: AFRY will deliver the template for a sustainability plan with instructions to all competence centers (centre manager, board chairman and others involved in the work).
- January 2025: read through the documentation for the sustainability plan (template and instructions), prepare questions, involve the right people among project parties before the workshop on January 17th.
- January 17, 2025: kick-off digital workshop (2h) via Teams with the participation of all competence centers, AFRY and Vinnova's respective center managers.
- 20 January - 31 January 2025: Individual coaching with AFRY
- February 2025: Individual competence centre work with the sustainability plan.
- March 3-March 21, 2025: Individual coaching with AFRY
- 3 April 2025, 10am-3pm, Joint workshop at AFRY in Gothenburg with presentation of the sustainability plan for each competence centre.

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Project overview and poster teaser

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Project overview and poster teaser

PhD student projects. On-going or recently started:

- Erik Sevonius. *Collaborative Localization in GNSS Denied Environments*

Project overview and poster teaser

PhD student projects. On-going or recently started:

- Viktor Uvesten. *Autonomous farming – agricultural sensing and control*

Project overview and poster teaser

PhD student projects. On-going or recently started:

- Nils Dressler. *Optimal Control of Tightening Processes*

Project overview and poster teaser

PhD student projects. On-going or recently started:

- Carl Steen. *Thermotronic digital twins supporting the digital transformation*

Project overview and poster teaser

PhD student projects. Very recently started:

- Filip Lindström. *Human Senses Mimicking: Mechanical Integrity Self-Assessment*

Project overview and poster teaser

PhD student projects. Very recently started:

- Xiaojing He, *Modeling and distributed large-scale sensing for optimal fleet routing of heavy BEVs*

Project overview and poster teaser

Summer projects:

- Carried out in collaboration with a subset of the industrial partners.
- The companies propose tasks suitable for six weeks of work for two talented students.
- SEDDIT hires students who are between year four and five in their studies and have suitable background.
- In most cases, the work is carried out at the site of the company.
- The work is presented via posters at the annual workshop.

Project overview and poster teaser

Summer projects:

- Simon Persson & Arvid Önsten. *Monitoring Elevator Usage With a ToF Camera*. Safeline

Project overview and poster teaser

Summer projects:

- Johan Larsson & Adam Lundgren. *Improving Air Quality Sensors*. Sensorbee

Project overview and poster teaser

Summer projects:

- Martin Bildhjerd & Gustaf Carbonnier. *2-Axis Motion Test Rig*. Actia Nordic

Project overview and poster teaser

Senior projects. Industry in-kind:

- Zoran Sjanic. *Estimation and information handling in a heterogenous SoS*

Project overview and poster teaser

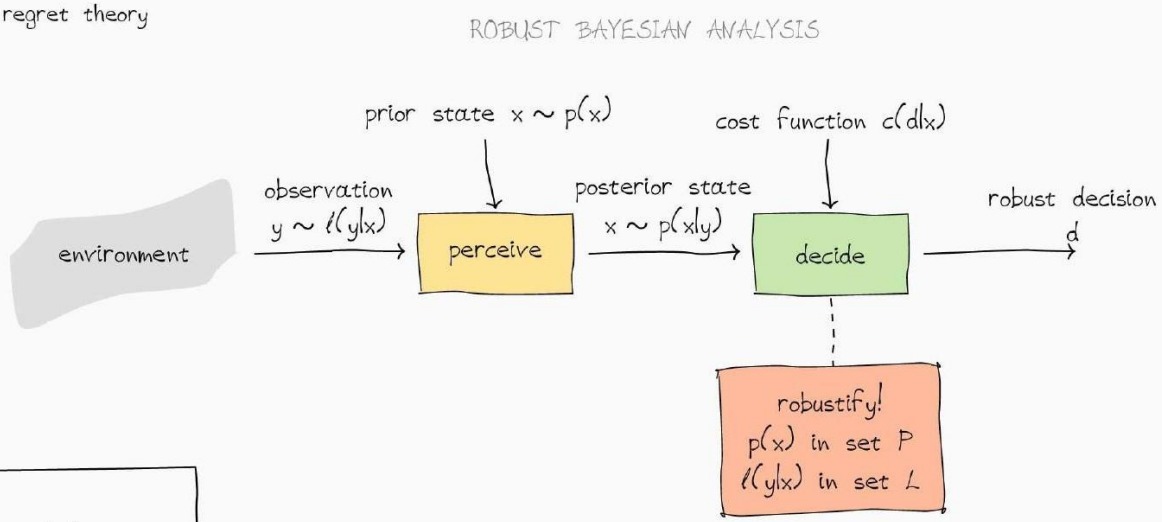
Senior projects. Industry in-kind:

- Robin Forsling. *Robust Decision-Making Under Uncertainty and Model Errors*

Robust Decision-Making Under Uncertainty and Model Errors

Key words: autonomous decision-making, uncertainty, model errors, robustness

Initial approaches:
- robust Bayesian analysis
- human-like decision-making
  - prospect theory, regret theory



Poster:
- detecting complex model errors

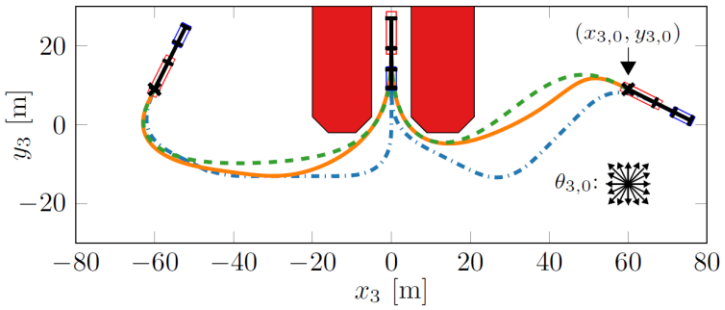
Project overview and poster teaser

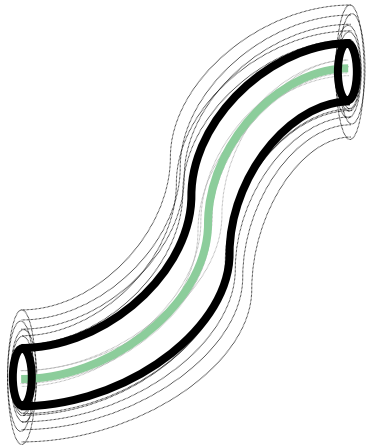
PhD student projects. Recruitment ongoing:

- *Safe motion-planning with learning in the loop*. Daniel Axehill

Safe motion-planning with learning in the loop

- To integrate methods from AI and optimal control into new methods has been successful in our previous research
- New AI tools to be integrated in the proposed research:
  - reinforcement learning.
  - generative AI.
- **Challenge:** Hard to *guarantee safety* with these tools
- **Research question:** How can reinforcement learning and generative AI be *beneficially* and *safely* integrated in optimal motion planning and motion execution?
- Preliminary directions
  - Tightly integrate optimal model-based motion planning and reinforcement learning.
  - Explore residual learning to correct for model errors.
  - Investigate if ideas from tube MPC can be used to guarantee robust performance during motion execution with RL.
  - Investigate heuristics learning for computational performance using generative AI.





Project overview and poster teaser

PhD student projects. Recruitment ongoing:

- *Foundation Model and Reinforcement Learning*. Farnaz Adib Yaghmaie

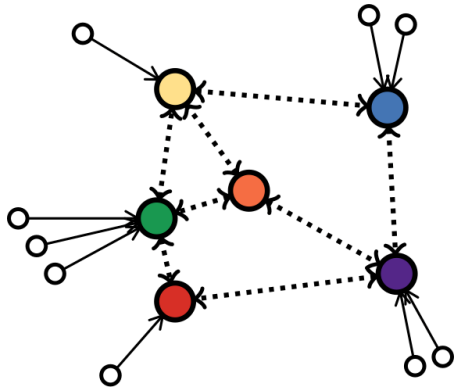
Project overview and poster teaser

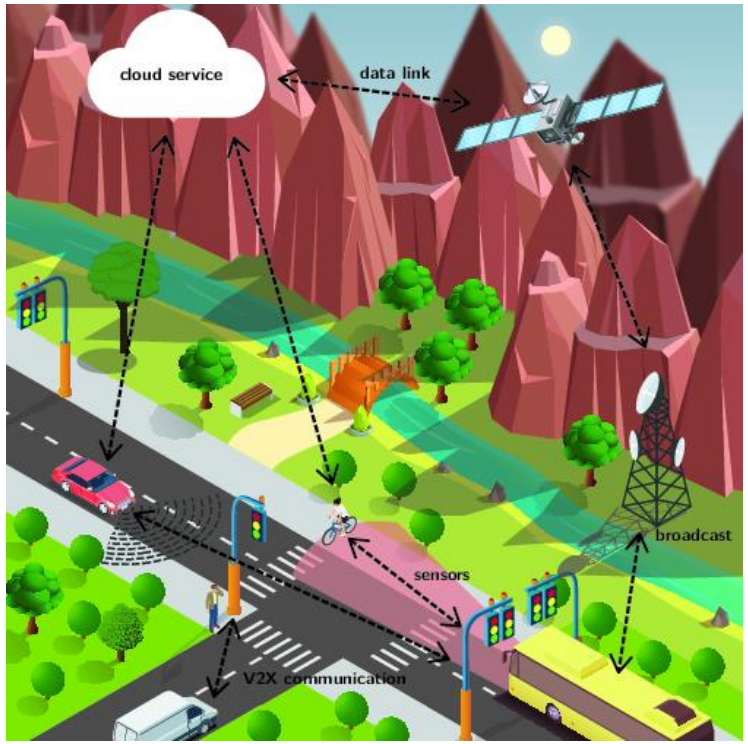
PhD student projects. Recruitment ongoing:

- *Robust Large-Scale Estimation*. Gustaf Hendeby

Robust Large-Scale Estimation

- Large distributed estimation problems
- Ad hoc network of nodes/agents
- Aspects to consider:
  - Scalability (compute and communication)
  - Changing network structure
  - Node uncertainties and failure





Project overview and poster teaser

PhD student projects. Recruitment ongoing:

- *Collaborative decision-making in uncertain scenarios*. Johan Löfberg

Project overview and poster teaser

PhD student projects. Recruitment ongoing:

- *Reinforcement learning for multi-agent systems under semantic and perceptual uncertainties*. Roland Hostettler

Think tanks

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Think tanks

- Topics:
  - Data-driven modeling and diagnostics – Martin Enqvist
  - Sensor fusion and sensor systems – Gustaf Hendeby, Fredrik Gustafsson
  - Complex systems – Lars Eriksson

Think tanks

- Topics and rooms:
  - Data-driven modeling and diagnostics – Martin Enqvist - Systemet
  - Sensor fusion and sensor systems – Gustaf Hendeby, Fredrik Gustafsson - Transformen
  - Complex systems – Lars Eriksson – Stora konferensrummet i Visionen

Dinner tonight

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Dinner

Place: Stångs Magasin. Close to the river, Scandic City

Time: 19.00

Study visit to Väderstad

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Study trip to Väderstad

- Departure from Scandic City 8.30
- Departure from Linköping University, Zenit, 8.45
- ……
- ……
- Departure from Väderstad, 13.15

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Med finansiering från:

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