Tokyo Institute of Technology

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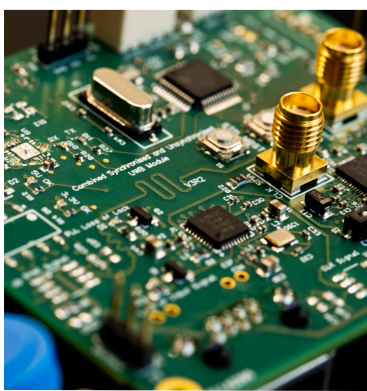
RWTH Aachen University

joint Workshop on „Robotics“

December 12 – 14, 2022

Institute of Mechanism Theory, Machine Dynamics and Robotics
Eilfschornsteinstraße 18, 52062 Aachen



Agenda

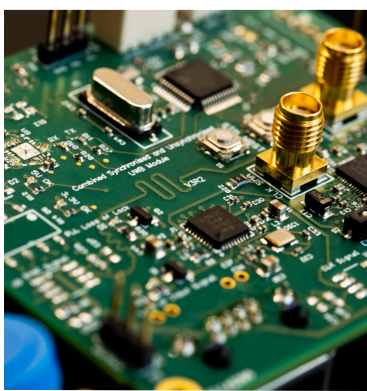
Monday, December 12

Institute of Mechanism Theory, Machine Dynamics and Robotics, Eilfschornsteinstraße 18, 52062 Aachen
Faculty Club Room, 8th Floor

Opening

8:30 - 8:45 CET 16:30 - 16:45 JST	Videos from Tokyo Tech Annex and Institute of Mechanism Theory, Machine Dynamics and Robotics
8:45 - 8:55 CET 16:45 - 16:55 JST	Greetings Prof. Sven Ingebrandt Representative for cooperation with Japanese universities of RWTH Aachen University Tatsuya Mizukoshi Director of Tokyo Tech ANNEX Aachen Satoshi Suzuki Japan embassy in Berlin
8:55 - 9:00 CET 16:55 - 17:00 JST	Move to the Lecture Hall



東京工業大学
Tokyo Institute of Technology

RWTH AACHEN UNIVERSITY

Agenda

Monday, December 12

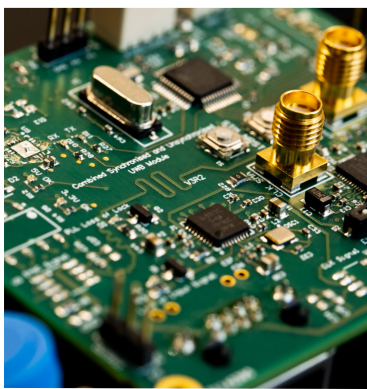
Institute of Mechanism Theory, Machine Dynamics and Robotics, Eilfschornsteinstraße 18, 52062 Aachen
Lecture Hall MS, Ground Floor

Robotics & Health

Chair: Prof. Nobuyuki Iwatsuki
Prof. Heike Vallery

9:00 - 9:20 CET 17:00 - 17:20 JST	Medical Robotics Using Human Bio-signal Assoc. Prof. Satoshi Miura, Tokyo Tech School of Engineering
9:20 - 9:40 CET 17:20 - 17:40 JST	Development of Robotic Collaboration for Inclusive Workplaces in the First Labour Market Prof. Mathias Hüsing, Institute of Mechanism Theory, Machine Dynamics and Robotics, RWTH Aachen University
9:40 - 10:00 CET 17:40 - 18:00 JST	Robotic and biomechanical approach to human activities Prof. Motomu Nakashima, Tokyo Tech School of Engineering
10:00 - 10:30 CET 18:00 - 18:30 JST	Coffee Break
10:30 - 10:50 CET 18:30 - 18:50 JST	Minimalistic robotics to support human gait and balance Prof. Heike Vallery, Institute of Automatic Control, RWTH Aachen University
10:50 - 11:10 CET 18:50 - 19:10 JST	Modular Cooperative Robotic Systems for Surgery Prof. Klaus Radermacher, Chair of Medical Engineering, RWTH Aachen Universtiy
11:10 - 11:30 CET 19:10 - 19:30 JST	Computer-aided surgical planning – from individualized cutting guides to Robot-assisted surgery Prof. Frank Hölzle & Dr. Stefan Raith, Chair of oral and maxillofacial surgery, RWTH Aachen University
11:30 - 12:00 CET 19:30 - 20:00 JST	Discussion
12:00 - 13:00 CET 20:00 - 21:00 JST	Lunch



Robotics & Health

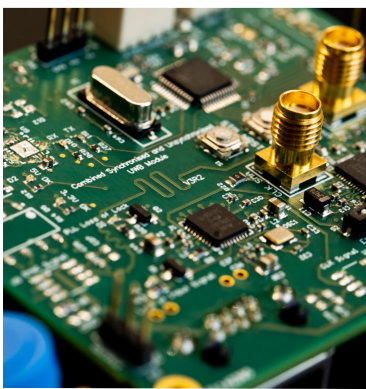
December 12, 2022

Medical Robotics Using Human Bio-signal

Assoc. Prof. Satoshi Miura, Tokyo Tech School of Engineering

Medical robotics are greatly developing all over the world. Furthermore, the super aging society promotes the importance of medical robotics. We have studied some medical robotics research. For example, we developed a virtual surgical simulation system for efficient design of surgical robots. We measured and analyzed the user's brain activation by the functional near-infrared spectroscopy, and investigated the intuitive surgical robot. Moreover, we developed some augmented reality systems such as the forceps shadow drawing system, pseudo viewpoint changing system, and the needle grasping posture feedback system.
Also, we developed some welfare robotics such as the typing assistance device. The device always contacts the user's fingers, hence the user can type by tiny movement of fingers. Furthermore, we developed the rehabilitation system using brain-machine interface. And, we delopved an augmetend reality system for prevention of the fall on stairs using visual illusion.
Considering not only mechanical performance but also human bio-signal and operability is necessary to develop the useful medical robotics.



Robotics & Health

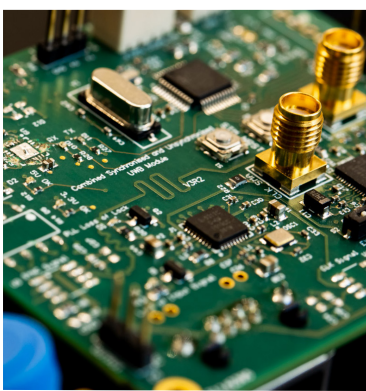
December 12, 2022

Development of Robotic Collaboration for Inclusive Workplaces in the First Labour Market

Prof. Mathias Hüsing, Institute of Mechanism Theory, Machine Dynamics and Robotics, RWTH Aachen University

In several projects we could show that collaborative robotics is perfect to improve the working situation of disabled and severely disabled people and also to get them into the first job market. We were able to show that the use in different business areas such as manufacturing, assembly, quality control and packaging is useful and conceivable in many other segments. The presentation reports on such projects and their implementation. In particular, a guide to implementation was developed, aimed at companies and institutions for the disabled. This guide focuses attention on people with severe multiple disabilities in the context of human-robot collaboration (HRC) and movement support in employment-related work processes. The robot is integrated directly into the employee's work environment.



Robotics & Health

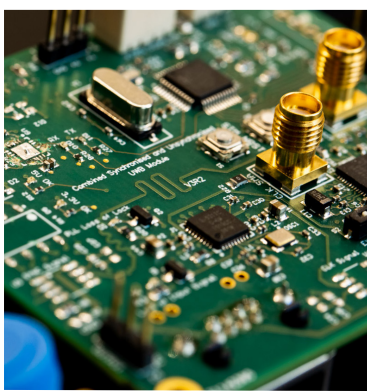
December 12, 2022

Robotic and biomechanical approach to human activities

Prof. Motomu Nakashima, Tokyo Tech School of Engineering

Several works related to human activities which were approached from the robotic and biomechanical viewpoints are introduced. The first example is the sports motion. Based on the biomechanical body segment model, the method of mechanical simulation for human swimming was developed. In addition, the humanoid robot which could perform swimming motions was also developed for validation of the simulation. The developed simulation method was utilized for various purposes, such as optimization of underwater arm stroke, not only for abled-bodied swimmers but also for swimmers with physical disabilities. The similar biomechanical simulation methods were recently applied to the other sports, such as skateboarding, wheelchair tennis and cross-country sit ski. Besides sports, as an example of more daily activities, a research of soaking in bathwater is also introduced. In the research, the unconscious intention of a bather when soaking was modelled using the biomechanical model.



Robotics & Health

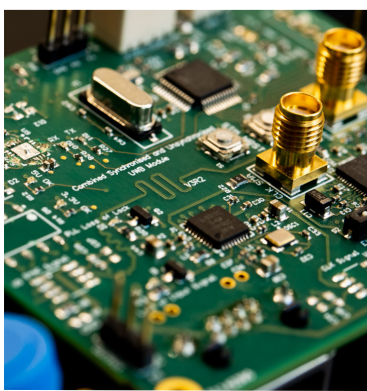
December 12, 2022

Minimalistic robotics to support human gait and balance

Prof. Heike Vallery, Institute of Automatic Control, RWTH Aachen Universtiy

Robotics designed to empower motor-impaired individuals are often highly complex, which hinders their implementation. This talk outlines how implicit assumptions and long-standing design paradigms can lead to unnecessary complexity in hardware and control, and how simpler solutions might more readily be found. For example, our surprising experimental results with robotic body-weight support systems challenge assumptions on what humans need or prefer in order to walk or balance better. Questioning such assumptions may lead to surprisingly simple, effective, and commercially viable alternative solutions. The principles will be derived and illustrated using a range of examples, including control design for wearable balance assistance, technology for fall injury prevention, and robotic toys for paediatric rehabilitation.



Robotics & Health

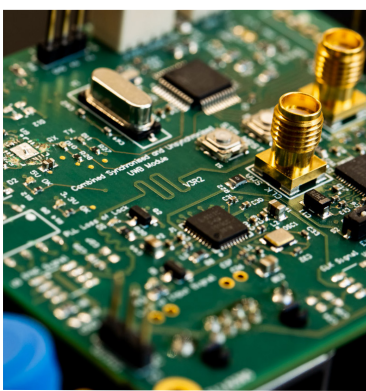
December 12, 2022

Modular Cooperative Robotic Systems for Surgery

Prof. Klaus Radermacher, Chair of Medical Engineering, RWTH Aachen University

Digitalization has been making its way into surgery for years, and the complexity of technical systems in the operating room (OR) is constantly increasing. In this context, we currently see a revival of robots in surgery. However, their application in different surgical disciplines continues to be discussed very controversially. In particular, safety issues and the high cost-benefit ratio in general are major criticisms. Against this background, miniaturization and modularizationare are major objectives of research and development at our institute (https://www.meditec.hia.rwth-aachen.de). The presentation will provide insights into three focus areas of modularization for surgery: (a) mechatronic modularization and kinematics, (b) functional modularisation and human-system-interaction (c) digital modularization and the internet-of-things in the OR.



Robotics & Health

December 12, 2022

Computer-aided surgical planning – from individualized cutting guides to Robot-assisted surgery

Prof. Frank Hölzle, Dr. Stefan Raith, Chair of oral and maxillofacial surgery, RWTH Aachen University

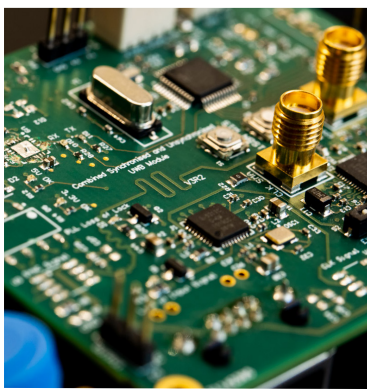
For patients with body defects at the facial bones the autologous bone transplant from the fibula, scapula and iliac crest (pelvic bone) has become the gold standards in treatment permitting functional and aesthetic rehabilitation. These interventions are particularly challenging, as the bone transplantation requires microsurgical anastomoses if the supporting blood vessels. Furthermore, a patient-specific preoperative planning is required, as both defects and donor bones are unique. To tackle these challenges, computer-aided planning has more and more found its way to routine clinical use.

A focus of research at the Department of Oral and Maxillofacial Surgery, RWTH Aachen University Hospital, is set on the developing of innovative approaches in computational planning of reconstructive surgery. Within that scope a completely automated process chain for individualized surgical planning has been developed. This chain starts with the processing of volumetric CT data leveraging cutting-edge technologies in artificial intelligence (convolutional neural networks). For the actual geometric planning of reconstruction, optimization algorithms are used to find the best possible solution for each individual patient. To transfer this planning to the operating room, surgical guides are virtually designed and eventually 3D printed from bio-compatible material that can be used to place the surgical instruments at the exact locations and orientations of the virtually planned incisions. With this procedure, a fully digital planning can be achieved that permits to standardize and simplify this procedure that is otherwise times-consuming and complicated.

One alternative to 3D printed surgical guides for the transition of virtual surgical planning to the operating room is using intraoperative real-time navigation and robot-assisted or direct robotic surgery. Combinations of these technological advances with the novel surgical planning are the scope of current research. It could be demonstrated in a feasibility study that a marker-less system for guided navigation for harvesting of bone flaps could be implemented using a commercially available 3D camera and a mini-projector. The projection of virtually planned flap configurations was first tested on 3D printed iliac crests and then validated on human cadavers and compared to the conventional technique using surgical guides. The marker-less guided experimental setup was characterized by an accurate reproduction of the virtually planned flap configurations. However, precisely defining the osteotomy angle in areas of complex 3D anatomy remains a challenge given the inherent limitation of image projection technology.

The productive synergy between computer-aided surgery and robotic image-guided navigation offers an innovative possibility for navigated support of complex reconstructions of the facial skeleton and can deliver a great alternative to the conventional technique.



Agenda

Monday, December 12

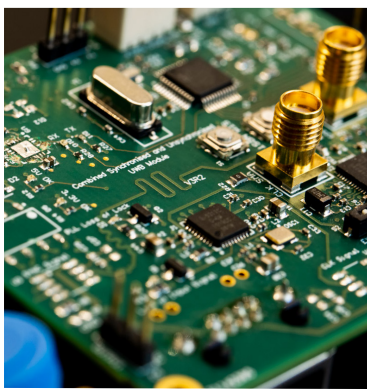
Institute of Mechanism Theory, Machine Dynamics and Robotics, Eilfschornsteinstraße 18, 52062 Aachen
Lecture Hall MS, Ground Floor

Robotics & Production

Chair: Assoc. Prof. Wataru Hijikata
Prof. Robert Schmitt

13:00 - 13:20 CET 21:00 - 21:20 JST	Kinematic/dynamic analysis and synthesis of parallel mechanisms with application to industrial robots and assistive devices Prof. Yukio Takeda, Tokyo Tech School of Engineering
13:20 - 13:40 CET 21:20 - 21:40 JST	Lineless Robotic assembly Prof. Robert Schmitt, Chair of Production Metrology and Quality Management, RWTH Aachen University
13:40 - 14:00 CET 21:40 - 22:00 JST	Flexibly grasping and manipulating robot hand mechanism composed of many elastic cords Prof. Nobuyuki Iwatsuki, Tokyo Tech School of Engineering
14:00 - 14:30 CET 22:00 - 22:30 JST	Discussion
14:30 - 15:00 CET 22:30 - 23:00 JST	Coffee Break



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Robotics & Production

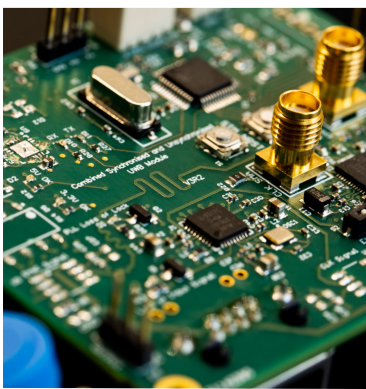
December 12, 2022

Kinematic/dynamic analysis and synthesis of parallel mechanisms with application to industrial robots and assistive devices

Prof. Yukio Takeda, Tokyo Tech School of Engineering

In our living space and industry, there are several types of “parallel mechanisms”, such as the so-called “parallel kinematic machine”, a closed-loop mechanism composed of a human’s skeletal structure and a wearable assist device, and integrated system composed of multiple mechanisms operating in parallel. Due to the structural complexity of such systems, a simple and comprehensive, but physically meaningful method for supporting the design has been hardly developed. Over the last decades, the presenter has been involved in the development of several general methods to support kinematics and dynamics analysis and synthesis of parallel mechanisms with applications to the developments of industrial robots and assistive devices. In this presentation, ideas and methods from the kinematic and dynamic point of view for the performance optimization of parallel mechanisms are introduced with several examples. Structural/dimensional synthesis and prototyping of a pipe bending machine using a novel spatial parallel mechanism with six dof, kinematic and dynamic performance optimization of industrial Delta robot, and kineto-static design and prototyping of a wearable wrist and forearm rehabilitation device with improved comfort are introduced.



Robotics & Production

December 12, 2022

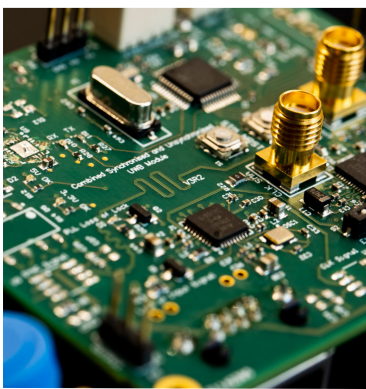
Lineless Robotic assembly

Prof. Robert Schmitt, Chair of Production Metrology and Quality Management, RWTH Aachen University

Line-less Mobile Assembly Systems are a novel paradigm addressing the production of large, high-value components with a high degree of automation and traceability at lot sizes as small as 1. This ambition is supported by a more cost-efficient and sustainable use of capacity-limited assembly resources as well as an increasing awareness for in-process data availability, analysis and continuity enabling (semi-)automated model- and knowledge-driven decisions, eventually contributing to more resilient production systems. Deploying mobile, standardized automation resources in conjunction with unrestricted and dynamic process planning resolves fixed shop floor layouts with monument based automation. For this scenario, model-based system control is mandatory for reliable and resilient processes, which in turns demands elaborated models evaluable with traceable real-time information. Distributed Sensor Services complement this demand constituting a ubiquitously available metrology-based reference frame and infrastructure. The service-oriented architecture and sensor models allow for physical distribution and heterogeneity of sensors, diverse network and persistence interfaces and flexible utilization of computational capabilities on different hardware.

With 5G a key enabling technology for data-intensive industrial environments with numerous mobile resources has recently become available, motivating the presented concept and prototype of future assembly systems for, among others, automotive and aerospace use-cases.



Robotics & Production

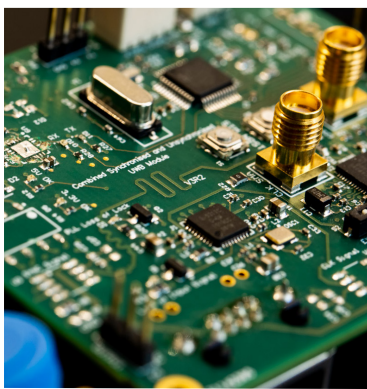
December 12, 2022

Flexibly grasping and manipulating robot hand mechanism composed of many elastic cords

Prof. Nobuyuki Iwatsuki Tokyo Tech School of Engineering

Aiming to realize to grasp and manipulate objects with a non-uniform shape or fragile structure using a simple mechanism, a novel mechanism composed of many elastic cords connecting two circular rings is proposed. By giving a relative rotation between the circular rings, the elastic cords wind around an object and the mechanism can grasp the object softly. By giving a relative translation, the mechanism can change the posture of the object.
Euler's belt theory is extended to calculate the pressing and friction forces to a three dimensional object by an elastic cord. Motion of elastic cords on an arbitrary object modelled as a polyhedron and grasping force and moment acting on the object can then be theoretically calculated. Actual algorithm to judge contact, slippage, passing beyond vertex and taking off between an elastic cord and an object is established and coded by using optimization. The translational and angular motions of a grasped object due to relative displacements between the rings can then be calculated with an iterative calculation based on the equilibrium of the force and moment applied by elastic cords while taking account of inertial forces. The performance to grasp objects with various shape is theoretically evaluated and is experimentally validated with a simple prototype.
The second prototype with a planar parallel link mechanism with 2 DOF to give a pure relative translation between the upper and lower rings is built and experimentally examined. The prototype mounted on a spatial serial robot arm can grasp a cylinder and insert it into a circular hole in inclined surface by utilizing posture control with translation between the rings and the flexibility due to the elastic cords which plays a role of the remote center compliance.
The third prototype in which the lower circular ring is replaced to the Hoberman link mechanism so as to magnify the diameter of the lower ring is designed and built. A new simple control system which can easily detect a longitudinal direction of an object with two cameras and pattern matching with ellipsoidal approximation and makes the mechanism approach to the detected longitudinal direction is developed. A robot arm equipped with the prototype can pick and place objects with various shapes, sizes and locations without any complicated control system.



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Agenda

Monday, December 12

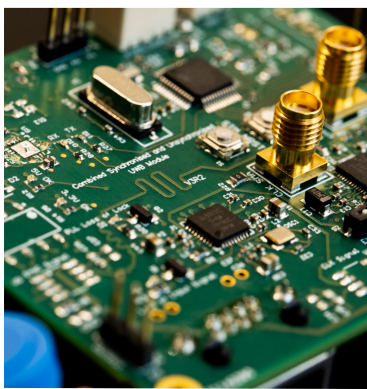
Institute of Mechanism Theory, Machine Dynamics and Robotics, Eilfschornsteinstraße 18, 52062 Aachen
Lecture Hall MS, Ground Floor

Robotics & Construction

Chair: Prof. Yukio Takeda
Prof. Sigrid Brell-Cokcan

15:00 - 15:20 CET 23:00 - 23:20 JST	Construction robotics Prof. Sigrid Brell-Cokcan, Chair of Individualized Production, RWTH Aachen University
15:20 - 15:40 CET 23:20 - 23:40 JST	Automatic Control of Dart Loading to Dump Truck and Other Control Applications Assoc. Prof. Masaki Yamakita, Tokyo Tech School of Engineering
15:40 - 16:00 CET 23:40 - 00:00 JST	Bots2ReC – Analysis of Key Findings for the Application Development of Semi-Autonomous Asbestos Removal Tobias Haschke, Institute of Mechanism Theory, Machine Dynamics and Robotics, RWTH Aachen University
16:00 - 16:30 CET 00:00 - 00:30 JST	Discussion
from 18:00 CET from 2:00 JST	Dinner at Restaurant „Ratskeller“ Markt 40, 52062 Aachen



Robotics & Construction

December 12, 2022

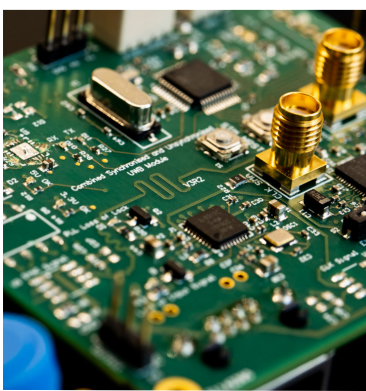
Internet of Construction- robotics, automation and cyber physical systems for the construction site of the future

Prof. Sigrid Brell-Cokcan, Chair of Individualized Production, RWTH Aachen University

In the construction industry, a large number of different companies work together along the value chain to create highly individualized products. Time delays, construction defects and cost overruns often result from insufficient data exchange between companies, expecially at the interface between pre-prodution to the construction site. Digital building models (BIM) have the potential to improve the networking of companies along the value chain, however the digital building models of the planning phase are currently insufficiently used for prefabrication or on-site construction.

In the BMBF funded research project Internet of Construction (IoC), our objectives were to increase the adherence to schedules and construction quality by means of an integrated flow of information along the value chain, track & trace construction elements to enable the flow of information and logistics, extend the BIM framework by information flows between building planning, modular prefabrication and on-site construction and to develop and test exemplary demonstrators for the use of data and data feedback, mobile robotics in prefabrication and on-site construction.



Robotics & Construction

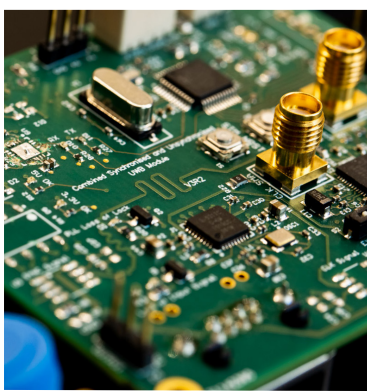
December 12, 2022

Automatic Control of Dart Loading to Dump Truck and Other Control Applications

Assoc. Prof. Masaki Yamakita, Tokyo Tech School of Engineering

In this presentation, applications of control engineering and AI techniques for automatic dart loading to dump truck will be introduced. In our project, only visual information is used to model and control the system which consists of a bucket, a vessel, and dart. Prediction capability of change of dart profile on a vessel by repeated loading operations using the obtained model, which will be used for controller design and MPC (Model Predictive Control), will be demonstrated. Other control applications using lifting linear or bilinear models are also introduced if time is allowed.



Robotics & Construction

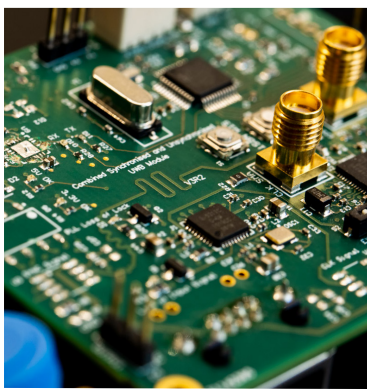
December 12, 2022

Bots2ReC – Analysis of Key Findings for the Application Development of Semi-Autonomous Asbestos Removal

Tobias Haschke, Institute of Mechanism Theory, Machine Dynamics and Robotics, RWTH Aachen

The removal of asbestos from existing buildings is a socially important and challenging renovation process due to the handling of hazardous materials. The EU project Robots to Re-Construction (Bots2ReC) has developed a robotic system for semi-autonomous asbestos removal for apartment buildings. The removal of plaster and tiles and the associated tile adhesive is implemented as a semi-autonomous construction task by mobile manipulators and integrated into the existing construction process. The development is based on a test-driven approach in order to obtain information about the achievable performance and the acceptance of the human operators as early as possible. The identification of the control variables for the respective tools and the embedding in the on-site process flow are named as the main reasons for the test-driven approach. The analysis of selected key findings of the project shows for the developed semantic mapping via mobile robot that a minimal, application-specific data format favours an efficient overall process control via task planning up to execution. In the development of mobile bases for the application, it can be shown that a holonomic drive is preferable to a differential drive due to the partly narrow and angled parts of the building. To carry out the intended processes and to guide the automated power tools, the in-house development of serial manipulators is necessary, since the combination of the required working space with the occurring weight and process forces cannot be solved within the requirements by an industrial manipulator. Finally, the main benefit of this papers contribution is seen in the transferable outcomes to other on-site automation projects.



Agenda

Tuesday, December 13

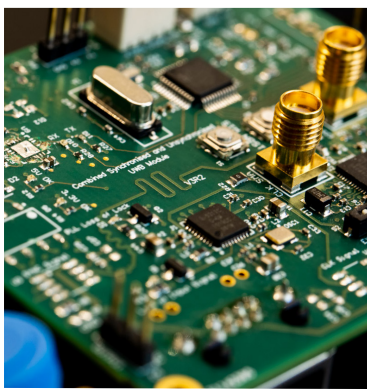
Institute of Mechanism Theory, Machine Dynamics and Robotics, Eilfschornsteinstraße 18, 52062 Aachen
Lecture Hall MS, Ground Floor

Robotics & Control

Chair: Assoc. Prof. Masaki Yamakita
Dr. Marian Walter

9:00 - 9:20 CET 17:00 - 17:20 JST	Patient-oriented Development of Lower-Limb Exoskeletons Dr. Marian Walter & Lukas Bergmann, Chair of Medical Information Technology, RWTH Aachen University
9:20 - 9:40 CET 17:20 - 17:40 JST	Coordinated Control of Multi-Robot Systems towards Smart Agriculture Assoc. Prof. Takeshi Hatanaka, Tokyo Tech School of Engineering
9:40 - 10:00 CET 17:40 - 18:00 JST	Model-based design and control of skeletal muscle and its medical application Prof. Wataru Hijikata, Tokyo Tech School of Engineering
10:00 - 10:30 CET 18:00 - 18:30 JST	Discussion
10:30 - 11:00 CET 18:30 - 19:00 JST	Coffee Break



Robotics & Control

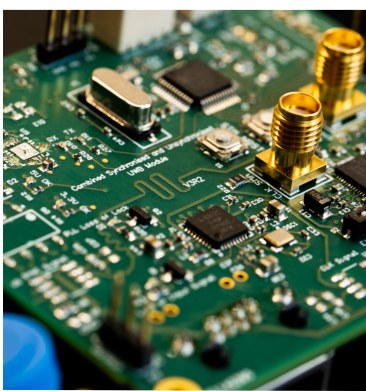
December 13, 2022

Patient-oriented Development of Lower-Limb Exoskeletons

Dr. Marian Walter, Lukas Bergmann, Chair of Medical Information Technology, RWTH Aachen University

Lower limb exoskeletons are increasingly being used for rehabilitation and everyday mobility. However, the demands that patients place on these mobility devices differ strongly due to the varying degrees of impairment. For this reason, we present two different lower limb exoskeleton concepts. The first concept is designed for patients without residual movement functions and features parallel-elastic actuators in combination with functional electrical stimulation (FES). The second approach include serial elastic actuators enabling cooperative control strategies for patients with residual functions, e.g., post-stroke hemiplegia. We achieve patient-cooperative assistance by implementing model-based control approaches and utilizing nonlinear state observers for estimating the user's movement intention.



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Robotics & Control

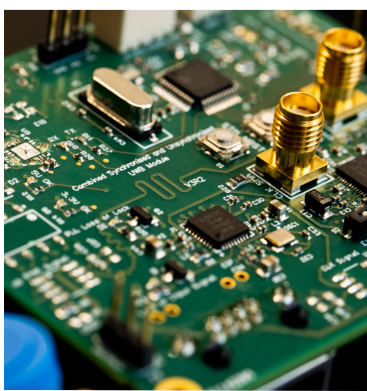
December 13, 2022

Coordinated Control of Multi-Robot Systems towards Smart Agriculture

Assoc. Prof. Takeshi Hatanaka, Tokyo Tech School of Engineering

Drone technology has been highly matured and the use of fully autonomous drones for precision agriculture has moved beyond the demonstration stage and is almost at the practical application stage. Meanwhile, coordinated control of multiple drones is expected to enhance the mission efficiency especially for vast and/or spatially dis-tributed fields while ensuring energy persistency. In this talk, we begin by presenting various coordinated control strategies for a network of drones with rich simulations and experimental videos on our experimental platform, termed Tokyo Tech Robot Zoo Sky. We then address the coordination for efficient aerial image sampling for 3-D map reconstruction of a farmland, and present our latest research outcomes on the issue. Finally, we discuss future prospects for multi-drone field experiments to realize precision agriculture, including smart agriculture re-search and education field under construction in our campus.



Robotics & Control

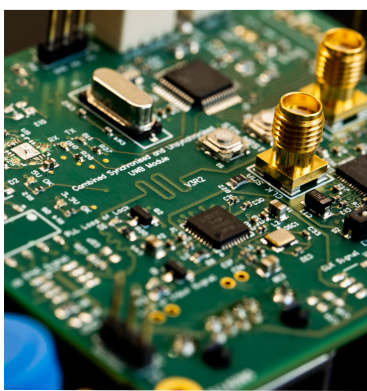
December 13, 2022

Model-based design and control of skeletal muscle and its medical application

Prof. Wataru Hijikata, Tokyo Tech School of Engineering

In addition to the characteristics of soft actuators, such as flexibility and elasticity, biohybrid actuators consisting of skeletal muscles and artificial skeletons also exhibit few distinctive functions, such as self-growth and self-healing. In this study, we propose a muscle contraction model, and develop a model-based design and model-based control method for a bio-hybrid actuator in order to use skeletal muscles in the industrial field. The model comprises three sub-models—the electrical dynamic, physiological, and mechanical dynamic characteristics. Experiments using skeletal muscles of toads demonstrated the feasibility of model-based control and model-based design of biohybrid actuators. In addition, we have applied the system to an implantable power generation system that converts mechanical energy generated by the contraction of skeletal muscles into the electrical energy.



Agenda

Tuesday, December 13

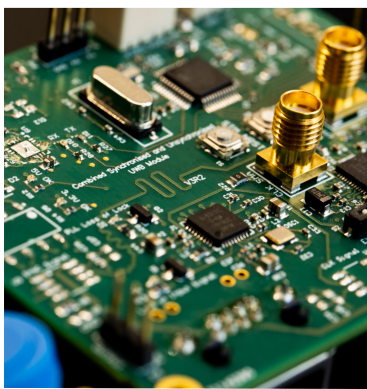
Institute of Mechanism Theory, Machine Dynamics and Robotics, Eilfschornsteinstraße 18, 52062 Aachen
Lecture Hall MS, Ground Floor

Robotics & Service

Chair: Prof. Yoshifumi Nishida
Prof. Verena Nitsch

11:00 - 11:20 CET 19:00 - 19:20 JST	Usability and Acceptance of Human-Robot Interaction within Textile Composite Production Hanna Dammers, Institute of Textile Technology, RWTH Aachen University
11:20 - 11:40 CET 19:20 - 19:40 JST	Ambient Understanding of Daily Behavior for Making Our Society Resilient to Human Physical and Cognitive Changes Prof. Yoshifumi Nishida, Tokyo Tech School of Engineering
11:40 - 12:00 CET 19:40 - 20:00 JST	Social Engineering of Service Robots: What Makes Robots Likeable? Prof. Verena Nitsch, Institute of Industrial Engineering and Ergonomics, RWTH Aachen University
12:00 - 12:30 CET 20:00 - 20:30 JST	Discussion
12:30 - 14:00 CET 20:30 - 22:00 JST	Lunch
14:00 CET 22:00 JST	Laboratory Tour
from 18:00 CET from 2:00 JST	Dinner at Restaurant „Pippin“ Hubertusstraße 43, 52064 Aachen



Robotics & Service

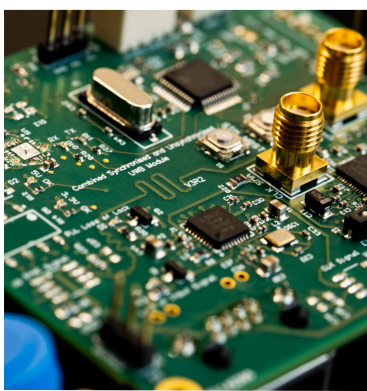
December 13, 2022

Usability and Acceptance of Human-Robot Interaction within Textile Composite Production

Hanna Dammers, Institute of Textile Technology, RWTH Aachen University

The development towards Industry 4.0 and the increasing introduction of collaborative robots (cobots) open new possibilities. However, the automation of textile composite production is complex because the behavior of limp materials is difficult to predict. Thus, the processing of textiles in human-robot interaction (HRI) offers a promising approach and the deployment of a cobot is regarded as an assistive remedy for performance optimization. So far, however, only technical and safety factors have been considered, while human factors are often neglected in recent research. Therefore, we present an empirical user-centered study (n = 21) which investigates how and whether the collaboration type in terms of role assignment influences the satisfaction of the performed task, perceived autonomy, and perceived control, as well as which factors predict and influence the acceptance. The results emphasize that generally the cobot contributes to satisfactory task performance and high perceived control, with a low perceived autonomy across all types of collaboration. The study identified usability, hedonic motivation, and experience in textile processing as acceptance-relevant factors.



Robotics & Service

December 13, 2022

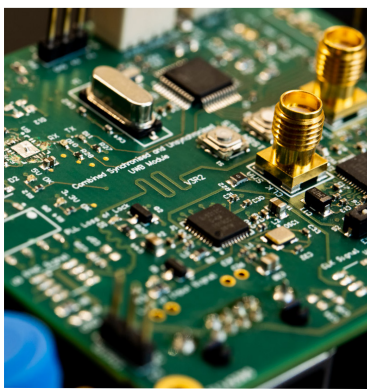
Ambient Understanding of Daily Behavior for Making Our Society Resilient to Human Physical and Cognitive Changes

Prof. Yoshifumi Nishida, Tokyo Tech School of Engineering

Today it has become more necessary to address the physical and cognitive changes faced by the elderly, ensure their safe living, and maintain active social participation levels. Our society should be redesigned into such one that is resilient to human living function changes. Cognitive and physical capabilities change of the elderly is diversified. Such diversity in the change needs personalized support based on personalized capabilities assessment. Conventionally, sensing technology for daily behavior has been proposed. However, wearable sensors have drawbacks from the viewpoint of the feasibility of individual and longitudinal monitoring and ease of operation. Users have to exchange/recharge a battery routinely, and sensors embedded in living spaces also have difficulty in personal identification if multiple people live in target living spaces.

On the other hand, recent artificial intelligence technology and internet of things technology allow us to systematically collect and analyze living data fragmented into multiple institutes and other living spaces. In this talk, as new ambient monitoring systems for detecting elderly gait change based on the recent Internet of Things (IoT) and artificial intelligence technology, the followings are introduced; 1) a battery-less shoe-shaped wearable sensor, 2) RGB-D cameras with face and posture recognition, and 3) handrail-shaped sensor. To evaluate their effectiveness of them, we conducted experiments in nursing homes and ordinary homes. The results of experiments using a battery-less shoe-shaped wearable sensor show that it enabled tracking people with dementia in real nursing home settings. The handrail-shaped sensor was evaluated for over two years in ordinary homes. The results indicate that it could monitor not only longitudinal gait data but abnormal gait such as stumbling. The RGB-D technology was evaluated in the nursing home. The above experimental results indicate that the three kinds of systems are promising methods for monitoring individual elderly in actual living spaces such as nursing homes and ordinary homes in terms of easiness of operation and dependability of data.



Robotics & Service

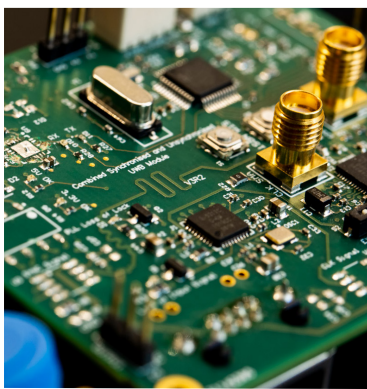
December 13, 2022

Social Engineering of Service Robots: What Makes Robots Likeable?

Prof. Verena Nitsch, Institute of Industrial Engineering and Ergonomics, RWTH Aachen University

Robots that cook us delicious meals, keep our rooms tidy, entertain our guests and keep us company. Researchers around the world have envisioned service robots that assist us in our daily chores and provide (physical and psychological) support in times of need for a long time. Aside from the numerous technical challenges that must be tackled before this vision can become a reality, multi-disciplinary research efforts are also invested into the social engineering of robots. In order to engineer robots that we accept, trust and welcome into our homes, it is paramount that we identify and investigate the factors that affect social interactions between humans and robots. For this purpose, computer scientists and engineers collaborate increasingly closely with psychologists. Together, they tackle important questions that will determine whether robots will be perceived as helpful and reliable companions or as irritating nuisances. How should robots look, behave and communicate with us? Should robots express emotions and deliberately appeal to our emotions? How do we expect robots to behave in a social context? The talk will address these questions and present recent research on the social engineering of robot companions.



東京工業大学
Tokyo Institute of Technology

RWTH AACHEN UNIVERSITY

Agenda

Wednesday, December 14

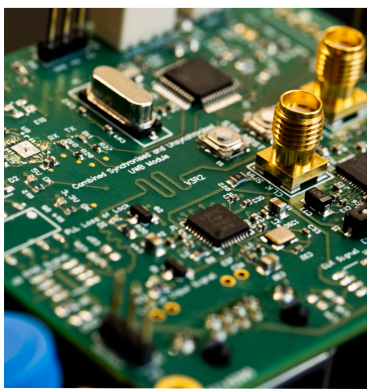
Institute of Mechanism Theory, Machine Dynamics and Robotics, Eilfschornsteinstraße 18, 52062 Aachen
Lecture Hall MS, Ground Floor

Robotics & Rescue

Chair: Prof. Gen Endo
Prof. Dieter Moormann

9:00 - 9:20 CET 17:00 - 17:20 JST	Mobile Robot Companion for Indoor Firefighting Support Prof. Burkhard Corves, Institute of Mechanism Theory, Machine Dynamics and Robotics, RWTH Aachen University
9:20 - 9:40 CET 17:20 - 17:40 JST	Development of a Long-reach Manipulator for Decommissioning Task in Fukushima Daiichi Nuclear Power Plant Prof. Gen Endo, Tokyo Tech School of Engineering
9:40 - 10:00 CET 17:40 - 18:00 JST	Aerial Robots supporting Rescue Forces Prof. Dieter Moormann, Chair and Institute of Flight System Dynamics, RWTH Aachen University
10:00 - 10:30 CET 18:00 - 18:30 JST	Discussion
10:30 - 12:00 CET 20:30 - 22:00 JST	Coffee Break & Closing



Robotics & Rescue

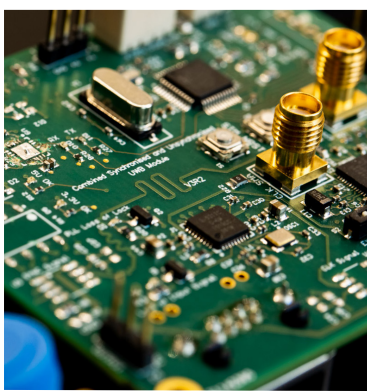
December 14, 2022

Mobile Robot Companion for Indoor Firefighting Support

Prof. Burkhard Corves, Institute of Mechanism Theory, Machine Dynamics and Robotics,RWTH Aachen University

In critical situations of human rescue, firefighting, technical assistance or NBC operations, robots can contribute to increasing efficiency and at the same time reduce risks for rescue forces. For this purpose, human-robot collaboration must be realised in tactical concepts with a capability-oriented task assignment for human-robot collaboration in critical mission situations. For this purpose, existing approaches of skill-oriented task allocation for human-robot collaboration from production engineering as well as the application context are presented. The aim of the adaptation is a matchmaking between tasks that are inferred from process steps and capabilities that are mapped for humans and robots on the basis of a comprehensive model. In this way, the efficiency of operations and the safety of emergency personnel can be increased.



Robotics & Rescue

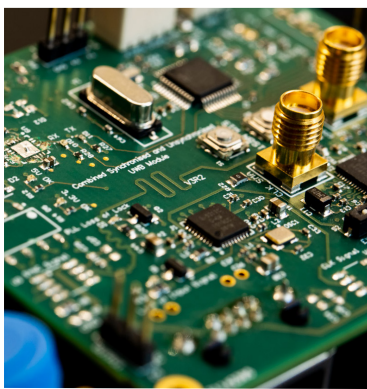
December 14, 2022

Development of a Long-reach Manipulator for Decommissioning Task in Fukushima Daiichi Nuclear Power Plant

Prof. Gen Endo, Tokyo Tech School of Engineering

The decommissioning of the Fukushima Daiichi Nuclear Power Plants is an urgent national problem in Japan. The Tokyo Electric Power Company must investigate the distribution and characteristics of the fuel debris inside the nuclear reactor to retrieve them safely. This presentation introduces a long-articulated manipulator for inves-tigation inside the primary container vessel (PCV).
Our research group employed a coupled tendon-driven mechanism and a gravity compensation mechanism using synthetic fiber ropes to design a lightweight and slender articulated manipulator. This tendon-driven me-chanism also contributes to a radiation-tolerant robotic system. All radiation-sensitive components, such as microcontrollers, motor drivers, and motors, can be mounted on the base, and the slender manipulator com-posed of the mechanical parts is inserted into the PCV where the radiation level is very high. We also intensively investigated the basic mechanical properties of synthetic fiber ropes because mechanical design guidelines for a driving mechanism using synthetic fiber ropes did not exist in general. After discussing the basic principle of a coupled tendon-driven mechanism and control algorithm, we show the basic experiments of the developed 10-meters-long manipulator „Super Dragon.“ Moreover, we also introduce the extended version of the Super Dragon with a 6-meters-long telescopic boom at the end of the manipulator to investigate the reactor pressure vessel (RPV), which is located above the center of the PCV. We increased the joint stiffness at the distal joint by introducing a torsional spring mechanism to change the telescopic boom‘s posture from horizontal to vertical. We successfully reconstructed the surrounding environment using Structure from Motion by camera images obtained by the experiment.



Robotics & Rescue

December 14, 2022

Aerial Robots supporting Rescue Forces

Prof. Dieter Moormann, Chair and Institute of Flight System Dynamics, RWTH Aachen University

As every second counts during rescue operations with injured persons, UAS (Unmanned Aerial Systems), especially multicopters at present, are increasingly being used in this context. UAS in tilt-wing configuration offer the possibility to support the operations even faster and more efficiently. Tilt-wing aircraft are characterized by their ability to perform efficient and fast forward flight for bridging longer distances as well as hover flight, allowing vertical takeoff and landing almost everywhere. Automation of the flight systems is necessary to reduce the workload of rescue forces during a mission.

The automation must be developed to a level where the flight system can autonomously perform the flight tasks issued by a rescue force, including the planning of necessary flight paths.

This presentation will focus on the application of tilt-wing aircraft in rescue operations as part of the FALKE project.