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Wednesday, June 20

Wednesday, June 20, 09:15 - 09:30

Welcome

Room: Plenary

Wednesday, June 20, 09:30 - 10:50

IERA Session

Room: Plenary

Wednesday, June 20, 10:50 - 11:30

K1: Sebastian Trimpe

Machine Learning for Dynamic Systems

Room: Plenary

Wednesday, June 20, 11:30 - 12:10

K2: Torsten Kröger

Transfer Learning

Room: Plenary

Wednesday, June 20, 12:10 - 13:30

Lunch and Poster Session

Room: Gallery

Wednesday, June 20, 13:30 - 14:10

K3: Sami Haddadin

Human Centered Robotics

Room: Plenary

Wednesday, June 20, 14:10 - 15:30

S2.1: Components

Room: Plenary

Chair: Ulrike Thomas (Chemnitz University of Technology, Germany)

14:10 ***A Compliant, High Precision, Pneumatic Rotary Drive for Robotics***

Johannes T Stoll (Fraunhofer IPA, Germany); Andreas Pott (University of Stuttgart, Germany)

14:30 ***Comparison of 3D Shape Reconstruction Methods with Fiber-Optic Sensors***

Christopher Riehs (Graduate School Of Excellence Advanced Manufacturing Engineering, University Stuttgart & Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Germany); Bernhard Kleiner and Urs Schneider (Fraunhofer IPA, Germany); Alexander Verl (Stuttgart University, Institute for Control Engineering of Machine Tools, Germany)

14:50 ***Development of Light and Compact Clutch Device using Jamming Effect***

Yasumichi Aiyama and Tianren Liu (University of Tsukuba, Japan)

15:10 ***Tactile Sensor Modules for Flexible Manipulation***

Veit Müller (Fraunhofer Institute for Factory Operation and Automation IFF, Germany); Christoph Urbahn, Reem AlGaifi, Maximilian Schmidt, José Saenz and Norbert Elkmann (Fraunhofer IFF, Germany)

S3.1: Industrial Robots

Room 1

Chair: Sebastian Reitelshöfer (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany)

14:10 ***On the implementation of transferable assembly applications for industrial robots***

Lorenz Halt, Philipp Tenbrock, Frank Nägele and Andreas Pott (Fraunhofer IPA, Germany)

14:30 ***Robotic Friction Stir Welding of complex geometry and mixed materials***

Gunnar Bolmsjö (Linnaeus University, Sweden); Ana Magalhães (University West, Sweden); Lars Cederqvist (SKB AB, Sweden);

Jeroen De Backer (University West, Sweden)

14:50 ***Online Motion Planning for Dual-Arm Industrial Robots*** &

Felix Beuke (University of Stuttgart & Robert Bosch GmbH, Germany); Sergey Alartsev, Simon Jessen and Christian Hanel (Robert Bosch GmbH, Germany); Alexander Verl (Stuttgart University, Institute for Control Engineering of Machine Tools, Germany)

15:10 ***Workpiece localization methods for robotic welding - a review*** \$

Gesine Schleth (Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Germany); Alexander Kuss and Werner Kraus (Fraunhofer IPA, Germany)

S4.1: Service Robots

Room 2

Chair: Myron Diftler (NASA/Johnson Space Center, USA)

14:10 ***Development and evaluation of a fingertip operated joystick*** *

Nobuto Matsuhiro and Satoru Suzuki (Shibaura Institute of Technology, Japan)

14:30 ***Design of a novel spherical robot with high dynamic range and maneuverability for flexible applications*** (

Vadym Bilous (Brandenburg University of Technology, Germany); Mayur Andulkar (BTU Cottbus Senftenberg & Chair of Automation Technology, Germany); Ulrich Berger (Brandenburg University of Technology, Germany)

14:50 ***Experimental Platform of Space Robot Grasping Various Non-prehensile Targets*** +\$

Xin Zhang (Shenyang Institute of Automation, Chinese Academy of Sciences & University of Chinese Academy of Sciences, P.R. China); Jinguo Liu (Shenyang Institute of Automation, Chinese Academy of Sciences, P.R. China); Jingkai Feng (Shenyang Institute of Automation, Chinese Academy of Sciences & University of Chinese Academy of Sciences, P.R. China)

15:10 ***Datasets of Long Range Navigation Experiments in a Moon Analogue Environment on Mount Etna*** ++

Mallikarjuna Vayugundla (Robotics and Mechatronics Center (RMC), Institute of Robotics and Mechatronics & Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR), Germany); Florian Steidle, Michal Smisek, Martin J. Schuster, Kristin Bussmann and Armin Wedler (Robotics and Mechatronics Center (RMC), Institute of Robotics and Mechatronics, Germany)

Wednesday, June 20, 15:30 - 16:00

Poster Session and Coffee Break

Room: Gallery

Stabilization of a hopper with three reaction wheels; (

Igor Ryadchikov (Kuban State University, Russia); Dmitry Sokolov (University of Lorraine, France); Andrei Biryuk (Kuban State University, Russia); Semyon Sechenev (Kuban State University & Dynamic Stabilization Systems LTD, Russia); Alexander Svidlov, Pavel Volkodav, Yury Mamelin and Kirill Popko (Kuban State University, Russia); Evgeny Nikulchev (Moscow Technological Institute, Russia)

Automated and Flexible Coil Winding Robotic Framework, ,

Stefano Michieletto, Francesca Stival and Francesco Castelli (University of Padova, Italy); Enrico Pagello (University Padova, Italy)

Estimating powered wheelchair driver intentions more accurately using force feedback information &

Alexander Huentemann, Emmanuel Vander Poorten and Eric Demeester (University of Leuven, Belgium)

About robot applications and robotic research * *

Christoph Hellmann, Thilo Zimmermann and Werner Kraus (Fraunhofer IPA, Germany)

Correlation between the dynamic behavior of a six-axis industrial robot and the milling process %&

Ali Karim (University of Stuttgart & University of Stuttgart, Germany); Melanie Munz (University of Stuttgart, Germany); Alexander Verl (Stuttgart University, Institute for Control Engineering of Machine Tools, Germany)

Design and Development of a Low-Cost Open-Source Robotics Education Platform %\$+

Timothy Darrah (Vanderbilt University & Electrical Engineering & Computer Science, USA); Nicole Hutchins (Vanderbilt University, USA); Gautam Biswas (Vanderbilt University & Institute for Software Integrated Systems, USA)

Online Intention Prediction and Task Planning for Human-Robot Collaboration and Competition %%%

Huan Tan (GE Global Research, USA)

Theoretical Aspects of Impedance Controllers' Modularization %%%

Ferenc Fodor (Technical University of Cluj-Napoca, Romania); Alexander Verl (Stuttgart University, Institute for Control Engineering of Machine Tools, Germany); Cornel Brisan (Technical University of Cluj-Napoca, Romania)

The Robotic ServiceAssistant - Relieving the Nursing Staff of Workload %%%

Simon Baumgarten, Birgit Graf and Theo Jacobs (Fraunhofer IPA, Germany)

Simulation of multi-axis machining using the BSP-dexel representation %&'

Evgenii Katz, Dmitry Kurenov and Alexander Petunin (Ural Federal University, Russia)

Systematic Analysis of Global and Local Planners for Optimal Trajectory Planning %%%&+

Maximilian Pittner, Markus Hiller and Florian Particke (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany); Lucila Patino-Studencki (Friedrich-Alexander Universität Erlangen-Nürnberg, Germany); Jörn Thielecke (Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany)

Performance Impact Assessment for SSM using Simulated Stations

Nicolas H. Lehment (ABB Gomtec GmbH, Germany); Remus Boca (ABB Corporate Research Center, USA)

HRIM: the Hardware Robot Information Model

Victor Mayoral Vilches (Erle Robotics & Acutronic Robotics, Spain); Irati Zamalloa (Erle Robotics, Germany)

A Virtual Robot to support Programming Learning

Joao Tiago Aparicio (Instituto Universitario de Lisboa (ISCTE-IUL), ISTAR-IUL, Portugal); Carlos J Costa (University of Lisbon, Portugal); Manuela Aparicio (Instituto Universitario de Lisboa (ISCTE-IUL), ISTAR-IUL, Portugal)

Positioning Error Analysis of Least Squares Method for Wireless Sensor Networks

XiangRui Tian (Nanjing University of Aeronautics and Astronautics, P.R. China); Weikun Zhen (Carnegie Mellon University, USA); Sebastian Scherer (The Robotics Institute, Carnegie Mellon University, USA); Xiong Lu (Nanjing University of Aeronautics and Astronautics, P.R. China)

The Potential of RFID-Technology in Combination with Robotic Manipulators

Christian Thormann and Alexander Winkler (Hochschule Mittweida, University of Applied Sciences, Germany)

Design Concept of an Automated Solid Waste Selection System

Catalin Boanta (Technical University of Cluj-Napoca, Romania); Mihai Margaritescu (The National Institute of R&D in Mechatronics and Measurement Technique, Romania); Alexander Verl (Stuttgart University, Institute for Control Engineering of Machine Tools, Germany); Cornel Brisan (Technical University of Cluj-Napoca, Romania)

Potentials of vacuum suction grippers in human-robot-collaboration applications

David Straub (Graduate School Of Excellence Advanced Manufacturing Engineering, Germany); Kevin Huber (J. Schmalz GmbH, Germany)

Evaluating Genetic Algorithm based parameter tuning of a black-box object localisation algorithm for random bin picking

Maarten Verheyen, Jeroen De Maeyer and Eric Demeester (University of Leuven, Belgium)

ESMERA - European SMEs Robotics Applications

Esra Icer, Sebastian Weisenburger, Michael Zechmair and Arne Peters (Technische Universität München, Germany); Alois Knoll (Technical University Munich Garching, Germany); Sotiris Makris and George Michalos (University of Patras, Greece)

Robotized transportation of existing carts

Niels Jacobsen (Mobile Industrial Robots ApS, Denmark)

Wednesday, June 20, 16:00 - 17:20

S2.2: Technologies

Room: Plenary

Chair: Bernd Kuhlenkötter (Ruhr-Universität Bochum, Lehrstuhl für Produktionssysteme (LPS), Germany)

16:00 **Augmented Reality Robot Operation Interface with Google Tango**

Michael Gradmann, Eric Orendt, Edgar Schmidt and Stephan Schweizer (Universität Bayreuth, Germany); Dominik Henrich (University of Bayreuth, Germany)

16:20 **Efficient Object Pose Estimation in 3D Point Clouds using Sparse Hash-Maps and Point-Pair Features**

Hannes Kisner and Ulrike Thomas (Chemnitz University of Technology, Germany)

16:40 **Determining robot contour accuracies on non-standard geometries using imaging techniques**

Christoph Scharfenberg, Ute Gauger, Adrian Wolf, Jan Fischer and Martin Schray (TRUMPF Laser- und Systemtechnik GmbH, Germany)

17:00 **Validation of workspace monitoring and human detection for soft safety with collaborative mobile manipulator using machine learning techniques in the ColRobot project**

Simone Bexten, Julian-Benedikt Scholle, José Saenz, Christoph Walter and Norbert Elkmann (Fraunhofer IFF, Germany)

S3.2: Automation

Room 1

16:00 **Towards plug and work - OPC UA as middleware of modern automation systems**

Florian Krebs (German Aerospace Center, Germany)

16:20 **Towards a Common Manufacturing Service Bus to Enable Flexible Plug-and-Produce Automation**

Fábio Miranda and Renato Martins (Introsys, Portugal); Kirill Dorofeev (Fortiss GmbH, Germany); Valerio Gentile (We Plus S. p. A, Italy); Pedro Ferreira (Loughborough University, United Kingdom (Great Britain)); Magno Guedes (Introsys, Portugal)

16:40 **Production Logistics with mobile robots**

Christian Wurll, Timo Fritz, David Hollnaicher and Yannick Hermann (Karlsruhe University of Applied Sciences, Germany)

17:00 **Using OPC UA for distributed industrial robot control**

Axel Vick and Jörg Krüger (Fraunhofer IPK, Germany)

S4.2: Service Robots

Room 2

Chair: Alexander Verl (Stuttgart University, Institute for Control Engineering of Machine Tools, Germany)

- 16:00 ***How to Always Keep an Eye on the User with a Mobile Robot?***
Alexander Vorndran, Thanh Q. Trinh, Steffen Mueller, Andrea Scheidig and Horst-Michael Gross (Ilmenau University of Technology, Germany)
- 16:20 ***Visual Classification of Single Waste Items in Roadside Application Scenarios for Waste Separation***
Jochen Lindermayr, Cathrin Senst, Manh-Ha Hoang and Martin Hägele (Fraunhofer IPA, Germany)
- 16:40 ***Immersive Teleoperation of the Gaze of Social Robots. Assessing Gaze-Contingent Control of Vergence, Yaw and Pitch of Robotic Eyes***
Rémi Cambuzat and Frédéric Elisei (GIPSA-Lab, France); Gérard Bailly (Institut National Polytechnique de Grenoble, France); Olivier Simonin (INSA Lyon, France); Anne Spalanzani (Pierre-Mendès-France University, France)
- 17:00 ***"Take a seat, please": Approaching and Recognition of Seated Persons by a Mobile Robot***
Thanh Q. Trinh, Tim Wengefeld, Steffen Mueller, Alexander Vorndran, Michael Volkhardt, Andrea Scheidig and Horst-Michael Gross (Ilmenau University of Technology, Germany)

Wednesday, June 20, 17:20 - 18:20

PD: Panel Discussion: On the Future of Robotics

Room: Plenary

Wednesday, June 20, 18:30 - 22:30

Conference Dinner at Hofbräuhaus München

IERA and Engelberger Award Ceremony

Thursday, June 21

Thursday, June 21, 09:00 - 09:40

K4: Jianwei Zhang

Synergic research on future robotics technologies from the Sino-German perspective

Room: Plenary

Thursday, June 21, 09:40 - 10:40

S1.1: Modeling

Room: Plenary

Chair: Karsten Berns (Technische Universität Kaiserslautern, Germany)

- 09:40 ***Pose Estimation of Mobile Robots with Quantized Measurements using EFIR Filtering: Experimental comparison with the EKF***
Daniel Heß and Christof Röhrig (University of Applied Sciences and Arts, Dortmund, Germany)
- 10:00 ***Functional Integration of a Robotics Software Framework into a Human Simulation System***
Kai Lemmerz and Paul Glogowski (Ruhr-Universität Bochum, Germany); Alfred Hypki and Bernd Kuhlenkötter (Ruhr-Universität Bochum, Lehrstuhl für Produktionssysteme (LPS), Germany)
- 10:20 ***A Cable-Driven Parallel Robot Remotely Controlled by a Human-Driven Parallel Cable Robot***
Chang-Sei Kim (Chonnam National University & School of Mechanical Engineering, Korea); Jinwoo Jung, Eui-Sun Kim, Xuejin Kim, Jinlong Park, Eunpyo Choi and Jongoh Park (Chonnam National University, Korea)

S6.1: Future of Work

Room 1

- 09:40 ***PowerGrasp: Concept for a novel Soft-Robotic Arm Support System***
Jan Kuschan, Jean-Paul Goppold, Henning Schmidt and Jörg Krüger (Fraunhofer IPK, Germany)
- 10:00 ***Design of a wearable robotic hand to investigate multisensory illusions and the bodily self of humans***
The Vu Huynh, Andrej Scherf and Alina Bittner (Technische Universität Darmstadt, Germany); Gianluca Saetta (University Hospital Zurich, Switzerland); Bigna Lenggenhager (University of Zurich, Switzerland); Philipp Beckerle (Technische Universität Darmstadt, Germany)
- 10:20 ***Integration of Safety elements into task-oriented programming system for human-robot-collaboration***
Julia Berg, Christoph Richter and Gunther Reinhart (Fraunhofer IGCV, Germany)

Room: Gallery

Thursday, June 21, 13:40 - 14:20

K6: Oussama Khatib

The Age of Human-Robot Collaboration

Room: Plenary

Thursday, June 21, 14:20 - 15:40

S1.3: Control

Room: Plenary

- 14:20 **Orientation dependent stiffness optimization of wearable robotics components** * *
Benedikt Kriegesmann (Technische Universität Hamburg, Germany); Robert Weidner (Helmut Schmidt University, Germany); Erik Fleming (Technische Universität Hamburg, Germany)
- 14:40 **Calibration of multiple 3D LiDAR sensors to a common vehicle frame** +&
Nina Heide, Thomas Emter and Janko Petereit (Fraunhofer IOSB, Germany)
- 15:00 **Behavior-Based Low-Level Control for (semi-) Autonomous Vehicles in Rough Terrain** , \$
Thorsten Ropertz and Patrick Wolf (TU Kaiserslautern, Germany); Karsten Berns (University of Kaiserslautern, Germany)

S3.4: Robotics in Production

Room 1

Chair: Christian Schlosser (Lufthansa Technik AG, Germany)

- 14:20 **Guiding Robots to Predefined Goal Positions with Multi-Modal Feedback** , ,
Michael Riedl and Dominik Henrich (University of Bayreuth, Germany)
- 14:40 **Intuitive visual definition of part aligned coordinate systems and motions for industrial robots** - (
Bernd Winkler (Fraunhofer IPA, Germany)
- 15:00 **Simulation-based Control of Reconfigurable Robotic Workcells: Interactive Planning and Execution of Processes in Cyber-Physical Systems** \$\$
Marc Priggemeyer (RWTH Aachen University, Germany); Juergen Rossmann (Technical University of Aachen, Germany)

S6.2: HRC Applications

Room 2

Chair: Annika M Raatz (Leibniz Universität Hannover & Institute of Assembly Technology, Germany)

- 14:20 **Improvements in Robot Teaching for Handling Operations in Production Environments** { \$,
Jan Hodapp (Daimler AG & Brandenburg University of Technology Cottbus-Senftenberg, Germany); Mayur Andulkar (BTU Cottbus Senftenberg & Chair of Automation Technology, Germany); Thorsten Reichling (Daimler AG, Germany); Ulrich Berger (Brandenburg University of Technology, Germany)
- 14:40 **Fast Graphical Task Modelling for Flexible Human-Robot Teaming** { %
Dominik Riedelbauch (Universität Bayreuth, Germany); Dominik Henrich (University of Bayreuth, Germany)
- 15:00 **Sparse and Precise Reconstruction of Static Obstacles for Real-Time Path Planning in Human-Robot Workspaces** { &\$
Tobias Werner and Maximilian Sand (Universität Bayreuth, Germany); Dominik Henrich (University of Bayreuth, Germany)
- 15:20 **Identifying Human Hand Position around a Cylindrical Handlebar** { &+
Antony Tran (University of Technology, Sydney & Center for Autonomous Systems, Australia); Dikai Liu (University of Technology, Sydney, Australia); Ravindra Ranasinghe (University of Technology, Australia); Marc Carmichael (University of Technology, Sydney, Germany)

Thursday, June 21, 15:40 - 16:00

Poster Session and Coffee Break

Room: Gallery

Thursday, June 21, 16:00 - 17:20

6.4: HRC Technologies

Room: Plenary

- 16:00 **Framework for automated program generation of HRC applications** (')

Fabian Müller, Christian Deuerlein, Daniel Rucker, Michael Koch and Peter Heß (Technische Hochschule Nürnberg Georg Simon Ohm, Germany); Alexander Hasse (Technische Universität Chemnitz, Germany)

16:20 **User-Centered Design of Multimodal Robot Feedback for Cobots of Human-Robot Working Cells in Industrial Production Contexts** (&

Johannes Höcherl (OTH Regensburg, Germany); Maïke Schmargendorf (University of Regensburg, Germany); Britta Wrede (Bielefeld University, Germany); Thomas Schlegl (OTH Regensburg, Germany)

16:40 **Collaboration-Gap: A bus-modular architecture for human-robot-collaboration systems in production environments** (\$) \$

Markus Schiemann (Daimler AG & Brandenburg University of Technology Cottbus-Senftenberg, Germany); Ulrich Berger (Brandenburg University of Technology, Germany); Jan Hodapp (Daimler AG & Brandenburg University of Technology Cottbus-Senftenberg, Germany)

17:00 **Gesture based robot programming using ROS platform** ()

Zoltán Forgó (Sapientia University, Romania); Alfred Hypki and Bernd Kuhlenkötter (Ruhr-Universität Bochum, Lehrstuhl für Produktionssysteme (LPS), Germany)

S6.3: Safe HRC

Room 1

Chair: Alexander Meißner (Dürr Systems GmbH, Bietigheim-Bissingen, Germany)

16:00 **A user study on robot path planning inside a Virtual Reality environment** (* &

Christian Just, Tobias Ortmaier and Lüder A. Kahrs (Leibniz Universität Hannover, Germany)

16:20 **New concept of safety to realize improvement of higher productivity and safety in an environment of human-robot collaboration, and proposal of the concept of Collaboration Safety Level** (* ,

Takayoshi Shimizu and Ikuo Maeda (IDEC Corporation, Japan)

16:40 **A Method for Robot Confidence Measurement in its Human** (+ (

Antony Tran (University of Technology, Sydney & Center for Autonomous Systems, Australia); Dikai Liu (University of Technology, Sydney, Australia); Ravindra Ranasinghe (University of Technology, Australia); Marc Carmichael (University of Technology, Sydney, Germany)

S5: New Robotics Applications

Room 2

Chair: Cornel Brisan (Technical University of Cluj-Napoca, Romania)

16:00 **Learning Multi-Goal Inverse Kinematics in Humanoid Robot** (, &

Phaniteja Singamaneni (International Institute of Information Technology, India); Parijat Dewangan (International Institute of Information Technology, Hyderabad, India); K Madhava Krishna (IIIT H, India); Abhishek Sarkar (IIIT Hyderabad, India)

16:20 **Performance characterization and improvement of an underactuated robot gripper** (, ,

Giovanni Carabin and Renato Vidoni (Free University of Bozen-Bolzano, Italy); Dominik T Matt (Polytechnic University of Torino, Italy)

16:40 **TrimBot2020: an outdoor robot for automatic gardening** (-)

Nicola Strisciuglio (University of Groningen, The Netherlands); Radim Tylecek (University of Edinburgh, United Kingdom (Great Britain)); Michael Blaich (Bosch, Germany); Nicolai Petkov (University of Groningen, The Netherlands); Peter Biber (Bosch, Germany); Jochen Hemming and Eldert van Henten (Wageningen University and Research, The Netherlands); Torsten Sattler and Marc Pollefeys (ETH Zurich, Switzerland); Theo Gevers (University of Amsterdam, The Netherlands); Thomas Brox (University of Freiburg, Germany); Robert Fisher (University of Edinburgh, United Kingdom (Great Britain))

Thursday, June 21, 17:20 - 17:30

Best Paper Award

Room: Plenary