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

WE CONTROL THE FUTURE

INNOVATIVELY
INTERDISCIPLINARILY
SCIENTIFICALLY

We are recruiting staff for

HIGH PERFORMANCE AUTOMATION

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

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Current job offers can be found under

www.isw.uni-stuttgart.de

Preface

For more than 50 years, ISW has successfully conducted fundamental research activities and challenging industrial projects.

Our core competencies are industrial control engineering and production IT ranging from research and development activities of innovative control approaches and their implementation in embedded and cloud-based solutions. Industrial communication is addressed from the field level with hard real-time requirements up to networks in the cloud. Advances in engineering methods and in simulation keep the increasing complexity manageable.

This brochure gives not only an overview of the research competencies and the teaching curriculum, but also of ISW´s history and its extensive network. At ISW, Industry 4.0 has existed for 50 years!

Consistently high quality publications, proximity to the industry, high-ranking international contacts in both academia and industry, as well as excellent and sustained teaching of our Mechatronics Bachelor and Master students are what marks our strengths.

We are looking forward to future challenges.
Get in touch with us!

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Prof. Dr.-Ing. Alexander Verl

Prof. Dr.-Ing. Oliver Riedel

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)

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

since 2005
TFB 59: Adaptable systems: reconfigurable machines

since 2006
Real-time simulation with VIRTUOS

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

Interdisciplinary research center IZST Stuttgart/Tuebingen

2008
Energy-efficient production through automation – ECOMATION

since 2010
FPGA technology in drive controls

Pendulum for the German Pavilion at the EXPO in Shanghai

since 2012
Control methods for inductive heating

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

since 2013
Increased dynamics of feed drives via actuator systems

since 2015
Increased productivity in machining with industrial robots

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

since 2016
Initiative in the field of time-sensitive networking

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

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

since 2018
Active Member of OPC UA TSN Field Level Communication

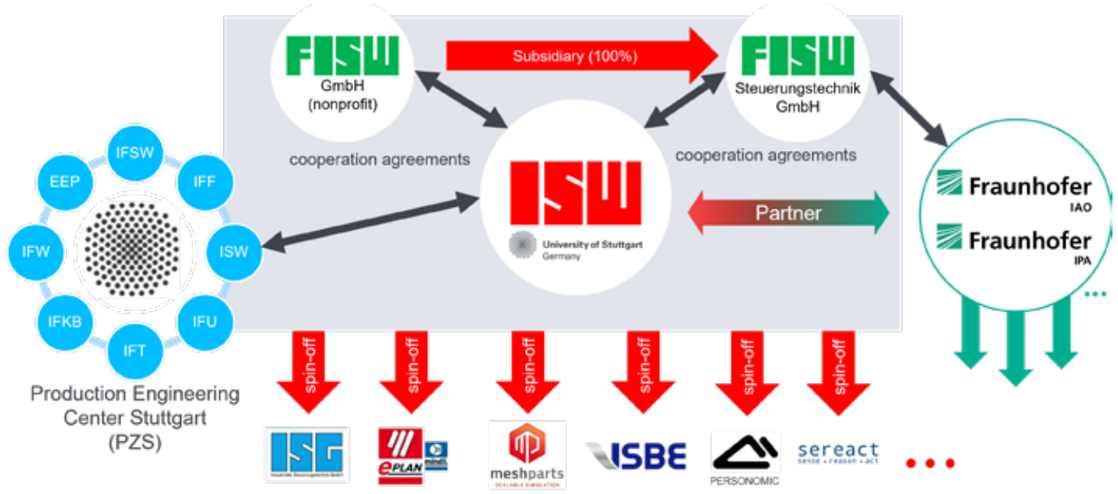
since 2019
Cluster of Excellence IntCDC and SimTech

since 2020
Active Member of OPC UA TSN Field Level Communication

since 2021
SDM4FZI lighthouse project on software defined-manufacturing

since 2022
Realization of the vision for the production environment of th future: „Stuttgarte machine factory"

Financing



The ISW is financed for its research work by various research bodies and works in close cooperation with the companies FISW GmbH and FISW Steuerungstechnik Gmbh on industry-oriented developments. Funding necessary for research, technical, and administrative staff are covered by budgetary resources of the university, publicly funded basic research, cooperative industrial research and direct industrial contracts.

Team

In November 2016, Prof. Dr.-Ing. **Oliver Riedel** redoubled management of the Institute for Control Engineering of Machine Tools and Manufacturing Units together with Prof. Dr.-Ing. **Alexander Verl**. Dr.-Ing. **Armin Lechler** continues as Deputy Director of the ISW. Prof. Riedel is holder of the newly established chair *IT for Production* at the University of Stuttgart. Since January 15, 2021, Jun.-Prof. Dr. rer. nat. **Andreas Wortmann** complements the management of ISW. Through Dr. Andreas Wortmann, the competence fields of the ISW in model-driven system development and the systematic conception of new modeling techniques for production engineering will be further consolidated. Since 2021, **Michael Neubauer** has been supporting the management of the ISW. As CTO, he coordinates the institute's research activities.

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

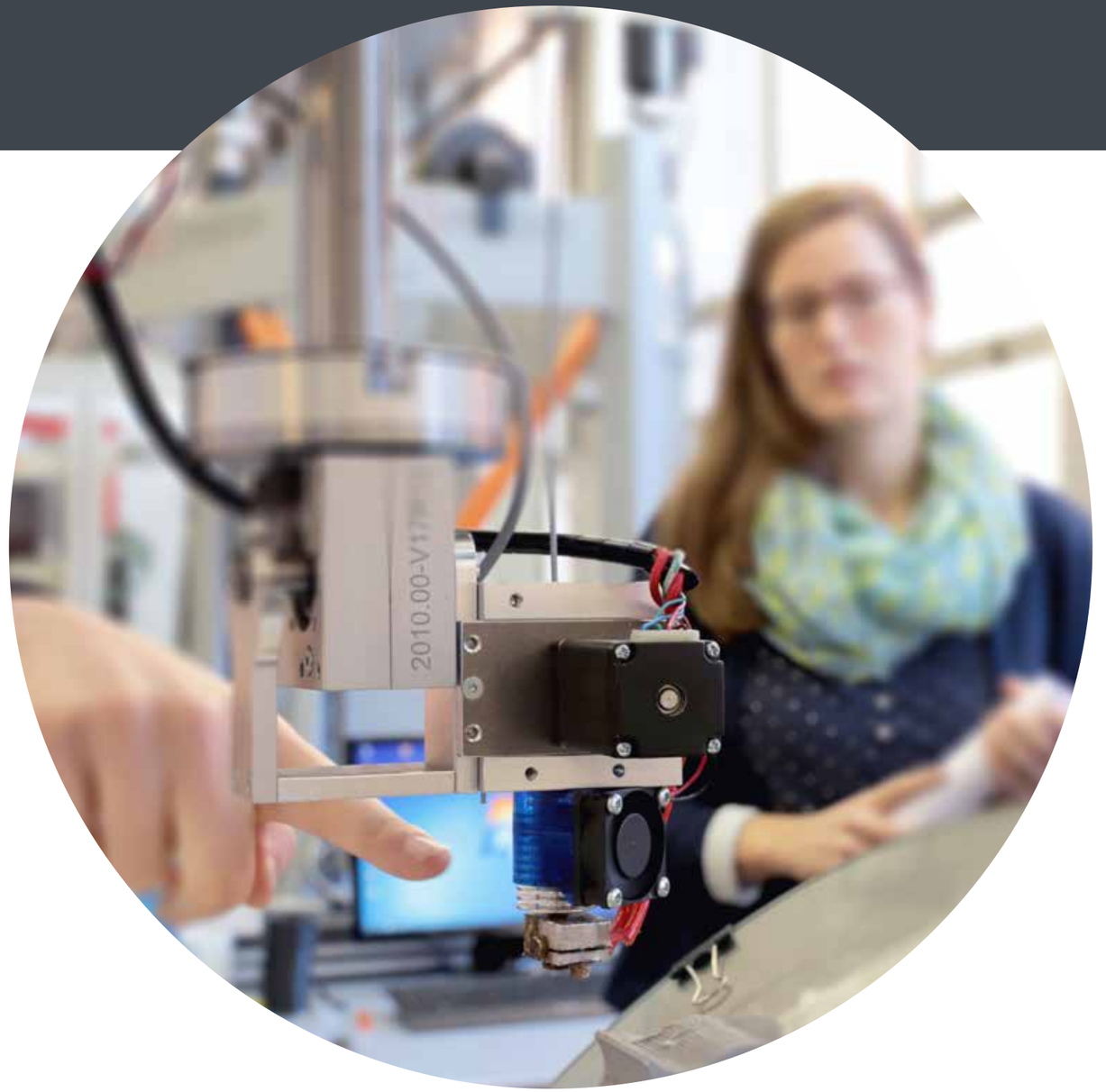
Each group works independently and innovatively on fundamental research and industry-related projects constantly extending state of the art through innovative ideas. Further, the ISW is responsible for the scientific supervision of the Graduate School GSaME for Cluster G at the University of Stuttgart. 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

Integrated within the faculty of “Construction, Production, and Automotive Engineering“ (Konstruktions-, Produktions- und Fahrzeugtechnik (Maschinenbau)) of the University of Stuttgart, our research focuses on the conception and application of control technologies for automation of machine tools, robots, and other production facilities. We place special emphasis on the conception and development of planning systems and engineering methods, real-time-capable simulation of production and material flow systems, the design of new, also cloud-based control architectures, and industrial communication, drive, measuring, and control technologies. Being at the edge of current industrial automation technology directly transfers to the lectures we give our students imparting knowledge of control not only related to machine tools and industrial robots.

The ISW works in equal parts on fundamental research and industry-oriented developments, the latter being conducted in close cooperation with industrial partners on national and international level. This allows our students to write their thesis on exciting cutting-edge topics on the pulse. Besides the deep technical knowledge, they acquire valuable qualifications in project handling, scientific work methods and direct contact to industrial enterprises in the field of automation engineering. Numerous opportunities for a successful transition into an industrial career are propelled by direct contact with industrial companies in the field of automation engineering.

Our research findings are subject to practice-oriented testing and validation, the results of which are directly used in our lectures, but also in seminars for experienced engineers.



Working on industrial projects offers our students and research staff possibility to take a peak into industrial companies and allows them to gain first hands-on experiences much like building a life-long lasting network of contacts.

Are you looking for a chance to study abroad? Our international contacts in both academia and industry can provide for great opportunities. We can support you in many different ways to make your stay abroad a successful time.

In our diverse range of lectures, internships, and seminars you will surely find one that suits you perfectly, no matter whether you study machine engineering, mechatronics, technical cybernetics, technology management or medical engineering:

- 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
- Modeling Software-Intensive Systems
- Planning of robotic systems
- Production Information Technologies
- IT architectures in production
- Control architectures and communication technologies
- Development of scientific software
- Oil hydraulics and pneumatics in control engineering
- 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, its connectivity and deployment within enterprises gains more and more importance. Especially in areas of industrial manufacturing the borders between shopfloor and office floor become blurred. To take these developments into account the ISW adapts methods, concepts and technologies from the field of software engineering onto control engineering. Service-oriented architectures and containerization are transferred and adapted aiming a flexible production.

Furthermore, ISW does conduct research at model-based and data-driven engineering methods as well as integration of different companies into the manufacturing process under the headline of cloud manufacturing. Research is addressed to industrial processes and attempts to eliminate known deficiencies.

Software methods

- Innovative development and project planning methods (simulation-based, functional, modular, etc.) for manufacturing units
- Functional consideration of (IT) safety requirements
- Cloud-based system architectures for automation technology
- Capability-based scheduling of orders

Engineering methods

- Model-based process and path planning
- Task and process planning of hybrid manufacturing processes (additive and subtractive)
- Deployment strategies of software for production engineering

System analysis and optimization

- Data-driven identification of system (mis)behavior
- Information and system modeling (process planning, data, semantic and communication models)

Projects:

- DAsCloud: integrating cloud-native approaches to plant control
- ESIC: Enhancing control functionality by integrating container technologies
- FluPro ARENA2036: Fluid vehicle production for the mobility of the future
- LiBo: Process control in arc welding
- SCOLAR: Systematic component-oriented reuse of software languages
- SDM4FZI subproject 2: Development of a reference model for mapping existing and future supplier networks

- SDM4FZI subproject 3: Configuration and deployment using real-time containers
- SDMFlex: Extension of digital process images by self-learning capability models
- Software Defined Car: Development of methods for semantic integration of digital twins
- Tandem: Research cooperation in the field of process simulation in numerical control systems with the company “Industrielle Steuerungstechnik GmbH”.
- ViSa: Virtualization of Safety

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Research

INDUSTRIAL CONTROL ENGINEERING

The Control technology is benefiting greatly from developments in IT. Increasing computing performance through multi-core, GPU and cloud systems in combination with innovative software solutions enable further development of classic control technology. The „Industrial Control Technology“ group is seizing these opportunities to develop new solutions for NC core functionality on the one hand, and to optimize and standardize communication between cyber-physical systems and across company boundaries on the other.

Communication technology plays an important role for mechanical and plant engineering. In the context of the initiatives on Industry 4.0 and IoT, the importance of communication technology has increased even further. In this context, ISW is driving innovations in the field of real-time and non-real-time communication. In addition to the specification of communication protocols and profiles, this also includes validation and testing. Activities in the area of industrial control technology focus strongly on the standardization of OPC UA usage. Coordination and active cooperation of different expert groups, led by VDW and VDMA, form the basis of research projects dealing with the use of the developed standards. From automated creation of OPC UA servers, to testing of implemented OPC UA companion specifications integrated in the deyplomet process, to enabling reconfigurable networks for deterministic data exchange with OPC UA, all layers in the field of communication are considered. In addition to Machine-2-Machine communication, data exchange between shop floors will also be considered to enable new business models. Topics such as cloud manufacturing and usage-based machine leasing have networking in the value network as a mandatory requirement. Different research projects at ISW are dealing with the accompanying challenges in this area. Data and communication models for the exchange of information for the distributed production of goods as well as a consistently traceable and tamper-proof exchange of sensor data across company boundaries are two examples of research topics.

In addition to application-based communication, basic research on algorithms for control engineering in the context of machine tool and plant engineering plays a major role in this department. Classical structures such as monolithic control architectures are being broken down and supplemented by new approaches. AI-based algorithms for collision-free path planning and clothoid-based interpolation methods for machine tools are examples of this.

Industrial communication

- Communication in and between production networks
- TSN-based communication
- Use and creation of industry-wide specifications of OPC UA information models

Control engineering

- NC core functionality
- Manufacturer-specific and comprehensive control interfaces
- Technology transfer of current technologies (AI, containerization, ...)

Projects:

- Cornuspline 2: G2-continuous smoothing algorithm for CNC controls with piecewise defined clothoids
- FabOS: vision for an open, distributes, real-time capable and secure operating system for production
- ICM-SDSeq: Software-defined model and function sequencing for the utilization of modular production systems
- IntCDC: Development of a modular manufacturing platform for the production of wood components
- IntCDC RP14: Additive cyber-physical manufacturing platform for multifunctional, load-optimized structural elements made of fiber-reinforced composites
- KOSMoS: Traceable and secure data exchange from sensor to cloud for collaborative value networks
- SDM4FZI subproject 4: Software defined manufacturing for the automotive industry - generation of OPC UA servers based on machine models

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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 areas, technologies from the IT sector are increasingly merging with OT systems, with requirements for real-time capability and reliability.

In the area of communication technology, the research focus is increasingly shifting to interoperable convergent communication systems that enable direct coupling of IT and OT. These include wired and wireless technologies but traditional fieldbuses continue to be supported as well. In addition to Sercos, EtherCAT and sensor data protocols, the focus is on TSN, DetNet, WiFi, 5G and OPC UA. The demands on the computing 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 existing platforms, custom hardware platforms are being developed using multicore architectures, GPUs and FPGAs, as well as printed circuit boards and power electronics. 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, hardware-accelerated simulation engines, drive and process control systems, and innovative sensor solutions.

Real-time communication

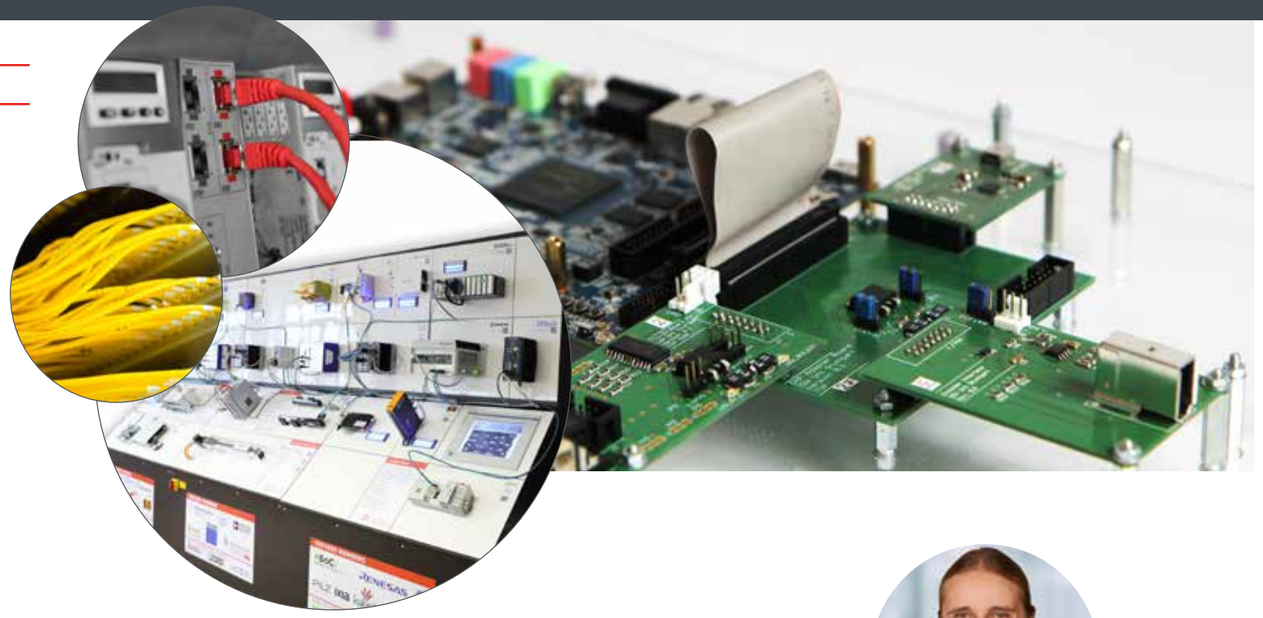
- Time-sensitive networking (TSN)
- OPC UA down to the field level
- Convergent networks
- Fieldbuses
- Wireless communication
- Open source stacks
- Hardware implementations
- Interoperability and Testing

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

Projects:

- Adaptive PWM: Increasing the energy efficiency of drives by switching frequency of the inverters according to demand.
- BrownfieldTSN: Integration of TSN-based convergent networks and fieldbus systems
- ControlTSN: Modular open-source solution for engineering and operating TSN-based distributed real-time applications
- EDK: Real-time synchronous wireless communication for production using LTE
- GAIA-X4ICM: Infrastructure for the end-to-end digitisation of manufacturing based on Gaia-X
- Open Automation Platform (OAP): Flexible and open-interface FPGA-based real-time platform
- SDM4FZI subproject 5: Implementation of the SDM infrastructure
- TSN4KMU: Modular TSN router platform with customizable hardware accelerators
- TSN Testbed: Interoperability testbed for TSN devices with regular plugfests and permanent installations



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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 movable machine components. Basic 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 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 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

Projects:
- Adaptive Post-Tensioning 2: Adaptive Post-Tensioning for Increasing the Efficiency of Electrically-Tensioned Rack-and-Pinion Drives
- AdaVos: Adaptive preloading of robot gearboxes for machining tasks
- CO2-HyChain: CO2 savings by increasing the maturity of the value chain of hybrid high-performance components for functional lightweight construction
- DataCon: Knowledge transfer between research and industry for industrial application of learning and real-time simulation
- HyComp: Hysteresis compensation on industrial robots using coupling force observers
- IMPULS 2: Improved path control of feed axes using axes by pulse actuation at the machine table

- Master-Switch: Master-Switch for electrically braced rack-and-pinion drive systems to increase accuracy
- RCAL-IMS: Static, workspace-spanning online calibration on articulated-arm robots with inertial sensors
- SDaR 2: Drive-based vibration damping on industrial robots for milling operations
- SDM4FZI subproject 6: Process adaptive control for accuracy enhancement of hybrid manufacturing with industrial robots
- SliMoReK: Sliding-mode machine table control for improving the dynamic behavior of feed axes with ball screws
- TopGen3: Lightweight parts using inner optimization and layer-by-layer LLM manufacturing
- VoKuMe: Preload adjustment on ball screws using passive mechanics
- ZRA synchronization: Increasing the accuracy of rack-and-pinion drives by model-based compensation of the synchronization error

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Research

MECHATRONIC SYSTEMS AND PROCESSES

We look at machines and production facilities, considering them as mechatronic systems. Our research improves process reliability, increases efficiency and allows new technologies to be transferred into the industry.

From individual processes to complete systems suitable for industrial use, we offer solutions for the networked and fully automated manufacturing facilities of the future by applying the latest research findings. For example, we increase the accuracy of CNC machines through intelligent path planning algorithms or reduce scrap in multi-stage production systems through data-driven optimization.

Our expertise in modeling and controlling from a single component up to the full system reflects well in our advanced additive manufacturing. We consider the process as a whole i.e., from the CAD file to the final product. Beside the competence in new multi-axis kinematics for 3D printing we also develop process oriented offline path planning strategies, online feed-forward and closed-loop control with high frequent real-time simulation.

Cable-driven parallel robots will gain momentum as they combine advantages of serial and parallel robots: large workspace, high payload, and high dynamics. We research the elasto-dynamics and closed-loop control of cable robots, as well as how to have them reconfigurable to changing requirements. With our tools for designing cable robots, we develop systems with endless rotation for handling tasks and design devices for additive manufacturing.

Dynamics of mechatronic systems

- Optimization and new development of mechatronic systems and modern software applications
- Modeling, simulation and system identification
- Methods for data acquisition and evaluation for the optimization of single- and multi-stage production systems
- Flexible process planning for the compensation of faulty components during the production process
- Autonomous laying of cable harnesses for the mobility sector

Additive manufacturing

- Free-form printing from CAD file to product
- Development of high-frequency control procedures
- Modeling and simulation of additive processes
- Special applications: from medical technology to construction using a wide range of technologies

Cable robots

- Reconfiguration and new kinematic structures
- Extension of the field of application by research of new robot kinematics
- Special application: e.g. additive manufacturing

Projects:

- Bioconcrete: Fundamentals and process principles for the production of CO2-neutral and resource-efficient components.
- ICM junior research group: Greybox-Modelling and identification of mechatronic systems on Digital Twins:
  - Increase of the dynamic accuracy via precise models
  - Application to manufacturing systems
  - Extension of the Digital Twin with dynamics models
- IKEPa: Identification and compensation of electromechanical properties of rope drives for parallel rope robots
- InnovationsCampus „Mobility of the Future“ (ICM):
  - Femtosecond 5D printing on freeform surfaces with submicrometer precision for optical sensors
  - Self Learning Functional Laser Micromachining
  - Easy Metal Printer
- IntCDC RP14: Extension of the Cyber-Physical Prefabrication Platform for Reliable Production of Large-Scale Fiber Composite Building Elements using Conventional and Alternative Material Systems
- IntCDC RP27: Cyber-Physical, Large-Scale Manipulation with Highly Reconfigurable and Multi-Functional Cable Robots for Construction in Existing Structures PISA: Development of a novel, integrated Industry 4.0 evaluation for production facilities
- SDM4FZI subproject 7: Machine-wide process optimization
- Soft Tissue Robotics: Control and regulation of soft material handling by industrial robots
- SPP2187: Development of an adaptable manufacturing process for modular lightweight concrete components using fully recyclable formwork systems
- UpFilt: Upcycling filaments from thermoforming production waste

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Research

VIRTUAL METHODS IN PRODUCTION ENGINEERING

The ISW is developing technologies for digital engineering of tomorrow. In the life cycle of machines and plants, there is need for innovative digital models, methods, and tools that make the increasing complexity of future production systems manageable, enable optimization, and even virtual factory acceptance tests using a comprehensive virtual image of production, and support production during operation. With scientific developments in the field of real-time simulation for virtual commissioning, the ISW is one of the leading research institutions in the field of virtual production.

Virtual commissioning
- End-to-end X-in-the-loop simulation models for engineering validation
- Hybrid commissioning with real and virtual components
- Extension of simulation with mixed reality approaches for training courses

Digital twin
- Computational intelligence based on model-based digital twins
- Merging of the simulative images of product, process and resource
- Simulation models and simulation architectures for mapping material flow systems, thermoforming and ablation processes
- Generation of digital twins for assembly design and optimization

Artificial intelligence
- Virtual production images as training environment for learning control systems
- Testing of AI-based control technology using the digital twin
- Intelligent, language-based requirements engineering using simulation

Projects:
- AI Control: Transfer of X-in-the-Loop simulation environments into learning environments for automated development and optimization of control processes
- AMDZ: Development of a design-based language for assembly process description for automated design planning of assembly lines
- MRiLS: Mixed-Reality-in-the-Loop Simulation as an immersive training environment for machine and system operators
- R2D2Twin: Requirements engineering using simulation based on semantic networks
- SDM4FZI subproject 8: The Digital Twin as a Test and Optimization Platform in the Context of Software-Defined-Manufacturing Generated Control Solutions
- SISI: Control-integrated digital twin for online optimization of forming processes
- Soft Tissue Robotics: Machine Learning for handling soft materials for biomedical applications

- v2r-IBN: Development of a modular development and service platform to implement a smooth transition from virtual to real commissioning of manufacturing plants
- Virtual table soccer: Student competition for PLC programming on a HiL system

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Virtual Methods in Production Engineering

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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, sercos, ProfiNet, EtherCat, TSN)
- Special purpose machines
- Modeling and simulation
- Modularized engineering
- FPGA solutions
- Optimization of machines and components
- Design of drives
- Software architecture
- Technology consulting
- Design and parametrization of closed-loop control systems
- Additive manufacturing
- Analysis of positioning accuracy of drive systems
- Security analysis of controls

Training and seminars:

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

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Stuttgart Innovation Days

As part of our event series "Stuttgart Innovation Days – Control Technology from the Cloud", today's possibilities and solutions are subjected to a reality check. It 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.

Stuttgart Innovation Days 2022 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

Lageregelseminar 2021, guided tour of the ISW machine hall

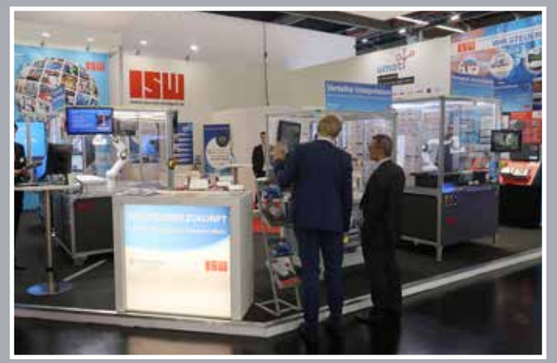
IIC-TSN-TESTBED

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:
www.iiconsortium.org/time-sensitive-networks.htm

IIC TSN Testbed Plugfest 2018 at the ISW

Fairs and Exhibitions

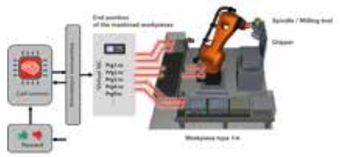
SPS Smart Production Solutions



HANNOVER MESSE

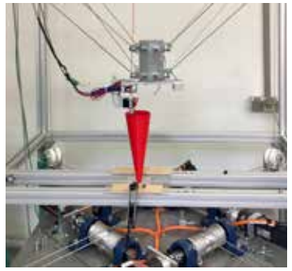
The institute presented its latest research topics at SPS IPC Drives 2019 in Nuremberg:

Industrial communication with TSN and OPC UA

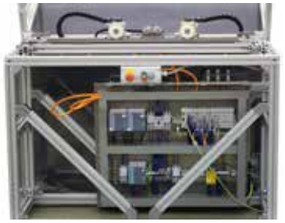


Machine learning of control logic using a digital twin

Real-time capable integration platform for virtual commissioning



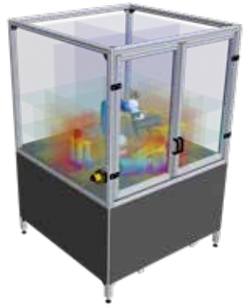
Cable-driven 3D printer



Adaptively braced rack and pinion drive system

At the **Automatica 2022**, a demonstrator for the handling of flexible line sets was presented by the ISW:

Cloud-based robot welding



Camera-based path planning for industrial robots

Machinery

ISW scores with versatile machinery

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"
- **Deckel FP3A**, universal milling machine, workspace: X500 Y300 Z400 mm

Robots:

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

Workshop machines:

- Band saws
- Bench drills
- Box column drills
- Bench grinders
- 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, grinding height 425 mm

Other equipment:

- Test stand "Ball screw drive"
- Test stand "Rack and pinion drive"
- Test stand "Small machine tool"
- Test stand "multi-axis demonstrator for distributed interpolation"
- Test stand laser machine with redundant Axles
- Linapod parallel kinematic as 3D printer
- Test facilities for additive manufacturing (various axle configurations)
- Control laboratory
- Drive laboratory
- Student application laboratory

Contact

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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.

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