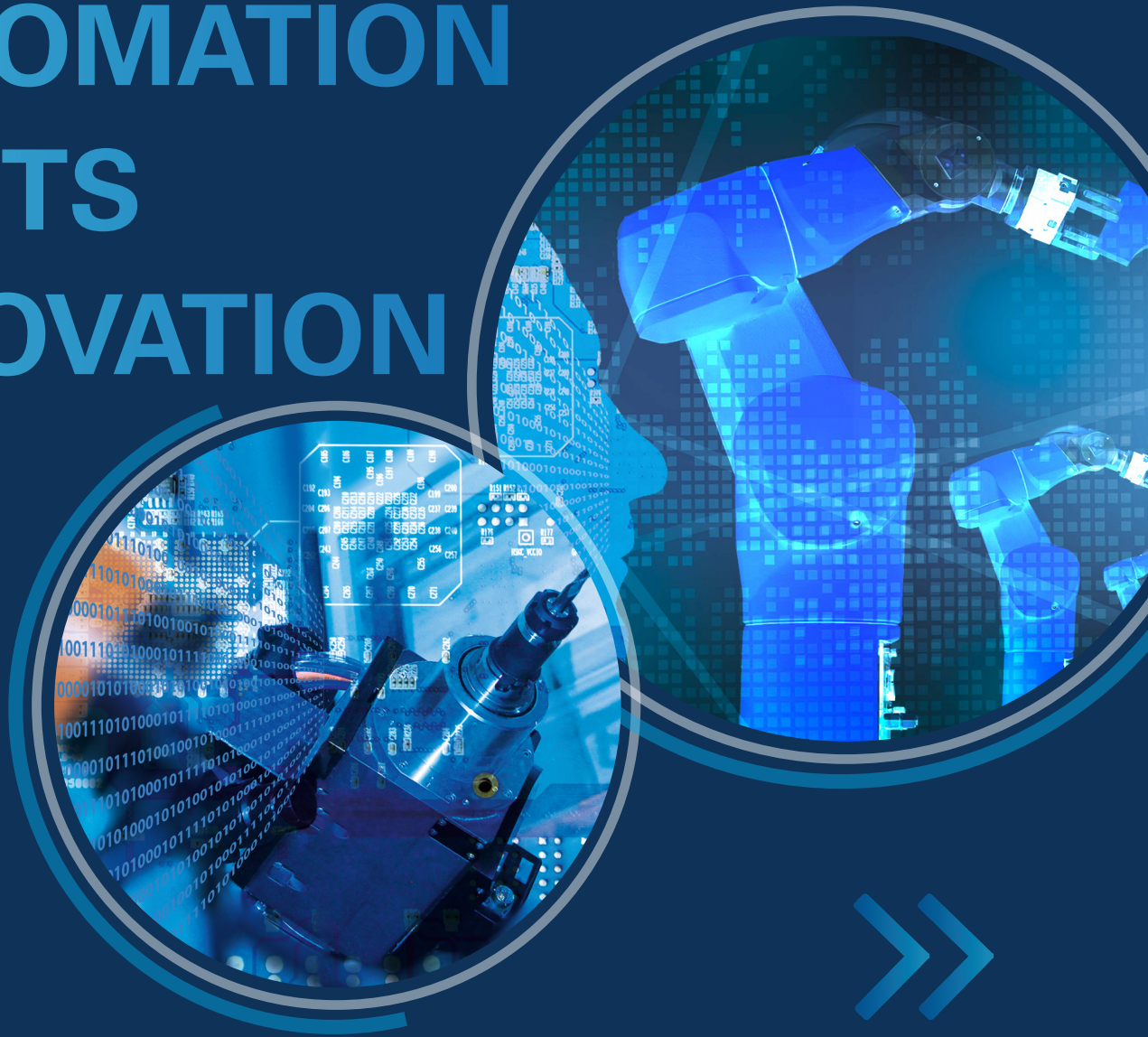
University of Stuttgart
Germany
Institute for Control Engineering of Machine Tools
and Manufacturing Units

ISW

AUTOMATION MEETS INNOVATION



English Edition

We are recruiting staff for

HIGH PERFORMANCE AUTOMATISIERUNG

The Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW) of the University of Stuttgart is one of the leading research institutes in the field of control and drive engineering as well as manufacturing automation.

The ISW provides a workplace with interesting and technically innovative tasks in various areas at the highest international level. Our graduates are now in leading positions of national and international engineering companies.

For graduates of mechatronics or engineering cybernetics and associated disciplines like informatics, mechanical and electrical engineering, ISW provides an excellent environment. As research assistant, you work on challenging projects on your own and within teams, developing new technologies while also fostering your scientific experience, interdisciplinary and creative expertise, and your management skills. Our projects range from fundamental research towards cutting-edge industry-related topics of the day after tomorrow. Ultimately, you are given a unique opportunity to obtain a PhD at one of the most prestigious and worldwide respected institutions in the fied of control and drive technologies.

Did we spark your interest? Then we are looking forward to your application.

Dr.-Ing.
Armin Lechler
Deputy Director
Managing Chief Engineer

+49 711 685-82462
armin.lechler@isw.uni-stuttgart.de

Current job offers can be found under
www.isw.uni-stuttgart.de

Preface

The Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW) at the University of Stuttgart is a leader in the fields of manufacturing automation and production IT. Innovative basic research is carried out at the ISW and profitably transferred into practice in a variety of co-operations with industry.

The ISW's core competences in the field of industrial control, regulation and drive technology as well as production IT on the shop floor and production control are continuously being expanded with new innovative methods from mathematics, software engineering, big data processing and artificial intelligence. The scientists' mission includes research and development activities on innovative control and regulation concepts, the implementation of which ranges from miniaturised embedded computing to cloud-based solutions.

This brochure provides an overview of the institute's current research activities, the services it offers to industry and the courses it offers, as well as its extensive network in science and industry.

Numerous international contacts, ongoing lively publication activity, excellent proximity to industry, sought-after and sustainable teaching activities and the management of the Mechatronics B.Sc. and M.Sc. degree programmes give the ISW particular significance and strength.

We look forward to future challenges and intensive contact with you!

Univ.-Prof. Dr.-Ing.
Alexander Verl

+49 711 685-82410
alexander.verl@isw.uni-stuttgart.de

Univ.-Prof. Dr.-Ing.
Oliver Riedel

+49 711 685-82466
oliver.riedel@isw.uni-stuttgart.de

Univ.-Prof. Dr. rer. nat. habil.
Andreas Wortmann

+49 711 685-84624
andreas.wortmann@isw.uni-stuttgart.de

Milestones

1965
Foundation of the institute on 1 Sept. by Prof. Gottfried Stute

1967-1975
EXAPT, Adaptive Control for 5-axis CNC milling processing

1974-1986
Conception and examination of “Flexible Production Systems” (FFS) and configuration of the first DNC-controlled system

1975-1980
First open modular multiprocessor CNC system (MPST)

1977-1982
Controlled asynchronous drives for machine tool axes

1984-1990
Modular robotics, joints with integrated drive and integrated control

1987-1990
Linear direct drives with digital control based on signal processors

1990-1997
Hardware-independent, modular and open control system (OSACA)

1992-2001
First level parallel kinematics for a CO2 laser processing machine

1994-2001
Acceleration sensors for rotatory and linear movements (Ferraris sensor) for use in highly dynamic drives

1998-2001
Kinematics and control engineering for spatial parallel kinematics

1999-2005
Multimedia machine information system (mumasy)

2000
Founding member and competence center of minimally invasive surgery, MITT

2001
Certification tools and certification authority for SERCOS

2002
Special research area SFB 467: Versatile company structures

ab 2002
Adaptronic components for machine tools, adaptive ball screw, oscillation rod

ab 2005
TFB 59: Adaptable systems: reconfigurable machines

ab 2006
Real-time simulation with VIRTUOS

Meilensteine

ab 2007
GSaME, Graduate School of Excellence, excellence cluster SimTech

ab 2007
Interdisciplinary research center IZST Stuttgart/Tuebingen

2008
Energy-efficient production through automation – ECOMATION

ab 2010
FPGA technology in drive controls

Pendulum for the German Pavilion at the EXPO in Shanghai

ab 2012
Control methods for inductive heating

ab 2013
Increased dynamics of feed drives via actuator systems

ab 2015
Increased productivity in machining with industrial robots

Cable robots for the German pavilion at (the universal exposition) Expo 2015 in Milan, Italy

ab 2016
Initiative in the field of time-sensitive networking

Presentation of the first multi-axis 3D printer at the SPS Drives in Nuremberg

ab 2017
International graduate college with New Zealand in the field "Soft Tissue Robotics"

ab 2018
Active Member of OPC UA TSN Field Level Communication

ab 2019
Cluster of Excellence IntCDC and SimTech

ab 2020
Active Member of OPC UA TSN Field Level Communication

ab 2021
SDM4FZI lighthouse project on software defined-manufacturing

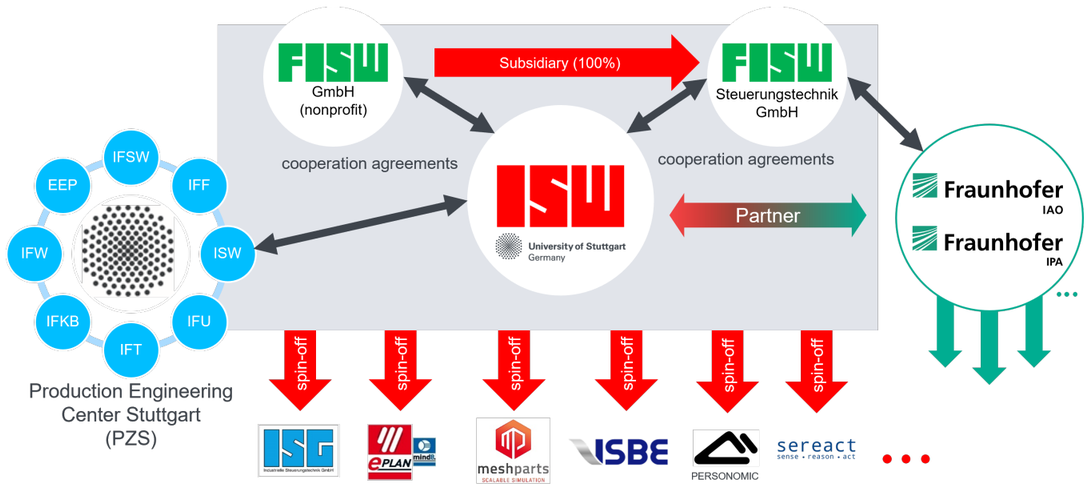
ab 2022
Realization of the vision for the production environment of the future: „Stuttgarter machine factory"

2023
56th International Symposium on Robotics - ISR Europe 2023 takes place in Stuttgart under the direction of ISW

ab 2024
Development and independent design of a fully modular machine tool for different manufacturing processes.

ab 2025
ISW is part of the leading consortium in the Robotics Institute Germany (RIG)

Financing



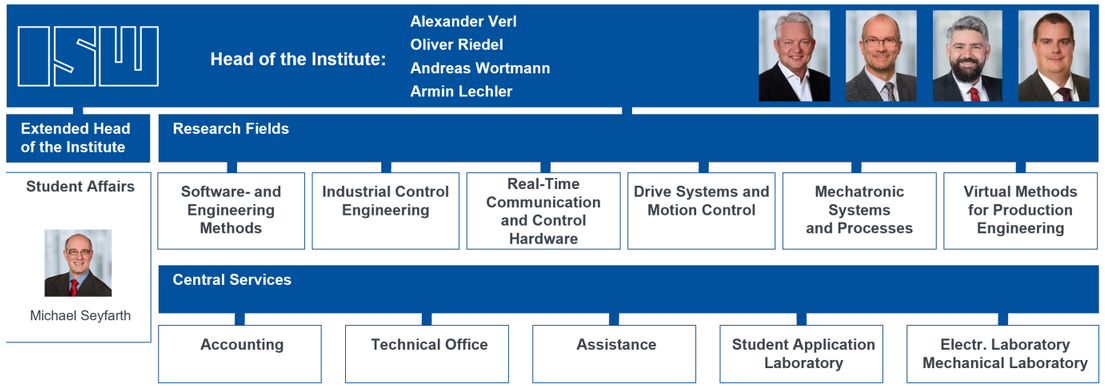
The ISW finances its research work through various research organizations such as DFG, BMBF, BMWK and works on industry-oriented developments in close cooperation with FISW GmbH and FISW Steuerungstechnik GmbH. The necessary funds for the scientific staff and employees in the technical and administrative departments are covered by the university's budget, publicly funded basic research, joint industrial research and direct contracts from industry.

The ISW has an extensive international network in science and industry. The ISW is also a recognized and active partner in many national and international committees.
In the immediate local area, there is close technical cooperation with the process-oriented institutes of the Stuttgart Production Technology Center (PZS) and, on the application side, with institutes of the Fraunhofer-Gesellschaft in Stuttgart. In particular, Prof. Riedel's position as Director of the Fraunhofer Institute for Industrial Engineering has resulted in excellent synergies in the processing of complex projects in the field of linking product development and production processes.

Due to the industry-oriented research with practical relevance, various companies have been successfully spun off over the years in accordance with the ISW's research fields. There is still close contact with the spin-offs. Through the cooperation with the two FISW GmbHs, very competent and suitable solutions for industry are developed and successfully implemented.

ISW-Team

The ISW management team consists of Prof. Dr.-Ing. Alexander Verl "Mechatronics in Production", Prof. Dr.-Ing. Oliver Riedel "Information Technology for Production", Prof. Dr. rer. nat. habil. Andreas Wortmann "Model-Driven Engineering for Manufacturing Automation" and Dr.-Ing. Armin Lechler as managing chief engineer.



The ISW is subdivided into the following six groups with the focus on:

- Software and Engineering Methods
- Industrial Control Engineering
- Real-Time Communication and Control Hardware
- Drive Systems and Motion Control
- Mechatronic Systems and Processes
- Virtual Methods forProduction Engineering

Each group works independently and innovatively on fundamental research and industry-related projects constantly extending state of the art through innovative ideas. Further, the ISW is significantly involved in the excellence initiatives of the University of Stuttgart and is responsible for the scientific supervision of the Graduate School GSaME for Cluster G at the University of Stuttgart. Central services ensure our success by assuming administrative tasks in student tutoring, organization of teaching and studying, accounting, and secretarial duties. Our technical consulting successfully coordinates our events and marketing activities, while our electrical and mechanical workshops guarantee fast and reliable implementation of test beds, prototypes, and functional patterns.

Teaching at ISW

The institute is part of Faculty faculty 7 “Construction, Production, and Automotive Engineering“ (Konstruktions-, Produktions- und Fahrzeugtechnik (Maschinenbau)) at the University of Stuttgart. Our research focuses on the conception and application of control technologies for automation of machine tools, robots, and other production systems. We place special emphasis on the conception and development of planning systems and engineering methods, IT architectures and information technologies in production, the real-time simulation of production and material flow systems, the design of innovative, cloud-based control architectures and industrial communication, drive, measurement and control technology. The lectures derived from this for you as a student convey the current, practical fundamentals of industrial automation technology and do not only relate to machine tools and industrial robots.

The ISW works in roughly equal proportions in basic research and application-orientated development. The latter is carried out in close co-operation with industry. This enables you as a student to work on exciting student projects that are ‘at the cutting edge’. In addition to in-depth specialist knowledge, you will acquire valuable qualifications in project work, scientific working methods and direct contact with industrial companies in the field of automation technology. This opens up a wide range of opportunities for a successful career start.

We attach great importance to the practical testing of our research and work results, which are incorporated into teaching as well as into courses and seminars for engineers from the field. Working on industrial projects also offers you the opportunity to better prepare for your future tasks through personal impressions and contacts.

Are you planning to study abroad? We have extensive contacts to research institutions worldwide and can support you in integrating a successful and purposeful stay abroad into your studies.

As a student of mechanical engineering, mechatronics, technical cybernetics, technology management, medical engineering, electrical engineering and computer science, you are sure to find the right courses in our wide range of lectures, internships and seminars:

- Control engineering with drive systems
- Control engineering of machine tools and industrial robots
- Applied control engineering in production plants
- Robotic systems – applications in industry and service
- Automation in assembly and handling technology
- Modelling, analysis and design of new robot kinematics
- Software technology for engineers
- Planning of robotic systems
- Production Information Technologies
- IT architectures in production
- Control architectures and communication technologies
- Data science in production
- Steuerungsarchitekturen und Kommunikationstechnik
- Software technology for engineers
- Oil hydraulics and pneumatics in control engineering
- Mechatronische Systeme in der Medizin
- Mechatronic systems in medicine
- Bionics

Research

Our interdisciplinary research in technologies for production and automation of the day after tomorrow is always within the focus of industrial applicability. Our research activities include the following key topics.

SOFTWARE AND ENGINEERING METHODS

Driven by the increasing digitalization of the process chain, software, artificial intelligence (AI) and digital twins, their networking and distribution within the company, are becoming more and more important. In order to take this development into account, the ISW not only adapts methods, concepts and technologies from software engineering to the context of production, but also fundamentally develops them further. With the aim of flexible, resilient and future-proof production, both the engineering and operation of automation software are being rethought. Industrial applicability is always the focus of design, implementation and testing.

While the focus of the "Software and Engineering Methods" working group has traditionally been on production planning, value creation networks, process optimization and automation architectures, the landscape of new technologies is subject to constant change. As a heterogeneous team of engineers, computer scientists and software developers, we are able to quickly transfer, apply and evaluate these new technologies to applications in the production context. This results in completely new paradigms, such as digital twin architectures, scalable cloud-based production control, new real-time concepts, language model-based agents for generating control code and much more.

Control System Architectures
- Real-Time Virtualization
- Numerical Control
- Edge & On-premise Computing

Industrial Metaverse
- Continuous Testing
- Model-driven DevOps
- Cloud Manufacturing

Digital Twin Engineering
- Domain-specific Languages
- Model-driven Software Engineering
- Asset Administration Shell

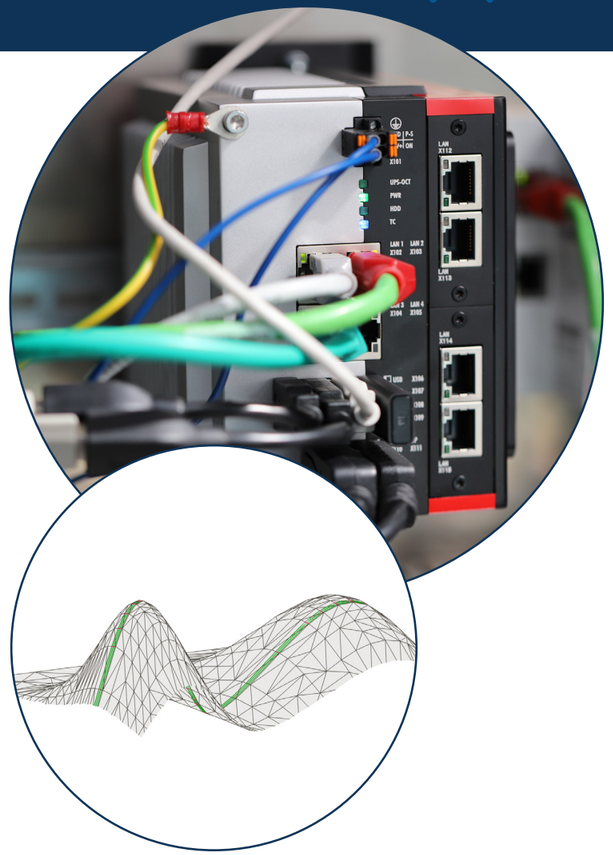
Smart Digital Twins
- Self-adaptive Digital Twins
- Compositional Twin Engineering

AI for Systems Engineering
- LLM-based Software-Engineering
- AI-based Process Control

AI Methods and Processes
- Big Data for Factories
- Applied Artificial Intelligence

Success-Stories:

- Integration of cloud-native approaches into the system control
- Expansion of control functionality through the integration of (real-time) container technologies
- 20-60% cost savings for the operation of automation technology through the use of real-time containers for their configuration and deployment
- Virtualization of safety for complex, numerical calculations
- Modeling of processes, systems and production networks in PPR models, ontologies and asset administration shells (AAS)
- Exploration of OPC UA and domain-specific languages (DSLs) for SMEs through the provision of target group-oriented engineering frameworks
- Provision of a software product line for digital twins
- Control code generation with large language models and prompt engineering
- Application of process-specific CNC solutions (additive manufacturing, casting, etc.)



Get in touch:
gruppe1@isw.uni-stuttgart.de

Research

INDUSTRIAL CONTROL ENGINEERING

The ‚Industrial Control Engineering' group at the ISW specialises in researching innovative control technologies for manufacturing systems, including machine tools, collaborative robots and mobile robotics, as well as digital services and industrial platform solutions. The primary objective of the research is to enhance the efficiency, flexibility and performance of modern production systems through the implementation of high-precision control systems and the integration of digital technologies.
The research focus of the group:

Control Engineering for Manufacturing Machines
- Modularisation and parallelisation of control systems
- Path and trajectory planning for machine tools and robots
- Redundant axis systems

Digital Services and Industrial Platform Solutions
- Assistance systems for engineering and operation of digital twins
- Provision of digital services for decentralised data exchange
- Data-driven online process optimisation

A key focus is on control technology for production machines. New approaches for modularising and parallelising the control of machine tools are being researched to improve the scalability and adaptability of production technology for customised products. Additionally, concepts for redundant axis systems are being developed to enhance precision during machining and improve process stability. Research on path and trajectory planning focuses on optimising motion sequences for more efficient and precise manufacturing.

In addition to control technologies, the group develops digital services and industrial platform solutions that facilitate the interaction between machines, processes and users. This includes the development of assistance systems for engineering and the operation of digital twins. Another key research topic is the secure and efficient exchange of data across company boundaries. With the help of blockchain technologies and other concepts of decentralised data management, innovative methods are being researched to ensure data integrity, transparency and traceability. In addition, digital services for intelligent data utilisation are being developed in order to realise data-based, adaptive online process customisation.

By closely integrating control engineering with digital solutions, the group at ISW is creating innovative solutions for the connected and intelligent production of the future.

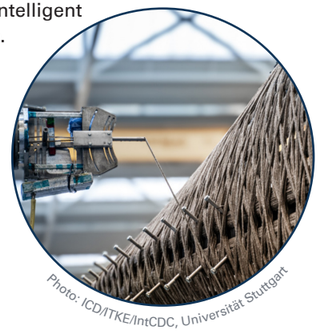


Photo: ICD/ITKE/IntCDC, Universität Stuttgart

Success-Stories:

CONTROL ENGINEERING FOR MANUFACTURING MACHINES
- Development of a modular manufacturing platform for the production of wooden components
- Development and improvement of a cyber-physical manufacturing platform for the reliable production of large-scale fibre composite components
- Development of workflows for the use of autonomous guided vehicles (AGVs) in timber construction
- Modularisation of control systems to increase efficiency and flexibility
- Path planning with clothoids to reduce vibrations during manufacturing
- Continuous adaptation of real-time communication at runtime in Time-Sensitive Networking (TSN) environments

DIGITAL SERVICES AND INDUSTRIAL PLATFORM SOLUTIONS
- Development of tools for OPC UA data modelling and test case generation
- Automatic modelling and enrichment of Asset Administration Shells
- Development of a methodology for automated data model generation through AI-based semantic matching
- Automated and secured process data exchange within the data space of an institute-wide demonstrator network using Gaia-X methods
- Use of Distributed Ledger Technologies (DLT) for tamper-proof communication

Get in touch:
gruppe2@isw.uni-stuttgart.de

Research

REAL-TIME COMMUNICATION AND CONTROL HARDWARE

The digitalization of manufacturing requires an increasing level of networking and a new generation of platforms for automation. In both domains, technologies from the IT sector are increasingly being merged with OT systems. However, requirements regarding determinism and reliability must be met.

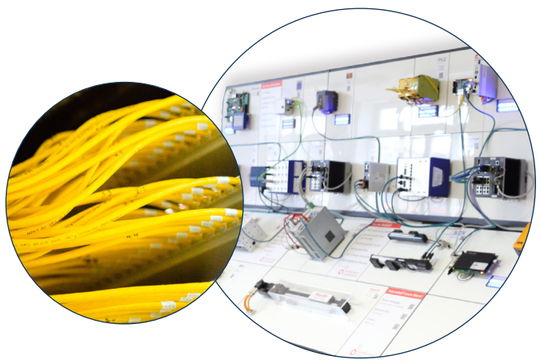
The research focus regarding industrial communication is increasingly shifting to interoperable converged communication systems that enable a direct coupling of IT and OT. These include wired and wireless technologies but also traditional fieldbuses continue to be supported. In addition to innovative solutions like TSN, DetNet, WiFi, 5G and OPC UA, the focus is on traditional fieldbus systems like EtherCAT, Sercos and sensor data protocols. The demands on the compute power of control systems are constantly increasing. The development of IIoT creates a demand for customized hardware platforms. In research, standard platforms often do not meet the requirements for performance, flexibility and interfaces. Therefore, in addition to using commercial platforms, custom hardware platforms are being developed using multicore architectures, GPUs and FPGAs, including power electronics and external interfaces. The focus is on co-design of hardware and software including the engineering process, resulting in developments such as the FPGA-based Open Automation Platform (OAP). Applications include drive control systems, process control systems, communication solutions and innovative sensor solutions with hardware acceleration.

Real-time communication

- Time-sensitive networking (TSN)
- OPC UA down to the field level
- Convergent networks
- Fieldbuses
- Wireless communication
- Open source stacks
- Hardware implementations
- Interoperability and testing

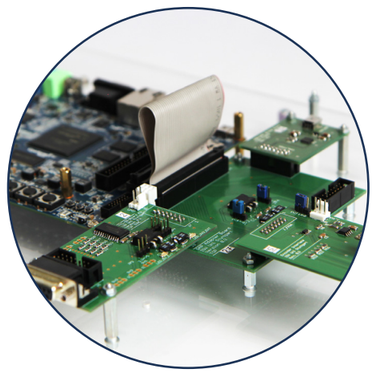
Control hardware & architectural concepts

- CPU and embedded platforms
- Open control platforms
- Application of FPGA technology
- Hardware development
- Recording and processing of sensor data
- Control concepts for servo drives and special
- applications
- Power electronics and converter technology



Success-Stories:

- Integration of TSN-based converged networks and fieldbus systems
- Modular open-source solutions for the engineering and the management of TSN-based distributed real-time applications
- Real-time wireless communication for manufacturing systems using Wireless TSN and LTE
- Infrastructure for the seamless digitalization of manufacturing
- Integration of consolidated virtualized control systems (vPLCs) with field busses using a TSN-Backbone
- TSN testbed with regular Plugfests and an Interoperability Test Rack for continuous evaluation
- Flexible and open-interface FPGA-based real-time control platform (Open Automation Platform – OAP)
- Increased energy efficiency of drives by dynamic adaption of the PWM switching frequency based on process requirements (Adaptive PWM)



Get in touch:
gruppe3@isw.uni-stuttgart.de

Research

DRIVE SYSTEMS AND MOTION CONTROL

The Dynamic behavior of machines and robots determines quality and cost of manufactured products. The overall behavior results from the coupled interaction between mechanical components and controlled drive systems. In order to meet the ever increasing requirements of machinery and plant engineering, the ISW is researching motion control and machine technology.

In the field of motion control, a major challenge is the precise and dynamic adjustment of position and speed of moving machine components. Fundamental requirements for controlled electromechanical drive systems are effective trajectory tracking control along with the compensation of disturbances. In order to achieve higher accuracies and dynamics for linear and rotary drive systems, novel control and compensation methods are being researched.

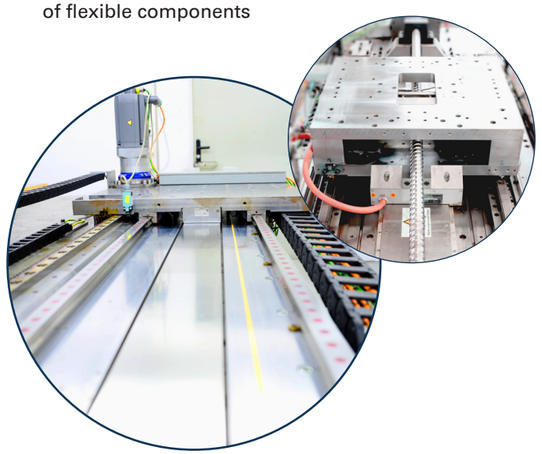
Within the field of machine technology, the ISW is researching innovative feed drive concepts and further developments of common drive systems (ball screws, rack and pinion drives, direct drives). This includes dimensioning, assembly, commissioning, and accompanying FE simulations as well as experimental investigations.

We have a wide range of test stands with different drive systems as well as various machines and industrial robots. This allows for a variety of experimental investigations and an application-oriented validation of novel approaches. In addition, we have parameterized dynamic models of common drive systems and industrial robots for the time-efficient simulation-based investigation of developed methods and new approaches.

Motion control
- System dynamics and novel control structures
- Model-based and learning compensation methods to increase accuracy

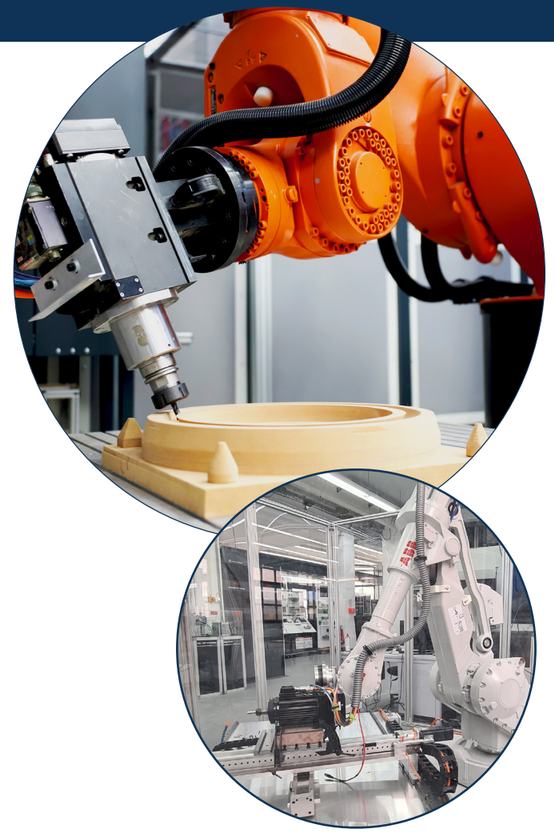
Machine technology
- Design optimization of drive system components
- Alternative feed drive systems and use of additional sensors and actuators

Industrial robotics
- Pose-dependent system dynamics and model-based adaptive control methods
- Machining of different materials & complex handling of flexible components



Success-Stories:

- Feed drives can be significantly improved in terms of their path and positioning accuracy through model-based control and learning error compensation. Compensating for backlash and non-linear transmission effects enables more precise motion control in machine tools and production systems.
- Control-based vibration suppression can reduce vibrations during mechanical processing with industrial robots. This increases machining quality while reducing tool wear and process forces. This enables the extended use of robots in production.
- Kinematic deviations can be measured and compensated for using online calibration across the workspace. The transmission errors of the joint gears are mapped and compensated for by learning error models. This increases the positioning accuracy of robots without additional manual adjustment.
- Model-based contact force estimation improves the control performance in manufacturing processes with industrial robots. This allows delicate assembly and machining tasks to be carried out with high precision without the need for external sensors.
- A passive mechanism for automatic preload adjustment significantly reduces wear in ball screws. Wear effects are continuously compensated for, ensuring consistently high stiffness and accuracy over the service life.
- The automated handling of cables poses a challenge for industrial robots due to their flexible and unpredictable deformation. The behavior can be forecast and the robot movements planned accordingly by means of camera detection and physical real-time simulations.



Get in touch:
gruppe4@isw.uni-stuttgart.de

Research

MECHATRONIC SYSTEMS AND PROCESSES

We view production facilities and their machines as mechatronic systems. Our application-oriented research is focused on ensuring process reliability, enhancing efficiency, improving product quality and introducing new innovative technologies.

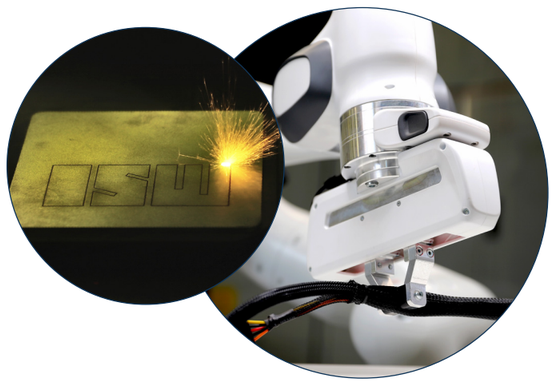
Our solutions optimise CNC machines using intelligent path planning algorithms and reduce waste in multi-stage production systems with the help of data-driven optimisations. In additive manufacturing, we cover the entire process chain - from process planning, CAD modelling and path planning to control and production. We develop multi-axis kinematics for 3D printing and laser applications as well as process-orientated path planning systems.

Cable-driven parallel robots combine the advantages of serial and parallel kinematics and offer large workspaces, high payloads and dynamics. Our research focusses on their elastodynamics, control and reconfigurability for flexible applications.

We also deal with the modelling, simulation and system identification of mechatronic systems as well as the development of modern software applications. We research methods for data acquisition and evaluation, flexible process planning to compensate for faulty components and autonomous cable routing in the mobility sector. Our solutions are used in medical technology, the construction industry and other specialised areas.

Success-Stories:

- CABLE HANDLING – robust, intelligent, autonomous – Our robot systems optimise the handling of cable harnesses. By using artificial neural networks and multi-sensor-based data fusion, we guarantee precise, reliable and adaptive automation solutions.
- LASER PROCESSING – efficient, stable, precise – We are setting new standards in laser process control with innovative control solutions. Through intelligent path planning, adaptive control concepts and powerful software and hardware optimisations, we increase the accuracy, efficiency and stability of laser-based manufacturing processes.



- CABLE ROBOTICS – dynamic, scalable, reconfigurable – Our cable robots showcase the strengths of cable kinematics. The COPacabana manipulates loads of over 50 kg within its 5 x 4 x 3 m frame. CARGOLin accelerates its platform with up to 30 times the acceleration due to gravity and reconfigures its own geometry depending on the task.
- ADDITIVE MANUFACTURING – modular, lightweight, sustainable – The Marinaressa Coral Tree represents an approach to sustainable concrete construction of the future at the Architecture Biennale 2023 in Venice. The lightweight structure was produced using 3D-printed, water-soluble sand moulds as a collaboration between the ISW and the ILEK.

Get in touch:
gruppe5@isw.uni-stuttgart.de

Research

VIRTUAL METHODS IN PRODUCTION ENGINEERING

The ISW is developing technologies for virtual production engineering of tomorrow: In the life cycle of machines and plants, digital models, methods and tools are necessary. In order to manage the increasing complexity of future production systems, further innovative approaches are required that integrate simulation technology wider and deeper in engineering and operation. New technologies in conjunction with the established method of virtual commissioning provide a very extensive toolbox across the entire engineering process up to optimization and validation during the operating phase.

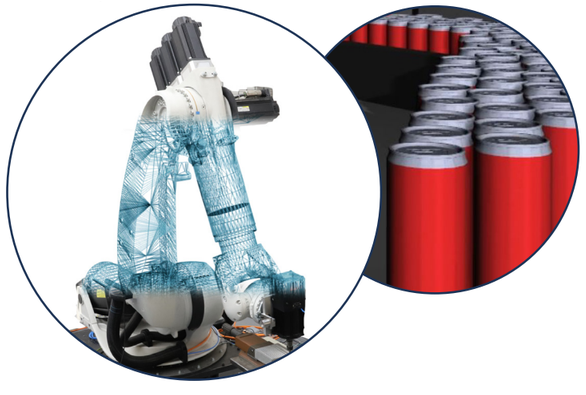
Virtual Commissioning
- Increasing model depth and breadth using AI or new model approaches
  - Material flow
  - Milling
  - Forming
- Novel architectures
  - Real-time co-simulation
  - Continuous simulation configurations
  - Virtualization

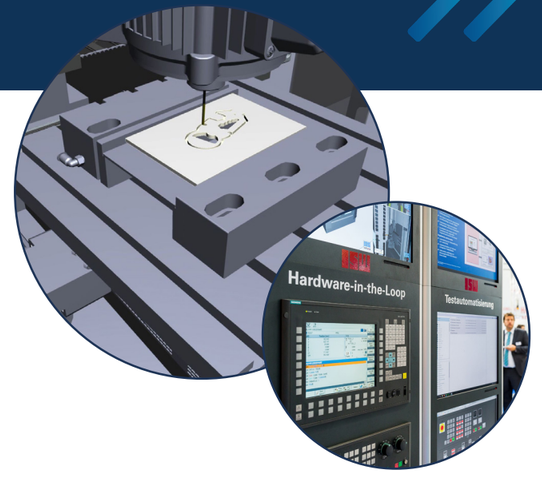
Simulation-based Engineering
- Automatic model generation
  - AI-based
  - Camera-based
- Simulation as a reinforcement learning environment for control programs
- Connection to the metaverse and integration of mixed reality

Digital Twins
- Coupling of real and virtual production
  - In-line and in-situ optimization
  - Collision-free motion control
- Seamless transition in the life cycle using hybrid commissioning

Success-Stories:

- Presentation of the basic principles of virtual commissioning on demonstrators in the ISW machine hall
- Support of companies in the introduction of virtual commissioning
- Development of virtual-based modular libraries for engineering
- Establishment of a platform for real-time co-simulation and further investigation of mechanisms for model partitioning and multi-rate methods
- Development of plugins for simulation tools of virtual commissioning for the connection of reinforcement learning agents according to OpenAI-Gym standard
- Development of a combined control and simulation architecture for online simulation during the operating phase
- Realization of online simulation on the online collision avoidance of multi-robot systems and online quality control during milling
- Prototypical realization of a continuous virtual commissioning from model-in-the-loop simulation to real operation





- Extended immersive visualization possibilities for virtual commissioning through mixed reality
- Extension of the model depth in virtual commissioning using graph neural networks
- Photorealistic representation of the ISW machine hall in the industrial metaverse

Get in touch:
gruppe6@isw.uni-stuttgart.de

Services for the Industry

The ISW advises companies on research topics dealt with at the institute and thus helps to ensure the knowledge transfer from fundamental research to the industry. Moreover, companies are supported in the implementation from prototypes to new products according to their requirements.

Consulting and development:

- Control concepts, architectures and algorithms
- Communication technologies (OPC UA, TSN, Ethernet-based bus systems)
- Special machines and kinematics
- Modelling and simulation
- Modular engineering
- FPGA solutions
- Machine and component optimisation
- Design of drives
- Software architectures
- Technology consulting
- Control processes, parameterisation and methods
- Additive manufacturing technology
- Laser controls
- Positioning accuracy analyses on drive systems

Training and seminars:

- Stuttgart Innovation Days
- „Lageregelseminar“
- Industrial Working Group Simulation Technology
- Ethernet-based communication (OPC UA in control and automation engineering)
- Industry Working Group „TSN for Automation“
- TSN Testbed Plugfest
- Hardware-in-the-Loop simulation
- OPC UA workshops to Companion Specifications
- Introduction to OPC UA - Basics of OPC UA

Dr.-Ing. Armin Lechler
Deputy Director
Managing Chief Engineer

+49 711 685-82462
armin.lechler@isw.uni-stuttgart.de

Stuttgart Innovation Days

As part of our ‘Stuttgart Innovation Days’ event series, today’s possibilities and solutions will be subjected to a reality check. The event serves as an interface and networking platform between research and industry and is intended to promote the exchange and inspiration of interdisciplinary solutions and ideas.
Information on the next event can be found at:
www.stuttgarter-innovationstage.de

Stuttgart Innovation Days at the Riding Hall, Maritim Hotel Stuttgart

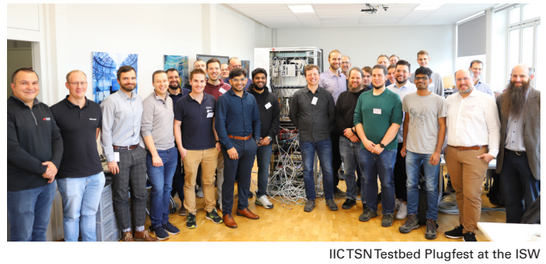
Lageregelseminar

Our „Lageregelseminar“ event series serves as a platform for technology experts from various sub-disciplines of mechatronics, additive manufacturing, drive engineering and industrial and cable robotics to actively exchange ideas. Speakers from industry and science will give an insight into current research and development topics in technical presentations. Breaks and a joint evening event offer sufficient opportunities for further discussions.
For further information, please visit:
www.lageregelseminar-stuttgart.de

IIC-TSN-TESTBED

Thanks to interoperability between devices from different manufacturers Time-sensitive Networking (TSN) has gained wide recognition by the industry as an enabling technology for the production of the future. To avoid coterminous development and varying interpretation of standards, as well as for enabling testing at an early stage, the Industrial Internet Consortium IIC’s test bed is hosted and supported fully by ISW.
Further information can be found at:
https://www.tsn4automation.com/

Lageregelseminar, guided tour of the ISW machine hall



IIC TSN Testbed Plugfest at the ISW

Fairs and Exhibitions

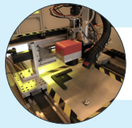
SPS Smart Production Solutions

HANNOVER FAIR

The institute presented its latest research topics at the **SPS** 2024 trade fair in Nuremberg:

Software-defined delivery network

Modular machine tool

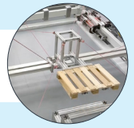


Laser material processing

Data platform Collectu

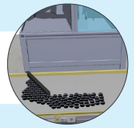
Digital Twin of Twins

Trust in collaborative data ecosystems



Reconfigurable cable robot

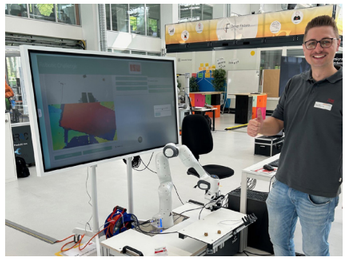
Energy monitoring



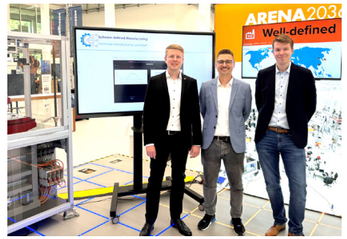
Material flow models for the VIBN

Brownfield TSN

The ISW took part in the **Robotics Challenge** as part of the Leitungssatz 2024 innovation forum, which was organised by the **Transformation Hub Leitungssatz**.



The ISW jointly presented the interaction between the Well-defined and SDM4FZI projects at the **über:morgen event** in the **ARENA2036**.



Student events

Girls´ Day

makeMINTcool

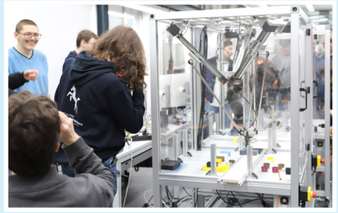
Science Day

First-semester students

TryScience

Robotics band

Mechatronics project work



Guided tours of the institute

Virtual table football tournament

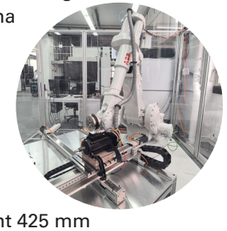
Summer party for students

Machinery

The ISW has a versatile range of machinery at its disposal.

Machine tools:
- **Maho MH800E,** CNC milling machine, workspace: X800 Y450 Z500 mm
- **DMG DMC 650V**, workspace: X650 Y520 Z475 mm
- **DMG DMU 50 ecoMill**, 5-axis CNC milling machine, workspace: X500 Y450 Z400 mm
- **Exeron Digma HSC600**, 5-axis CNC milling machine, workspace: X650 Y550 Z400 mm
- **7-axis CNC** „Model Milling Machine“

Robots:
- **Kuka KR210** mit offener Steuerung
- **Stäubli** TX40, 2 robots
- **Franka Emika** Panda, 2 robots
- 7-axis **KUKA KR500** robotic processing cell
- Spatial **cable robot** COPacabana
- **ABB IRB4400**
- **ABB IRB14000**



Workshop machines:
- Band saws
- Bench drills
- Box column drills
- Bench grinders, grinding height 425 mm
- Nibbling machine CN 500
- Notching machine Indumasch SAF 204
- Deburring machine ASO 600-ASL
- Turning machine Weiler Praktikant140, center height 140 mm, center distance 650 mm
- Turning machine VDF, center height 230 mm, center distance 1000 mm
- Horizontal surface grinding machine Blohm, grinding length 700 mm, grinding width 350 mm,rinding height 425 mm

Other equipment:
- Test benches “Ball screw drive“
- Test bench “Rack and pinion drive“
- Test bench „Small machine tool“
- Test bench „multi-axis demonstrator for distributed interpolation“
- Test bench „laser machine with redundant Axles“
- Test bench „Modular machine tool“
- 7-axis printing system
- Control laboratory
- Drive laboratory
- Student application laboratory (SAL)

Contact

Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW)
University of Stuttgart

Seidenstrasse 36,
70174 Stuttgart, Germany
Phone +49 711 685-82410
Fax +49 711 685-82808

info@isw.uni-stuttgart.de
www.isw.uni-stuttgart.de

Follow us on our social media:

TRAVEL DIRECTIONS

By car:
From direction Munich or Karlsruhe A8, take exit 52b (Stuttgart-Degerloch). Follow B27 towards Stuttgart-Zentrum. From Charlottenplatz, continue driving on Schlossstrasse towards Berliner Platz, then turn right onto Seidenstrasse.

Public transportation:
At **Stuttgart main station** (Stuttgart-Hauptbahnhof, Hbf) take bus 42 (direction Erwin-Schoettle-Platz) and alight at Rosenberg-/Seidenstrasse. From Rotebühlplatz/Stadtmitte take tram U4 (direction Hölderlinplatz) or bus 43 (direction Killesberg) and alight at Rosenberg-/Seidenstrasse.

From **Stuttgart Airport** (Flughafen/Messe) take the subway S2 (direction Schorndorf) or S3 (direction Backnang). Alight at Rotebühlplatz/Stadtmitte, and continue by tram U4 (direction Hölderlinplatz) or bus 43 (direction Killesberg) and alight at Rosenberg-/Seidenstrasse.

Institute for Control Engineering of Machine Tools
and Manufacturing Units
University of Stuttgart
Seidenstrasse 36
70174 Stuttgart
Germany

P: +49 711 - 685 82410
F: +49 711 - 685 82808

info@isw.uni-stuttgart.de
www.isw.uni-stuttgart.de