WASP

HIGHLIGHTS

2023

Preface

We are proud to present the WASP highlights from 2023, a year characterized by increased strategic collaboration and research projects with high impact on industry and society. The most prominent example is the approval of five multidisciplinary research projects within cybersecurity with a total funding of 100 MSEK, aiming to solve ground-breaking research challenges leading to a safer digital society.

By launching projects together with our sister programs within sustainable material science, data-driven life science and within our platforms for academia-industry collaboration, WASP accelerates the integration of foundational research and impactful applications.

On the average, one WASP PhD student per week is now graduating, and 100 new PhD students joined the program during 2023. We are also pleased to see that the WASP alumni are to a large extent being employed by Swedish industry or are starting off their academic careers by pursuing international postdocs, in line with the overall aims of the programs.

The ambition to provide excellent career opportunities in Sweden for our PhD students and researchers are of highest priority. You can read more about Rebekka Wohlrab, a WASP alumna who has taken advantage of the career possibilities offered by WASP and now is an assistant professor. Furthermore, initiatives that promote mobility between an academic and industrial career have been executed.

Approaching 10 years of the program, renewed strategies on how to target the investments with the highest impact for the coming years are being developed. Preparing for the future, we are looking forward to what is ahead while relishing the various research activities in the program which are currently running at top capacity.

Anders Ynnerman, Director of WASP
Pontus de Laval, Chair of WASP Board of the Directors

About WASP

Wallenberg AI, Autonomous Systems and Software Program (WASP) is Sweden's largest individual research program ever, a major national initiative for strategically motivated basic research, education and faculty recruitment. The program addresses research on artificial intelligence and autonomous systems acting in collaboration with humans, adapting to their environment through sensors, information and knowledge, and forming intelligent systems-of-systems. Software is the main enabler in these systems and is an integrated research theme of the program.

The program runs from 2015-2031 with a total budget of 6,2 billion SEK.

GOALS

600
Graduated
PhD students

80
Faculty
recruitments

STATUS
BY DECEMBER 2023

112
Graduated
PhD students

65
Faculty
recruitments

Vision

Excellent research and competence in artificial intelligence, autonomous systems and software for the benefit of Swedish society and industry.

Mission

Build a platform for world class academic research that interacts with leading companies and actors in Sweden to develop knowledge and competence for the future.

WASP Highlights 2023

- 140+ projects granted WASP funding

- WASP-WISE collaboration initiated

- 39 new doctoral theses (112 in total)

- 100 new PhD students admitted to the WASP Graduate School

- 21 new postdoctoral fellows

- 13 new WASP Recruited Faculty

- New Chair of the WASP Board

- New Director of WASP Research Arenas WARA

- 1st Wallenberg Advanced Scientific Forum

100 MSEK
to cybersecurity research projects

In total, 100 MSEK was awarded to five CyberNEST projects which will be run for five years. A NEST should address a specific strategic high-priority research challenge within WASP with international impact and visibility that requires the gathered competence of a multidisciplinary team of investigators to be solved. NEST is an abbreviation for Novelty, Excellence, Synergy, and Teams.

Secure Operation of Uncontrolled and Reliable Computing on the Edges
Christian Gehrmann, Mikael Asplund, Fredrik Heintz and Amir Aminifar

AI-Based Side-Channel Attacks and Countermeasures for Autonomous Systems
Elena Dubrova, Carl-Mikael Zetterling, Thomas Johansson and Christian Gehrmann

Dynamic Attack Detection and Mitigation for Secure Autonomy
Henrik Sandberg, György Dán, Andrei Gurtov and Martina Maggio

ShiftLeft: Securing the Software Supply Chain by Code-centric Analysis
Musard Balliu, Alexandre Bartel, Christoph Reichenbach, David Sands and Rebekka Wohlrab

SCAnDorama - Where Software and Communications Meet in the Next Decade: Cybersecurity Attacks and Defences
Simin Nadjm-Tehrani, Monowar Bhuyan, Jendrik Seipp and Rolf Stadler

WASP Graduate School

The WASP Graduate School is at the peak of activity with over 400 active PhD students. The engagement in courses, study visits and knowledge exchange are boiling.

During 2023, WASP admitted more than 100 new PhD students to the program and saw its 100th PhD student successfully defend their doctoral thesis. A majority of the graduated PhD students are now boosting Swedish companies with their unique set of competencies and strong network from the WASP Graduate School.

International Study Trips

Many of the first- and second-year students participated in the international study trips in 2023. The international study trips are an important part of their research education where they get an opportunity to see world-class research environments abroad, interact with students and faculty at the hosting organizations and get to know their peers within WASP.

The 2023 international trips went to the AI-ecosystem in Québec and Toronto, Canada; to prominent universities and research-heavy companies in Boston and Pittsburgh, US; and to one of the world's most well-renowned robotics labs in Zürich.

Innovating academia-industry collaboration

To promote careers with mobility between academic and industrial research, WASP has initiated an industrial postdoc program. A position uncommon in Sweden. The first call was launched in spring 2023 and four postdocs were admitted.

To make it easier for more PhD students to build their research around the technologies and the scenarios of the WASP Research Arenas (WARA) from scratch, a new type of call was announced in 2023. The WARA PhD call enables more foundational research with strong industrial and societal relevance, leveraging on the infrastructure investments made in the arenas.

Expanding collaboration with strategic partners

The collaboration with the SciLifeLab and Wallenberg National Program for Data-Driven Life Science (DDLS) has so far resulted in two joint calls for research projects and one call for research visits. The ambition is to bridge the gap between the data science and life science disciplines.

A new collaboration between WASP and the Wallenberg Initiative Materials Science for Sustainability (WISE) was initiated in 2023. In addition to strategy discussions, the first step was a joint call which resulted in 28 collaboration pre-projects.

Research Highlights

Failure prediction in large-scale software systems

Adha Hrusto, Industrial PhD student, Lund University and System Verification
Supervisors: Per Runeson, Emelie Engström and Magnus C Ohlsson

Addressing the complex challenge of operational software failures, Hrusto's research introduces a novel proactive monitoring solution. It is a cloud-based, machine-learning-driven solution that offers precise and actionable alerts. This innovative approach streamlines alert processes, ensuring that critical issues are addressed promptly. The research was conducted in collaboration with industrial partners, showcasing the potential of academic research in solving real-world challenges.

Image Restoration with Mean-Reverting Stochastic Differential Equations

Jens Sjölund, Assistant Professor, Uppsala University

Image restoration is a classic computer vision problem with the overall goal of restoring high-quality images from their corrupted counterpart. Most data-driven approaches try to train deep neural networks that directly output high-quality images, but the results are often too smooth. Luo et al. propose a mean-reverting stochastic differential equation (IR-SDE) that simulates the image degradation iteratively and can restore high-quality images with a corresponding reverse-time SDE process. The IR-SDE works well on various image restoration tasks, without modifications, and restores more details and textures than previous neural network-based methods.

3D from Few Images and the AISG-SLA Visual Localisation Challenge

Johan Edstedt, PhD student, Linköping University and Georg Bökman, PhD student, Chalmers University of Technology

Robust localization and mapping from images reduce the need for other sensors and is particularly useful when GPS is unavailable. This was the topic of the AISG-SLA Visual Localization Challenge (IJCAI 2023) where Edstedt and Bökman won the first prize. The solution was based on their deep learning-based image matcher RoMa (CVPR 2024) and keypoint detector DeDoDe (3DV 2024). Relatedly, their work Steerers (CVPR 2024) enables image matching for arbitrary rotations, with applications to remote sensing.

MorphOMICs: a Topological Data Analysis approach to the study of microglia cells

Martina Scolamiero, Assistant Professor, KTH Royal Institute of Technology

In the brain, neurons are surrounded by microglia, which continuously sense their environment. Microglia are seen as first responder to changes in brain activity due to diseases, however to pinpoint changes in their shape has been challenging. The teams of KTH, ISTA, and EPFL used Topological Data Analysis, which provides robust shape descriptors of noisy data, and developed the morphOMICs pipeline (Colombo et al.) allowing to resolve subtle yet functionally informative morphological adaptations early on, before the onset of neurological symptoms and strengthen the role of microglia as sensor.

Research Arenas

Media and Language

WARA M&L contributed to the launch of GPT-SW3 – the first truly large-scale generative language model for the Swedish language. The model was developed together with AI Sweden, RISE and NVIDIA.

Robotics

WARA Robotics inaugurated the laboratory at ABB Corporate Research in Västerås. A physical testbed and a digital counterpart for simulation. Both environments offer realistic settings to identify and address novel research challenges in industrial robotics.

Public Safety

WARA PS has broadened its scope to include more diverse scenarios. The core system has been updated for better adaption to new challenges. It was demonstrated together with researchers at Gränsö23 where over 10 vehicles participated in a mission with unforeseen changes.

Operational Data

WARA Ops launched an online portal hosting industrial operational data. The portal is an advanced data storage and processing infrastructure that enables users to interactively store, annotate, process, and visualize large operational datasets. It provides a collaborative environment where users can interact, share data and results, and set challenges and research questions.

Events

WASP Digital Career Day
March 14, 2023

The Career Day was organized with the aim to support contacts between PhD students approaching the end of their studies and Swedish companies. The digital event hosted a great number of one-to-one meetings between WASP PhD students and industry research leaders.

WASP4ALL 2023 – Building the future Cyber Security landscape
June 1, 2023

How can state-of-the-art research tackle the growing societal and industrial demand for improved Cyber Security? That was the topic of WASP4ALL 2023, with the purposes to create awareness of industrial and societal needs, to identify and discuss research challenges for the future and to showcase existing research in Sweden.

Wallenberg Advanced Scientific Forum
October 3-6, 2023

With the ambition to introduce a new high-level scientific meeting in Sweden, inspired by the successful Dagstuhl seminars, WASP hosted a first pilot event named Wallenberg Advanced Scientific Forum in the autumn of 2023. The meeting attracted both Nobel and Turing price laureates together with senior and junior researchers from Sweden and abroad. The pilot event was themed "The Nobel-Turing Grand Challenge", aiming to develop AI Scientists: AI systems capable of making Nobel-quality scientific discoveries highly autonomously at a level comparable, and possibly superior to the best human scientists by 2050.

WASP Industry Days 2023
November 6-7, 2023

The purpose of Industry Days 2023 was two-fold – to support cross-sector discussions on the theme "Building a sustainable future in a rapidly changing AI landscape", and to put the spotlight on the WASP Research Arena Robotics and its newly finalized lab at ABB. The event was held in Västerås to enable guided tours at the ABB facilities.

WASP Winter Conference
January 9-11, 2024

To conclude 2023 and kick off 2024, more than 500 PhD students and researchers gathered at the Louis de Geer concert and congress hall, Norrköping. The biggest internal event of the year hosted research presentations, program updates, ample of time for networking and an impressive poster session showcasing almost 200 PhD projects.

Rebekka Wohlrab Alumni of the year

Rebekka Wohlrab has laid the foundation for outstanding research in the engineering of self-adaptive systems. As a WASP alum she leveraged upon a WASP international postdoc scholarship at Carnegie Mellon University to build upon her PhD work at Chalmers.

Through the WASP repatriation grant, Rebekka was recruited to Chalmers for a tenure-tracked assistant professorship. With a competitive research output in top venues, a series of best paper awards, funding acquisition far beyond expectation, and last but not least through a pedagogical prize at University of Gothenburg, Rebekka Wohlrab has exhibited a model career as a WASP alum.

Recruitments

To strengthen Swedish research on AI, autonomous systems and software long-term, recruitment is one of the main pillars of WASP. During 2023, the following faculty were recruited to our partner universities with full funding from WASP, including support to build research groups.
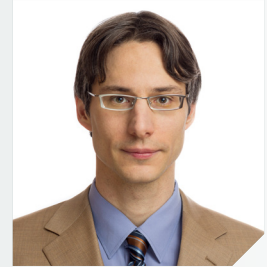
Dániel Varró
Professor
Linköping University

Filip Tronarp
Assistant Professor
Lund University

Hamed Nemati
Assistant Professor
KTH Royal Institute of
Technology

Hazem Torfah
Assistant Professor
Chalmers University of
Technology

Jan Gerken
Assistant Professor
Chalmers University of
Technology

Johan Thunberg
Assistant Professor
Lund University

Matthieu Barreau
Assistant Professor
KTH Royal Institute of
Technology

Olov Andersson
Assistant Professor
KTH Royal Institute of
Technology

Rocío Mercado
Assistant Professor
Chalmers University of
Technology

Silun Zhang
Assistant Professor
KTH Royal Institute of
Technology

Stefan Neumann
Assistant Professor
KTH Royal Institute of
Technology

Stephanie Lowry
Assistant Professor
Örebro University

Zoe Falomir
Associate Professor
Umeå University

WASP
Dissertations

In 2023, 39 PhD students in the WASP Graduate School defended their doctoral theses:

Adam Lindhe
KTH Royal Institute of
Technology

Albin Heimerson
Lund University

Alexander Karlsson
KTH Royal Institute of
Technology/Saab AB

Alexander Nilsson
Lund University/Advenica AB

Cesar Soto Valéro
KTH Royal Institute of
Technology

Damianos Tranos
KTH Royal Institute of
Technology

David Gillsjö
Lund University

Dhasarathy Parthasarathy
Chalmers University of
Technology

Diarmuid Corcoran
KTH Royal Institute of
Technology/Ericsson AB

Emil Brissman
Linköping University/Saab
Dynamics AB

Erik Gärtner
Lund University

Fabian Burghart
Uppsala University

Filippo Vannella
KTH Royal Institute of
Technology/Ericsson AB

Francesca Tombari
KTH Royal Institute of
Technology

Fredrik Hellström
Chalmers University of
Technology

Georg Schuppe
KTH Royal Institute of
Technology

**Goncalo Pedro
Collares Pereira**
KTH Royal Institute of Technology/
Scania AB

Guangyi Zhang
KTH Royal Institute of
Technology

Hannes Eriksson
Chalmers University of
Technology/Zenseact

Haorui Peng
Lund University

He Ye
KTH Royal Institute of
Technology

Héctor Rodríguez Déniz
Linköping University

**Inês de Miranda
de Matos Lourenço**
KTH Royal Institute of Technology

Jens Henriksson
Chalmers University of
Technology/Semcon Sweden AB

Jimmy Aronsson
Chalmers University of
Technology/Zenseact

Johan Källström
Linköping University/Saab AB

Karl Bäckström
Chalmers University of
Technology

Kristin Nielsen
Linköping University/Epiroc
Sweden AB

Masoud Bahraini
Chalmers University of
Technology

Matteo Iovino
KTH Royal Institute of Technology/
ABB Corporate Research

Md Sakib Nizam Khan
KTH Royal Institute of
Technology

Milda Poceviciute
Linköping University

**Mohammed Reza
Saleh Sedghpour**
Umeå University

Noric Couderc
Lund University

Olof Zetterqvist
Chalmers University of
Technology

Petter Restadh
KTH Royal Institute of
Technology

Quantao Yang
Örebro University

Tobias Sundqvist
Umeå University

Yassir Jedra
KTH Royal Institute of
Technology

The Wallenberg AI, Autonomous Systems and Software Program (WASP) is a major national initiative for strategically motivated basic research, education and faculty recruitment in artificial intelligence, autonomous systems and software development. WASP was initiated in 2015 and its mandate extends to 2031. WASP is mainly funded by the Knut and Alice Wallenberg foundation.

Knut och Alice
Wallenbergs
Stiftelse

CHALMERS

KTH
VETENSKAP
OCH KONST

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Luleå University of Technology, Uppsala University and Örebro University

WASP | WALLENBERG AI,
AUTONOMOUS SYSTEMS
AND SOFTWARE PROGRAI