Universität Stuttgart
Institute of Industrial Automation and Software Engineering (IAS)
Faculty V - Computer Science, Electrical Engineering and Information Technology of the University of Stuttgart

Research and Teaching at IAS

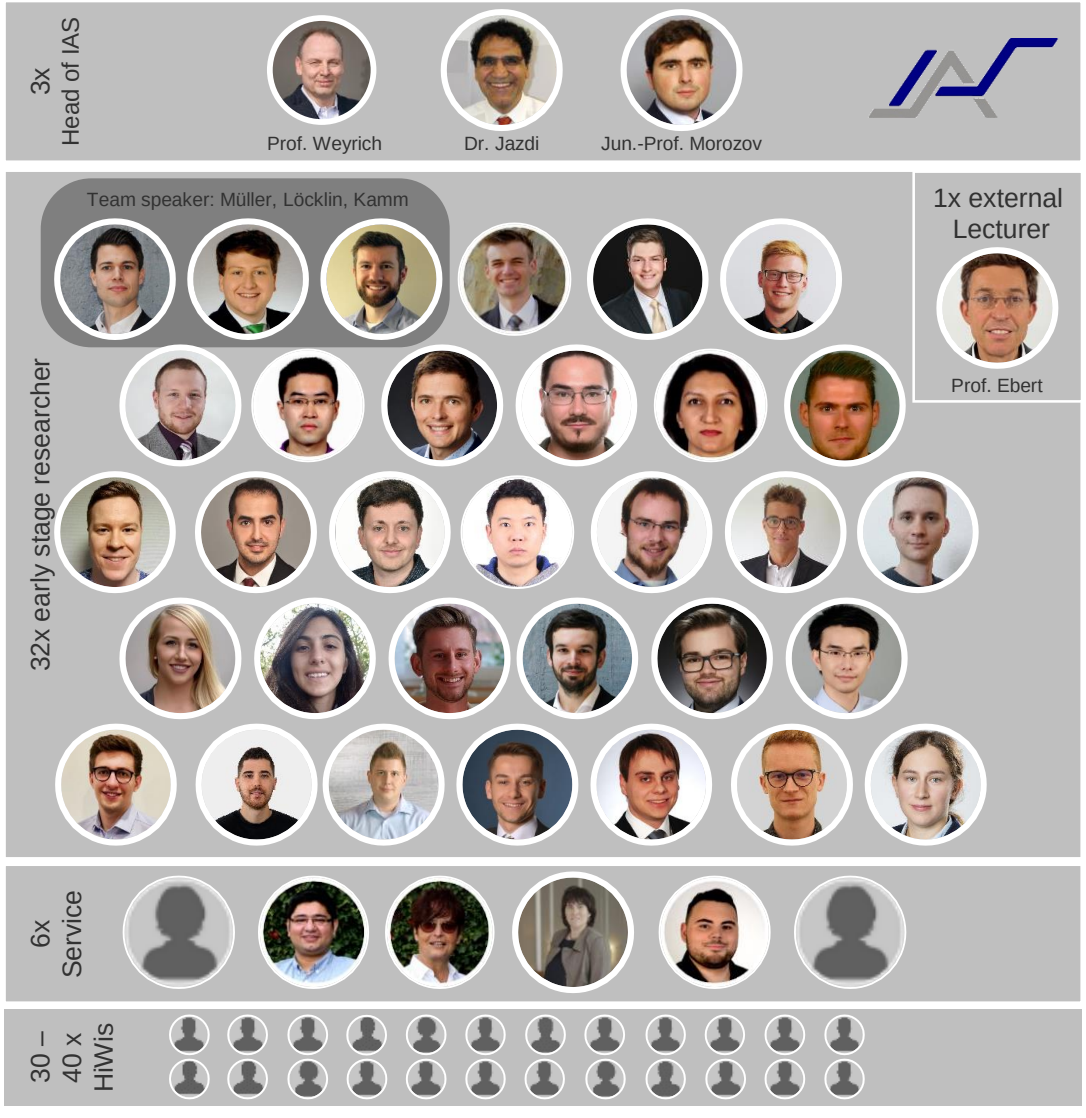
University of Stuttgart,
Institute of Industrial Automation and Software Engineering (IAS)

Institute of Industrial Automation and Software Engineering (IAS)

Research and teaching at the Institute focuses on the topic of **Software Systems for Automation Engineering**.

We see ourselves as a **bridgehead to Product and Plant Automation** in the research disciplines of **Information Technology, Software Technology and Electronics**.

For this purpose, we **collaborate with research institutions and companies** from the Stuttgart region, from Europe and worldwide.



Institute of Industrial Automation and Software Engineering (IAS)

Faculty of Computer Science, Electrical Engineering and Information Technology of the University of Stuttgart

85 years of Tradition and Progress

since 2013

Institute of Industrial Automation and Software Engineering

Professor M. Weyrich

1970 – 1995

Institute for Control Engineering and Process Automation

Professor R. Lauber

since 2020

Jun.-Prof. A. Morozov

Networked Automation Systems

1995 – 2015

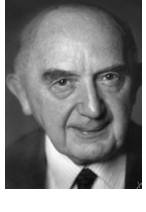
Institute for Automation and Software Engineering

Professor P. Göhner

1935 – 1970

Institute for Electrical Plants

Professor A. Leonhard



Teaching

The institute conducts about 1000 exams per year.

Lectures

- Industrial Automation I & II
- Technologies and Methodologies of Software Systems I & II
- Software Engineering for Real-Time Systems
- Industrial Automation Systems

- Basics of Software Systems
- Lecture Series: Software and Automation
- Lecture Series: Aspects of Autonomous Systems
- Reliability of intelligent distributed Automation Systems
- Modeling and Analysis of Automation Systems
- Seminar Intelligent Cyber-Physical Systems

- Laboratory Course Software Engineering
- Laboratory Course Industrial Automation
- Laboratory Introduction in Microcontroller Programming

Study programs

- Electrical Engineering department:
  - B. Sc. & M. Sc. Elektrotechnik und Informationstechnik
  - B. Sc. Erneuerbare Energien
  - M. Sc. Nachhaltige Elektrische Energieversorgung,
  - M. Sc. Elektromobilität
  - M. Sc. Information Technology
- Exports to other departments
  - Mechatronik, Technische Kybernetik, Informatik, Medizin-technik, Technikpädagogik, Verkehrsingenieurwesen
- Interdisciplinary
  - M. Sc. Autonome Systeme (Dean of Studies Office)

Research at IAS

We focus on automation systems, especially their software in connection with control systems.

Digital Twin for automation systems

- Multidimensional Synchronization of Digital Twins
- Automatic reconfiguration management

Complexity control in automation technology

- Development, test and monitoring of Sofdware-defined systems
- Safeguarding autonomous systems

Intelligent and learning automation systems

- Artificial intelligence and dynamic reliability
- Decentralized, cooperative machine learning in automation

Risk analysis and anomaly detection for networked automation systems

- Deep learning-based anomaly detection techniques
- Reliability analysis for networked automation systems

Research Area: Digital Twin for automation systems

How can the digital twin help to master the complexity of cyber-physical systems in engineering and operation?

Research topics at the IAS

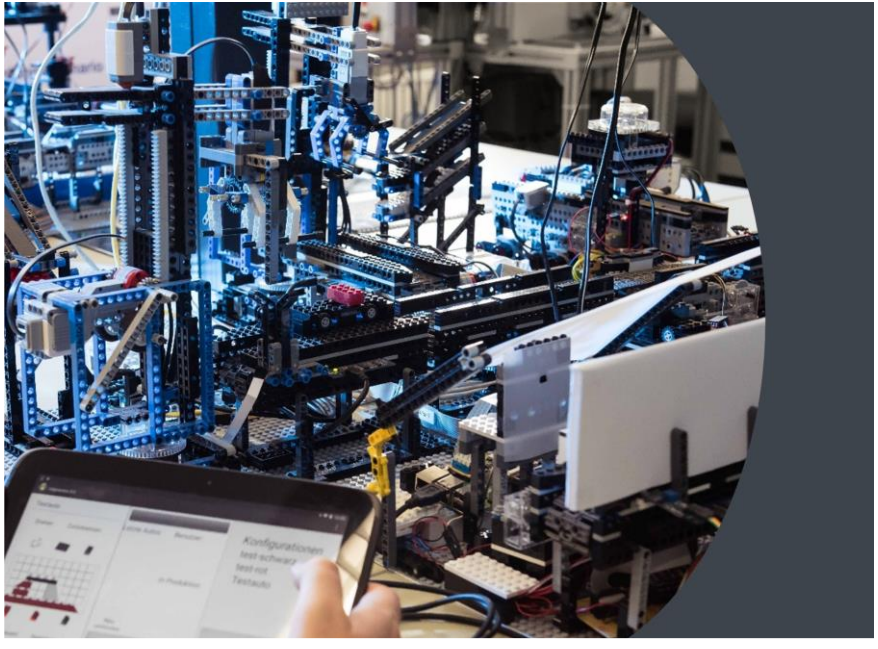
- 5G-based Intelligent Digital Twin
- Co-simulation of software-defined automated systems
- Autonomous reconfiguration management of software-defined systems
- Multidimensional synchronization of digital twins for different applications

Research Area: Intelligent Automation and Autonomous Systems

Are technical systems of tomorrow going to automate themselves?

Research topics at the IAS

- Dynamic Intelligent Reliability
- Optimization of automation systems using machine learning
- Soft sensors for networked automation architectures
- Decentralized, cooperative machine learning in automation
- Knowledge discovery in heterogeneous and unstructured data



Research Area: Complexity control in automation technology

How can the complexity of software-defined systems be made manageable in engineering and operation?

Research topics at the IAS

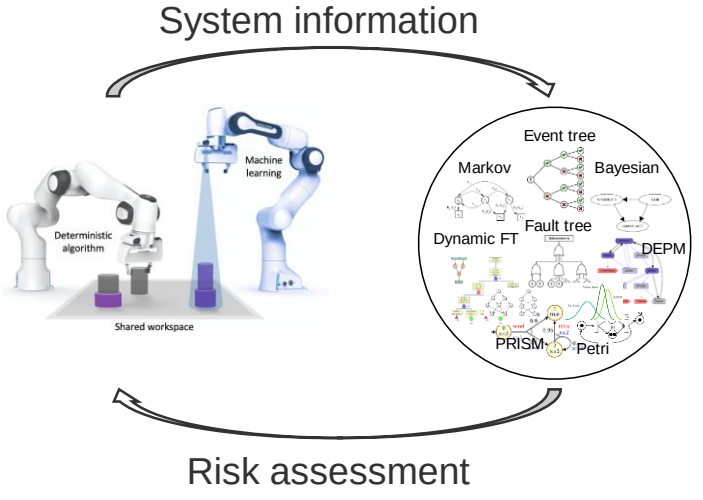
- Assisted CI/CD for Over-the-Air-Updates
- Cooperative sensor-fusion
- Software-Product-Line-based variant management
- Requirements-aware, scenario-based sensor and environment simulation

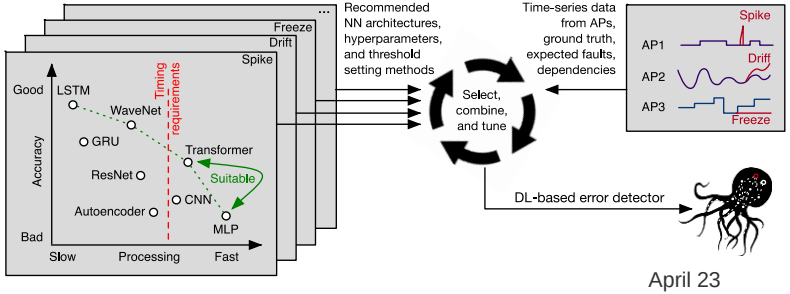
Research Area: Risk analysis and anomaly detection for networked automation systems

How to analyze risk of flexible manufacturing systems and how to exploit the deep learning method to efficiently detect anomalies of Industrial Cyber-Physical Systems?

Research topics at the IAS

- Combination of risk anlysis models.
- Automated, model-based generation of risk models each time the system is repurposed.
- Skill-based approach to risk analysis.
- Evaluation of DL architectures
- Deployment of anomaly detectors on special purpose embedded boards.





IAS in the Research Environment of Stuttgart

Universität Stuttgart

The Institute follows the mission statement "**Intelligent Systems for a Sustainable Society**" and is part of the **Excellence Strategy of the University of Stuttgart**.

Our flag ship projects:

- Leading Univ. of Stuttgart Team of 8PIs in the BMWi flagship project

SofDCar Consortium
We are paving the way for the software-defined vehicle.

- BMBF flagship initiative: H2Mare

We are part of the profile areas and emerging fields of the excellence strategy

- Associated in:

University of Stuttgart
Cluster of Excellence Integrative Computational Design and Construction for Architecture (IntCDC)

We are active in the following organizations:

ARENA2036 — Research Factory

Technologie Transfer Initiative — Technology Transfer Initiative

INNOVATIONCAMPUS FUTURE MOBILITY — Innovation Campus Future Mobility

GS-IMTR — Graduate School Intelligent Methods for Test and Reliability

GSaME Graduate School of Excellence advanced Manufacturing Engineering — Graduate School of Excellence advanced Manufacturing Engineering

Model Processes at IAS

The model processes are used to represent special automation technology and to demonstrate the capabilities of software systems.

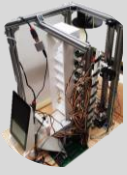
Intelligent Automation & Autonomous Systems

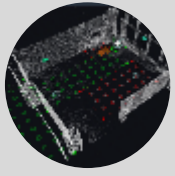
Intelligent Warehouse (ARENA 2036)

Data Analytics in Manufacturing

Cyber-physical production system

Context aware pill dispenser





Real-Time Locating System

Complexity control of CPS

Digital Truck Twin

Plug & Simulate

Simulation of plant modernization

Digital twin of a modular production system

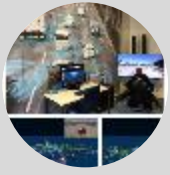
Reliability of Automation Systems

Intelligent Test of autonomous systems

Franka Emika Robots

SafeLegs: Safe exoskeleton

Scenario-based testing of autonomous driving functions



Cooperation with the following Companies

- CompWare Medical GmbH
- Daimler AG
- NAiSE GmbH
- Festo AG & Co. KG
- Hirschvogel Umformtechnik GmbH
- iss (Innovative Software Services GmbH)
- OTTO FUCHS KG
- Robert Bosch GmbH
- Siemens AG
- SMS group GmbH
- Vector Consulting GmbH
- Vector Informatik GmbH
- Infineon Technologies AG
- ZF Friedrichshafen AG
- ETAS GmbH
- Nokia Corporation
- T-Systems
- Tyssenkrupp AG
- Northland Power Inc.

- Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.
- EnBW Energie Baden-Württemberg AG
- INERATEC GmbH
- Climeworks
- EKU Powerdrives

Maker Space

IAS supports various start-up companies and cooperates in research projects

synthavo	Machine parts detection application for higher product quality	since 2021	**EXIST (approved)**
RoboTest	Validation and verification of highly automated and autonomous systems	since 2021	**VC (planned)**
NAiSE INDOOR NAVIGATION SYSTEMS	Indoor Navigation Systems	Jan. 2017 – Dez. 2017 Aug. 2019 – Juli 2022	**EXIST** **EUREKA-Projekt**
truphysics	Simulation and commissioning of robots in virtual reality	Apr. 2014 – März 2015 März 2016 – Feb. 2018	**EXIST** **Junge Innovatoren**
EKU POWER DRIVES	Create technologies that combine power generation with efficient control systems.	Juni 2014 – Mai 2015 Juni 2015 – Mai 2016	**EXIST** **Junge Innovatoren**

Prof. Weyrich is also the faculty's start-up officer and thus the first point of contact for those interested in starting a business.

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Thank you!

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