Görel Hedin
Wallenberg Autonomous Systems Program (WASP)

- 10.5 year strategic program on Autonomous Systems and Software
- Knut And Alice Wallenberg Foundation (KAW)
- Budget 1.8 BSEK
  - 1.3 BSEK – KAW
  - 300 MSEK – Industry
  - 200 MSEK – University
- Collaboration between
  - Linköping University, Lund University, KTH, Chalmers on equal terms
  - Umeå University with smaller share
Wallenberg Autonomous Systems Program (WASP)

• Program Director – Lars Nielsen, Linköping

• Board
  • Chaired by Mille Millnert, Linköping
  • One representative each from the main universities
  • Industrial representatives from Ericsson, Saab, and ABB

• International Scientific Advisory Board (ISAB)
WASP Program Board

Mille Millnert
Linköping University
Chair WASP

Sara Mazur
Ericsson AB, Vice President and Head of Ericsson Research
Vice Chair WASP

Alf Isaksson
ABB AB, Global Research Manager Control

Pontus de Laval
Saab AB, CTO

Mats Viberg
Chalmers, Vice President

Arne Johansson
KTH, Vice President

Ulf Nilsson
Linköping University, Dean

Viktor Öwall
LTH, Dean
Key Value:

Research excellence in autonomous systems and software for the benefit of Swedish industry

Mission:

Build a world-leading platform for academic research that interacts with leading companies in Sweden to develop knowledge and competence for the future
WASP Instruments

- Research
- Graduate School
  - 47 students currently (excl affiliated PhD students)
  - Around 150 in total after 10 years
  - Up to half of them industrial PhD students
- Recruitments
  - 18 international recruitments
  - Full Professor or Associated Professor
  - Considerable package associated with each position (19M)
- Demonstrator arenas (WARA)
- Industry-university network
- Industry network
- International network
WASP Research

Strategic Areas

Vehicles, Robots and Humans
Systems of Systems
Software

Thematic Areas

Data Analytics and Learning
Collaboration and Interaction
Model-Based System Engineering
Networked and Distributed Systems
Software for Engineering Design, Synthesis, and Autonomous Systems
Structure of Research Program

Possible visions:
- Completely automated mine
- Coordinated rescue operations
Structure of Research Program

In the future networked society everything will be connected.

To manage the complexity, the System-of-Systems has to have a certain level of autonomy, i.e., be self-organizing and capable of independent decision making.
Structure of Research Program

New requirements on Computer Science foundations:
- Domain-specific languages (mission specification languages, coordination & collaboration)
- Greater automation in development, verification and testing
- Leveraging Big Code and Machine Learning
- New development processes (continuous change, deployment, verification, system variants)

Software Methodology
Software Technology
Cloud
WASP Initial Projects

• Software Engineering for Smart Systems
  • Chalmers, Lund
  • Ericsson, Systemite AB
  • Coordinated by Jan Bosch, Chalmers

• Autonomous Cloud
  • Umeå, Lund, KTH
  • Ericsson, Axis
  • Coordinated by Karl-Erik Årzén, Lund

• Integrating Perception, Learning and Verification in Interactive Autonomous Systems
  • KTH, Linköping, Chalmers, Lund
  • Saab, ABB
  • Coordinated by Danica Kragic, KTH
WASP Initial Projects

• Interaction and Communication with Autonomous Agents in Sensor-Rich Environments
  • Linköping, Chalmers, Lund
  • SAAB, Atlas Copco, Sectra, Gothenburg Energy
  • Coord: Anders Ynnerman, Linköping

• Localization and Scalability for Distributed Autonomous Systems
  • Linköping, Lund, KTH
  • SAAB, Ericsson, Boliden, ABB
  • Coord: Fredrik Gustafsson, Linköping

• Automated Transport Systems
  • KTH, Linköping, Chalmers, Lund
  • Scania, Volvo Cars, Autoliv, Volvo
  • Coord: Bo Wahlberg, KTH
Wallenberg Autonomous Research Arenas (WARA)

Open demonstrator arenas with rich possibilities

Build on unique Swedish relation academia-industry
WARA-PS (Public Safety)

A few potential scenarios described, with research challenges and potential in-kind contributions.

- Search and rescue situation in Karlskrona
  - Flare indicating people in the water
  - Search using autonomous ships and quadcopters
  - Distributed command function
  - Incomplete and heterogeneous information

- Security at large events
  - Indication of violence at Almedalen / Bråvalla / Olympics in Stockholm
  - Provide enhanced security in the background, Ability to ramp up quickly
  - Fixed and mobile sensors
  - A fixed sensor triggers a dynamic hot-spot of UAV sensors

- Hazardous rescue
  - Explosion in chemical plant
  - Collapsed buildings and roads within a large area, risk of further explosions
  - Hazardous chemical agents make it unsafe to rescue people and clear the area
  - Need to map the environment and localize people both outdoor and indoors
  - Use autonomous heavy construction vehicles to clear roads and buildings

System of Systems:
- Autonomous Platforms / Vehicles
- (Distributed) Command & Control
- Sensors, Perception
- Communication Network
- Datacenters, Cloud, Learning

Example Research Challenges:
- Situation Awareness & Readiness
- Autonomy
- Perception, Learning
- Mission critical cloud
- Multi-sensor fusion
WARA-AD (Autonomous Driving)
Smart City Traffic

Goal:
• Optimize city traffic flow over few city blocks
• Increase safety, Reduce energy waste

Strategy:
• Collaborative traffic
  • Involving highly automated vehicles
  • Detecting and Predicting less automated vehicles, pedestrians, bikers, and other objects
  • Adapt routes, speed, coordination (e.g. traffic lights), guidance to pedestrians/bikers for maximum efficiency and safety

Example Research Challenges:
• Distributed and Hierarchical Traffic Control
• Time-critical and robust communication (V2V, V2I, V2N)
• Time-critical Cloud services, decision making, presentation for drivers
• Context-sensitive multi-sensor fusion with detection, tracking, prediction (infrastructure as well as vehicles)
  • All weather conditions
  • Rush hour flows vs. low-traffic individuals
• Highly-Automated Vehicles with Infrastructure information enhancements
• Supporting heterogeneous traffic mix: people, less automated vehicles, objects

System of systems:
• Highly Automated Vehicles
  • And other vehicles, pedestrians, …
• Infrastructure cameras and other sensors
• Data center, Cloud, Learning
• Communication
• Traffic Control & Management
• Traffic lights, signposts, etc.
• Optional: Security
Lund University in WASP

Currently four departments are involved:

• Automatic Control
• Computer Science
• Electrical and Information Technology
• Mathematical Imaging Group at Mathematics
Senior Researchers currently involved in WASP

• Karl-Erik Årzén – Automatic Control
• Bo Bernhardsson – Automatic Control
• Anders Rantzer – Automatic Control
• Martina Maggio – Automatic Control
• Per Runesson – Computer Science
• Görel Hedin – Computer Science
• Jacek Malec – Computer Science
• Elin Topp – Computer Science
• Fredrik Tufvesson – Electrical and Information Technology
• Maria Kihl - Electrical and Information Technology
• Kalle Åström - Mathematics
Lund Recruitments

• Four positions
  • Two now and two around 2020
• One Associate Professor in Software Technology
• One position in the open call for four WASP professors
Academic PhD Students in WASP

• Tommi Nylander – ”Control-based resource management in the distributed cloud”
  • Automatic Control
  • Karl-Erik Årzen / Maria Kihl

• Hamed Sedaghi – ”Control using Distributed Observers”
  • Automatic Control
  • Anders Rantzer / Giacomo Como

• Alfred Åkesson – ”Adaptive software architectures for autonomous systems”
  • Computer Science
  • Görel Hedin
Academic PhD Students in WASP

• Rasmus Ros – "Data collection and analysis for continuous experimentation"
  • Computer Science
  • Per Runeson

• Christian Nelson – "Link Modelling for Cooperative Transport Solutions"
  • Electrical and Information Technology
  • Fredrik Tufvesson

• David Gillsjö – "Semantic structure from motion for autonomous systems"
  • Mathematical Imaging Group
  • Kalle Åström
Industrial PhD Students in WASP

• Per Skarin – ”Mission-Critical Cloud”
  • Automatic Control
  • Karl-Erik Årzén / Maria Kihl
  • Johan Eker, Ericsson

• Alexandre Martins – ”Autonomous learning camera systems in resource constrained environments”
  • Automatic Control
  • Karl-Erik Årzén / Martina Maggio
  • Mikael Lindberg, Axis Communications

• Mårten Lager – ”Digital Cognitive Companion for Marine Vessels”
  • Computer Science
  • Jacek Malec / Elin Topp
  • Roger Berg, Saab Kockums
Industrial PhD students

- The way to become involved in WASP
- Industrial employee
- Research at 80-100% of the time
  - 4 or 5 years
- 600k per year at 100% from KAW
Industrial PhD Students

• Second call during Spring 2017
  • Deadline probably March 31
• Probably 17-20 positions
• Information meeting in Lund Nov 24
  • 13:15 – 16:00
  • M:B, Ole Römers väg 1
• Contact me
  • gorel.hedin@cs.lth.se
or
  • Karl-Erik Årzén – karlerik@control.lth.se
if you are interested