ROS Industrial Conference 2017
December 12–14, Stuttgart
About Fraunhofer IPA

**Sustainable. Personalized. Smart.**

Fraunhofer is the largest research organization for applied research in Europe. Its research fields are orientated towards man's needs: health, safety, communication, mobility, energy and the environment.

With nearly 1 000 employees, Fraunhofer IPA is one of the largest institutes in the Fraunhofer-Gesellschaft. It has an annual budget of over 70 million euros, with more than one third coming from industrial projects.

**We see opportunities. We give impulses. We manufacture the future.**

The 14 departments of Fraunhofer IPA are supplemented by six business units: Automotive, Machinery and Equipment Industry, Electronics and Microsystems, Energy, Medical Engineering and Biotechnology and Process Industry. This structure enables us to help our practice partners improve their market position as well as support their market entry into new application fields.

**Strategic cornerstones “Mass sustainability” and “Mass personalization”**

The focus of our strategic cornerstones is on sustainable projects with high industry participation. Mass sustainability aims at minimizing the consumption of resources while maximizing the standard of living. In flagship projects, such as the Ultra-efficiency Factory, Fast Storage BW, the Center for Lightweight Production Technology and the Center Smart Materials, we are putting this concept into practice together with our partners from industry, university research and politics. Mass personalization unites the advantages of economies of scale and scope. In ARENA2036, the research campus for functionally-integrated lightweight automotive construction and in Campus Personalized Production, we are working on ways to manufacture personalized products in batch sizes of one at the same price as mass-produced products.

www.ipa.fraunhofer.de
Agenda Tuesday, December 12, 2017
Day 1: Open Source Robotics: Vision and Business Insights
Chair: Björn Kahl

10.30   Registration opens (at campus.guest hotel)
11.30   Welcome snacks
12.30   Sessions start

Introduction – Status and Outlook of Open Source beyond Research and Service Robotics
Mirko Bordignon, Fraunhofer IPA

Flexible Automation for Manufacturing in Heavy Industries
Matt Robinson, Southwest Research Institute

13.30-13.50 Coffee break
The Robotics Market: Latest Statistics and Insights
Martin Hägele, Fraunhofer IPA

Business Rationale from ROS Installations in the Nordics
Anders Billesø Beck, Danish Technological Institute

14.50-15.10 Coffee break
From Factory-in-a-Day to ROSIN: Lessons Learned and Next Actions
Carlos Hernandez Corbato, TU Delft

RobMoSys: Model-Driven Software Development for Robotics
Dennis Stampfer, Hochschule Ulm

Micro Robot Operating System: ROS for highly resource-constrained devices
Jaime Martin Losa, eProsima

16.40   Transfer from campus.guest conference room to Fraunhofer IPA
17.00   Guided tours at Fraunhofer IPA: Robotics Lab, Application Center I4.0, „Milestones of Robotics“ exhibition
19.00   Welcome reception (at Fraunhofer IPA)

Please be advised that photos will be taken at the conference which may or may not include your recognizable image and may be used by Fraunhofer IPA and the ROS-IndustrialConsortia. If you do not wish to have us use your image, please notify the event organizer.
**Agenda Wednesday, December 13, 2017**

**Day 2: Technology, Communities and Next Challenges**  
**Chair: Mirko Bordignon**

- **8.00** Welcome coffee (at campus.guest hotel)
- **8.30** Sessions start
  
  **Bootstrapping ROS-Industrial in Asia Pacific**  
  Min Ling Chan, Advanced Remanufacturing and Technology Centre – A*Star

  **RoboWare: A “Product Oriented Design” IDE for ROS developers**  
  Tony Wang, Jinan Tony Robotics Co. Ltd.

- **9.30-9.50** Coffee break
  
  **ACROS: the Brain of Perception-Guided Robots**  
  Moritz Tenorth, magazino GmbH

  **ROS2 – it’s coming**  
  Dirk Thomas, Open Source Robotics Foundation

  **Data-Centric Vs Device-Centric Programming**  
  Stan Schneider, Real-Time Innovations, Inc. (RTI)

- **11.20-11.40** Coffee break

  **Challenges in Safety and Security for industrial Automation Systems**  
  Martin Zappe, ICS AG

  **Deterministic Robot Motion Planning for Safety-critical Robot Applications**  
  Torsten Kröger, Karlsruhe Inst. of Technology / Fraunhofer IPA

- **12.40-14.00** Lunch
14.00  The Eclipse way of growing Business Friendly Open Source Ecosystems  
Gaël Blondelle, Eclipse Foundation Europe

How the ROS Community cares for Quality  
Yvonne Dittrich, IT University of Copenhagen

ROS in Actual Practice: Mining Usage Patterns of its Primitive  
André Santos, University of Minho / INESC TEC

15.30-15.50  Coffee break

The e.DO project  
Arturo Baroncelli, COMAU

ROS-I Native Robot Controllers  
Hermann Steffan, KEBA

Smart Infrastructure for Smart Robots  
Marco Braun, HARTING

16.50  Transfer from campus.guest conference room to Fraunhofer IPA

17.10  Demos of ROS-native hardware and installations

18.30  Transfer from Fraunhofer IPA to city center

19:00  Visit to Christmas Market

20:00  Conference dinner
Agenda Thursday, December 14, 2017
Day 3: Applications – Today and Tomorrow
Chair: Nadia Hammoudeh Garcia

8.00 Welcome Coffee

8.30 Sessions start

**ROS-based Intralogistics Solutions**
Niels Jul Jacobsen, Mobile Industrial Robots

**Cloud Navigation for Mobile Robots in Intralogistics Applications**
Felipe Garcia Lopez, Fraunhofer IPA

**Cloud Robotics Applications with Virtual Fort Knox**
Joachim Seidelmann, Fraunhofer IPA

10.00-10.20 Coffee break

**Autoware: ROS-based OSS for Urban Self-driving Mobility**
Dejan Pangercic & Shinpei Kato, Autoware / Tier IV

**Making the Case for Safety of Machine Learning in Highly Automated Driving**
Lydia Gauerhof, Robert Bosch GmbH

11.20-11.40 Coffee break

**ROS in Space Robotics at NASA**
Kimberly Hambuchen, NASA Johnson Space Center

**Requirements on Software Frameworks for Space Robotics**
Martin Azkarate, ESA ESTEC

**Concluding remarks**
Mirko Bordignon, Fraunhofer IPA

13.00 Farewell snacks
Dr. Mirko Bordignon joined Fraunhofer IPA in 2015 as the ROS-Industrial Consortium Europe manager. Since 2017 he leads the Software Engineering and System Integration group within the Robot and Assistive Systems department of the same institution. During his previous positions, he worked on software architectures for automated guided vehicles and modular robotics, with a specific focus on model-driven software engineering and domain-specific languages. He received BS and MS degrees from the University of Padova, Italy, and a PhD degree from the University of Southern Denmark. He held visiting positions at Orebro University, Sweden, and Harvard University, USA, and spent four years in the automation industry as a software engineer and project manager before joining Fraunhofer IPA.

Abstract

After meeting mixed reactions when first presented at an industrial audience five years ago, the concept of an Open-Source Software stack for robotics and automation is steadily increasing. Developments and clarifications in technical and non-technical topics contributed to this, by providing a better understanding of what tools like ROS are well suited for, and what instead they are lacking on. The talk will summarize this first phase of the ROS-Industrial initiative, and present its current status as the starting point for the next actions envisioned to promote its further growth.

Matt Robinson is the Program Manager for the ROS-Industrial Consortium – Americas. Mat Robinson is setting the strategy and vision to align the open source development community with industry needs to deliver innovative and sustainable advanced robotics solutions ready for factory deployment in his role at Southwest Research Institute. Mr. Robinson is the Program Manager for the ROS-Industrial Consortium – Americas, an industry-driven open source program bringing advanced manufacturing solutions for the industrial robotics community. Prior to his current role, Mr. Robinson was team leader for Caterpillar’s Manufacturing Technology Automation Research. Here, Mr. Robinson led development and deployment of automation tools to improve the performance and productivity of Caterpillar manufacturing facilities around the globe. Mr. Robinson, during this time, also led manufacturing value stream design initiatives that led to the deployment of over 50 robotic/automated manufacturing systems around the world. Mr. Robinson has led developments for automated materials joining processes for titanium and other challenging dissimilar material combinations for high temperature applications. Mr. Robinson has a Master’s Degree in Welding Engineering from Ohio State University.

Abstract

Large fabricators have struggled introducing automation due to the lack of volume to drive effective utilization, and subsequent return on investment. ROS-Industrial has presented an opportunity to present agility to manufacturing operations that enables improved utilization of resources and a broader impact on the overall value stream. Use cases around ROS-enabled deployments will be discussed that talk about how to realize value through ROS-enabled implementations that impact not just the discrete process, but how the entire value stream can be improved, in certain cases, but adding new capability to legacy hardware. A sustainable model has been developed, for deployment, leveraging known entities and/or partners that allow smaller sites, with smaller staffs, to realize the benefits of ROS-Industrial.
Martin Hägele received his degree as Diplom-Ingenieur in mechanical engineering from the University of Stuttgart in 1989 and his degree of Master of Science in Engineering Science (Solid Mechanics and Materials Science) from the George Washington University in Washington DC, USA. In 1989 he started working as a research engineer in industry and transferred as a researcher in robotics to Fraunhofer IPA in 1992. In 1993 he was promoted to Head of Department "Robot Systems" and has been appointed a member of the Fraunhofer IPA managing board in 2001. Since 2016 Martin Hägele is Division Manager "Intelligent Automation and Cleanroom Technology" at Fraunhofer IPA. He is a 2007 Engelberger Awards winner.

Abstract

The International Federation of Robotics IFR monitors market developments and trends in industrial and service robotics worldwide.

Between 2011 and 2016, the average robot sales increase was at 12% per year to over 294,312 units delivered in 2016, a new peak for the fourth year in a row. The main driver of the growth in 2016 was again the electrical/electronics industry (+41%). However the automotive industry is still the major customer of industrial robots with a share of 35% of the total supply in 2016.

Robotics in professional applications has already had a significant impact in areas such as agriculture, surgery, rehabilitation, logistics, defense or public relations and is growing in economic importance. In personal/domestic applications robotics has experienced strong global growth with a relatively limited number of mass-market product types: floor cleaning robots, robo-mowers and robots for edutainment. Sales in service robots for professional use will increase 12% by the end of 2017 to a new record of US$5.2bn worldwide. The long-term forecast expects an average growth rate of 20-25% in the period 2018–2020. There are now 700 companies active in the field, 29% of which are start-ups.

The presentation will highlight on recent robot market developments and will explain the role of emerging robotics ecosystems with ROS currently playing an important role.

Anders Billesø Beck is Head of section within Industrial Robotics and Automation Technology at the Danish Technological Institute. He coordinator of the Horizon 2020 project RAMPUP (H2020-ICT-2016), project manager of several major EU FP7 projects which all is targeted towards the development of reconfigurable and flexible industrial robot solutions to fit the needs and requirements of Small and Medium sized companies. Within this scope, Anders has managed several successful technology transfer activities from research to industrial implementation. Beyond research, Anders’ group are actively consulting more than 100 companies and are a part of more than 15 industrial robot installations per year.

Abstract

Using ROS for industrial robot installations provides a number of benefits and especially to support the transfer of research technology to industrial implementation. In his talk, Anders will present three industrial robot installations, that are running ROS and DTIs own control distribution "Robot CoWorker" in full industrial production. He will also discuss the process and aftermath of developing these installations from a technical and business perspective.
Dr. Ing. Carlos Hernandez Corbato is a postdoctoral researcher at the TU Delft Robotics Institute, Delft University of Technology. Carlos is currently coordinator of the ROSIN European project granted in the H2020 program. He has participated in other national and European projects in the topics of cognitive robotics and factories of the future, such as Factory-in-a-day. Carlos graduated with honours in Industrial Engineering (2006) and received his MSc PhD in Automation and Robotics from the Universidad Politecnica de Madrid in 2013. Carlos’ research interests include: robot control architecture, autonomy, model-based engineering, and self-aware systems. Carlos led Team Delft to win the Amazon Robotics Challenge 2016.

Abstract

The “ROS-I Quality Assured Robot Software Components” ROSIN H2020 EU project has started its 4 years activity to help the European industry join the benefits of ROS-Industrial by fostering academic education and industrial trainings, quality assurance practices, and through 3.5M EUR available in grants for companies and research institutions doing ROS-I software development.

Dennis Stampfer is a Research Associate at the Service Robotics Research Center (www.servicerobotik-ulm.de) of the Ulm University of Applied Sciences in Germany. His research interests include systematic engineering of software for service robotics by system composition in an ecosystem using model-driven software development. Dennis Stampfer is a member of the „Technical Committee on Software Engineering for Robotics and Automation“ (IEEE RAS TC-SOFT) and the topic group on „Software Engineering, System Integration, System Engineering“. He has studied Computer Engineering and Information Systems in Ulm where he has received his Master’s degree.

Abstract

RobMoSys, an EU Horizon 2020 funded project, started in January 2017 with the goal of establishing a common methodology based on the use of composable software models. RobMoSys puts great importance in turning community involvement into active support for an open and sustainable European robotics software ecosystem. It envisions an integrated approach to robotic platforms by applying model-driven methods and tools on existing technologies for further use and improvement. RobMoSys establishes a composition-oriented approach to system-of-system integration that manages, maintains and assures system-level properties via model-driven techniques.

This provides an overview on RobMoSys. It provides insights to the current progress, the approach, and the opportunities to get involved.
Jaime Martin Losa: eProsima CEO, with 20 years of experience in project management and software development focused in networking middleware.

He is the Architect for all the company products, including eProsima Fast RTPS and eProsima RPC over RTPS/DDS. Jaime leads the eProsima OMG membership, and is the responsible of eProsima contribution to the DDS standards, as the Web-enabled DDS, DDS Security, RPC over DDS, and the upcoming specifications OPC-UA DDS Bridge and DDS-XRCE.

eProsima is an important contributor to ROS (Robot Operating System), being eProsima Fast RTPS the default middleware powering the upcoming version of this framework, and now the coordinator of the micro-ROS project, a joint effort between eProsima, Bosch, Acutronics, PIAP and FIWARE Foundation to extend ROS2 to microcontrollers.

Abstract

Micro-ROS bridges the technological gap between the established robotic software platform for high-performance computational devices and the low-level libraries for microcontrollers. By doing so, microprocessors and microcontrollers could be mixed together seamlessly in any robotic system. Through the end-user driven development of this innovative platform, we aim to substantially reduce the cost of initial investment in robotic systems and thus lower this market entry barrier for smaller and medium-sized companies.

Min Ling Chan is currently the Program Manager for the ROS-Industrial Consortium – Asia Pacific managed by ARTC, an initiative of A*STAR in Singapore. She aims to increase robotic development in industry through ROS development and adoption in Asia Pacific.

She holds a double major in Mechanical Engineering and Computer Science from RMIT University, Australia. She has worked in various manufacturing industries in Germany, Belgium and Australia, ranging from air compressors to automotive with Ford Australia. Prior to this role she worked in the Ford Asia Pacific team as the Asia Pacific lead on Engineering Design and Testing governance and process amongst supporting the AP Engineering team on process improvements. She brings with her experiences in manufacturing, product design & development, supply chain support to project management of large vehicle programs.

Abstract

Into its first year of commencement, ROS-Industrial Consortium in Asia Pacific is setting the objective and strategy towards understanding the industry needs of this region and bootstrapping software development, hardware integration to expand ROS-Industrial adoption and advance the ROS-Industrial Software platform through direct and community-based development.
Biography

**Prof. Tony Binhai Wang** was born in 1978. He received the B. Eng. degree in automatic control from the East China University of Science and Technology, China, in 2001, the M. Sc. degree in communication systems from the University of Birmingham, UK, in 2002 and the Ph.D. degree in image processing and pattern recognition from the University of East Anglia, UK, in 2008. Then, he moved to the Electric Power Robotics Laboratory (EPRL), State Grid Corporation of China as a senior R&D engineer in 2008 and established the Artificial Intelligence Group. In 2012, he became the director and the member of Technical Committee of EPRL. In 2015, he established Tony Robotics to provide robotic solutions and developer tools for ROS. His current research interests include robotics (robot control, ROS and ROS-I, developer tools), image processing and computer vision (mathematical morphology, model-based analysis, content-based image retrieval, scale-space analysis, perspective geometry and stereo vision, object recognition and tracking), machine learning (neural networks, regression and classification).

**Abstract**

RoboWare is a development kit specifically designed for ROS. It provides an integrated development environment, which has general purpose IDE functions: code editing, building and debugging; It fully supports ROS, including the creation and management of workspace, packages, libraries, nodes, msg/srv/action/launch/yaml/urdf files, etc. RoboWare supports “POD (Product Oriented Design)” development, it has a graphical designer for robot hardware architecture, the design diagram can be automatically exported as a ROS workspace for further development. It also provides a GUI development framework, which has plenty of robot-related controls and is cross-platform.

**Moritz Tenorth** is currently CTO at Magazino. After spending several years in robotics research, he previously worked as robotics consultant for Siemens Novel Businesses.

During his research at TU München, the CMU Robotics Institute in Pittsburgh, the ATR in Kyoto, and the University of Bremen, he investigated how autonomous manipulation robots can be equipped with Artificial Intelligence methods, in particular knowledge representation and reasoning capabilities. He published more than 50 articles and conference papers in robotics and AI.

Moritz Tenorth obtained a diploma in Electrical Engineering from RWTH Aachen University and a PhD in Computer Science from TU München.

**Abstract**

Advanced Cooperative Robot Operating System (ACROS) ñ the brain of perception guided robots.

In order to bring cutting-edge perception capabilities and artificial intelligence into robotics, it’s key to have an advanced cooperative robot operating system. With ACROS Magazino is building a software framework, which operates perception guided robots, manages their task execution, coordinates the robot fleet and gathers knowledge through a cloud based artificial intelligence.
Biography

**Dr. Dirk Thomas** is a software engineer at the Open Source Robotics Foundation. He received his Ph.D. in Computer Science from the Technische Universitaet of Darmstadt (Germany) in 2010. In 2012 he moved to California to start as a Research Engineer at Willow Garage where he took on the responsibility to work on the most crucial foundations of ROS. His area of expertise within ROS ranges from the build system and the CI infrastructure over the C++ and Python client libraries up to developer tools like rqt. Dr. Thomas is currently leading the ROS development team working on the next major generation of ROS, version 2.

**Abstract**

The Robot Operating System just celebrated its 10th anniversary. While ROS has been very successful in several domains there are specific use cases and requirement it can’t currently satisfy well. The next major version – ROS 2 – is aiming to address many of those limitations. Built upon an established communication standard it provides the advantages of a modular designed robotic software to be used all the way in production systems. It is designed from the ground up to meet the needs for a deterministic and reliability system behavior and supports a variety of platforms. This presentation will give an insight on what features are available in the latest release as well as what is planned in the future.

Biography

**Stan Schneider** is CEO of Real-Time Innovations (RTI). Stan is on the IIC Steering Committee & is its testbed chair. He was named Embedded Computing Design’s Top Embedded Innovator Award 2015 & IoTOne’s top-10 most influential in the IIoT 2017. He holds a PhD in EE/CS from Stanford.

**Abstract**

There are many standards that target industrial networking. The most important are OPC UA and the Object Management Group’s (OMG’s) Data Distribution Service™ (DDS) standard. While both standards offer data communications, they are very different. Most importantly, they differ in the integration approach for the final system design. OPC UA targets final device-centric integration by plant engineers. It offers easy interoperability between devices from different vendors. By contrast, DDS targets final data-centric software integration by software teams. As intelligent software gains importance, DDS provides the global data abstraction and dataflow interface control that software teams need. This distinction is profound; it is the primary reason these approaches are so different. This talk will review the programming techniques, the standards, and their differences. It will also overview the Industrial Internet Consortium (IIC) architecture for combining standards cooperatively.

**Data-Centric Vs Device-Centric Programming**
Biography

**Martin Zappe** (geb. 1969) studied electrical Engineering at the University of applied Science in Cologne [Dipl. Ing. (FH)]


1999 Head of Sales and Marketing at N.A.T. GmbH

2001 Key Account Manager Automotive / Branch Office Manager Cologne for Berner & Mattner Systemtechnik GmbH

2004 Sales Manager South Germany – Authorized Officer – Managing Director Lineas Automotive GmbH / ICT Software Engineering Nord GmbH

Since 2011 Business Unit Manager at ICS AG in Stuttgart - Think Safe Think ICS Industrial Engineering / Dependability – Services – Solutions

Abstract

In April 2016 the BSI (Federal Office for Information Security) released a study about the security status of OPC UA protocol. The performed analyzes showed, that OPC UA offers a good security level. In this context it is important to understand, that the OPC UA specification can specify IT-security-measures which secure the related communication only. Threads which attack e.g. the operating system have to be secured separately. Hence the engineer needs a bouquet of balanced measures for securing his system/application. These facts lead us to the „Challenges in Safety and Security for industrial Automation Systems“ - in this session we will describe an all-embracing engineering approach which incorporates also the system view by the application of IEC 62443.

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Biography

**Torsten Kröger** is a Full Professor of Computer Science and the Director of Intelligent Process Control and Robotics Laboratory (IPR) of the Institute for Anthropomatics and Robotics (IAR) at Karlsruhe Institute of Technology (KIT). He is also a Visiting Scientist at Stanford University and the founder of Reflexxes. From 2014 to 2017, he was a Staff Roboticist and the Head of the Robotics Software Division at Google. His research interests are real-time motion planning, transfer learning, and deterministic distributed real-time systems. Among multiple awards, he received Early Career Award of the IEEE Robotics and Automation Society.

Abstract

Embedding multiple sensors – force/torque, vision, and distance – in the feedback loops of motion controllers has enabled new robot applications. For instance, safe human-robot interaction and many assembly tasks that could not be automated before. As important as these real-time control features is the ability to plan robot motions deterministically and in real-time. To enable spontaneous changes from sensor-guided robot motion control (e.g., force/torque or visual servo control) to trajectory-following motion control, an algorithmic framework is explained that lets us compute robot motions deterministically within less than one millisecond. The resulting class of on-line trajectory generation algorithms serves as an intermediate layer between low-level motion control and high-level sensor-based motion planning. Online motion generation from arbitrary states is an essential feature for autonomous hybrid switched motion control systems. Building upon this framework and with the goal of significantly reducing the amount of resources needed for programming industrial and service robots, reinforcement learning offers a yet unused potential that will be introduced as well. Samples and use-cases – including manipulation and human-robot interaction tasks – will accompany the talk in order to provide a comprehensible insight into these interesting and relevant fields of robotics.
Gaël Blondelle is Director of European Ecosystem Development at the Eclipse Foundation. Gaël Blondelle has accumulated specialized experience with Open Source communities since 2002. Since 2010, he has been the manager of OPEES, a European project whose key result is the creation of PolarSys, the Eclipse Working Group dedicated to Open Source tools for Embedded Systems.

Since he started in the software industry in 1996, Gaël has been working primarily in Telecommunications, IT and Embedded Systems industries.

Since 2013 he has managed the PolarSys working group and contributes to the Eclipse ecosystem development in Europe.

**Abstract**

Since 2004, the Eclipse Foundation has successfully developed business friendly open source ecosystems. This talk will present how the Eclipse Foundation legal and organisational framework, initially designed to foster both collaboration and commercial exploitation of the Eclipse IDE and the Eclipse Rich Client Platform, has been used to develop open source ecosystems in new domains like IoT, tools for safety critical systems, management of geo spatial data or automotive for the past five years.

Yvonne Dittrich's research interests are software development as cooperative work. She has been working with action research combining understanding and improvement of software development practices and the development of methods, tools and techniques for more than 15 years. She currently focuses on software product development and continuous software engineering. Most of her research takes place in cooperation with industry and public agencies.

**Abstract**

As part of the EU H2020 project ROSIN promoting the usage of ROS for industrial applications, we investigate how the ROS community takes care of quality. The goal is to understand quality problems and to address them. We will report our preliminary findings based on analysis of bug reports in ROS and ROS-I based projects; interviews with members of the ROS and ROS-I community; analysis of the ROS and ROS-I wiki and other available resources. We both identified well working quality assurance (QA) practices, but also a number of challenges.

We conclude by outlining a number of possible directions of how to address the identified challenges: clarifying QA processes; making QA practices and tools easily available; making the quality of community contributed packages and drivers visible; supporting knowledge sharing and on-boarding among contributors; and developing and implementing code scanning tools.
André Santos

ROS in Actual Practice: Mining Usage Patterns of its Primitives

André Santos is a Computer Science Ph.D. student at University of Minho, Portugal, currently researching software safety and quality techniques applied to robotics. André graduated also in Computer Science from University of Minho, following it up with a Master’s degree in Formal Methods in Software Engineering and Distributed Systems. His Master’s thesis, named „Applying Coding Standards to the Robot Operating System“, focused on studying various coding standards and recommended programming practices, and how they applied to ROS robotics software. This thesis also led to the creation of HAROS, a software analysis framework presented at the IROS 2016 and ROS-Industrial 2016 Conferences.

Abstract

The Robot Operating System (ROS) is nowadays one of the most popular frameworks for developing robotic applications. To ensure the (much needed) dependability and safety of such applications we forecast an increasing demand for ROS-specific coding standards, static analyzers, and tools alike. Unfortunately, the development of such standards and tools can be hampered by ROS modularity and configurability, namely the substantial number of communication primitives (and respective variants) that must, in principle, be considered. To quantify the severity of this problem, we have mined a large number of existing ROS packages to understand how its primitives are used in practice, and to determine which combinations of primitives are most popular (e.g. publisher/subscriber versus client/server). In this talk, we will start by briefly presenting HAROS, a static analysis framework for ROS. Afterwards, we will present and discuss the results of our study, its relevance for tools such as HAROS, and hopefully provide some guidance for future standardization efforts and tool developers.

Arturo Baroncelli

The e.DO project

Arturo Baroncelli has a Mechanical Engineering degree from the University of Pisa and Scuola Superiore S. Anna; additionally, he has a post degree diploma in „Program in Executive Development“ at IMD, Lausanne, Switzerland.

In Robotics industry since 1985 and in Comau (FCA group), Turin, Italy, since 1988, where he is working now for Business Development Initiatives.

He has covered several positions in Project Management, Proposal Engineering, Product Planning, Marketing & Sales, Strategic Planning and Business Development.

Baroncelli has been President of the IFR, International Federation of Robotics, for the years 2013-2015 and a member of the Executive Board since 2008. Since 1998, he has been an Executive Board Member of SIRI, the Italian Robotics association. He was presented with the Joseph Engelberger Award in Tokyo in 2005, the most important Prize in Robotics Industry world-wide. He has written 27 papers for various Conferences and Magazines and holds two patents in the field of press to press automation and robot laser welding. Arturo Baroncelli frequently lectures at various Universities on themes related to Robotics Technology and Business Developments.

Since 2015 Arturo Baroncelli has been in the board of Directors of SPARC euRobotics.

Abstract

e.DO is a unique, modular, opensource, “build-it-yourself” robot, created for anyone who wants to explore or expand the world of robotics. Available with 4 or 6 axes, e.DO features an opensource hardware and native ROS software architecture. Its flexible structure fully supports personalized configurations and third-party devices. Created for education, it is also perfect for enthusiasts. The presentation will explain the main feature of the product and how we moved from the concept to the market.
Biography

**Hermann Steffan**

Hermann Steffan, born 06.01.1987 in Linz/Austria, studied Teleinformatics at the Graz University of Technology and graduated in 2016. During his studies, he worked for Dr. Steffan Datentechnik (DSD) that focuses on developing software in the field of accident reconstruction. His master thesis is dedicated to steering control for autonomous driving. In his current position at KEBA AG he is responsible for the technical integration of ROS into the robotic motion control.

**Abstract**

Robots are an indispensable part of increasing the productivity of industrial series manufacturing processes. Their range of applications is wider than ever before. An open robotics platform is the perfect basis for opening up these new markets fast. KEBA tries to offer a unique platform for implementing efficient solutions for any robotic applications, by combining its established KeMotion FlexCore and the dynamic ROS Framework.

Therefor the ROS-core is directly integrated in the PLC as an additional software component. Due to an open interface, it is possible to use KEBA industrial proven real-time motion control features out of ROS. As part of an industrial robot solution, a ROS application can benefit from a standard robot programming system and is embedded into a high quality safety environment.

Biography

**Marco Braun**

Marco Braun studied electrical engineering and completed a master’s degree in “Embedded Systems and Microrobotics” at the University of Oldenburg. He has worked for HARTING for two years at the research and development department in the area of robotics and distributed systems.

**Abstract**

ROS Industrial aims to extend the use of ROS to manufacturing. A number of impressive videos demonstrate examples from material handling or assembly processes. If you wish to integrate a ROS-controlled robot on the shop floor, an essential step is to interface the heterogeneous infrastructure. In most cases you are not starting in a greenfield environment. There are any number of dedicated machines and processes, which have to be interfaced. Typically you have to deal with a variety of communication interfaces, such as digital/analogue IO, fieldbus systems (e.g. Profibus), higher level communication stacks (e.g. OPC UA), progressing right up to high level ERP or Cloud integration. There is a gap between ROS based communication and the shop floor infrastructure.

The HARTING MICA is able to solve these communication problems. This Linux-based System with modular hardware components enables you to interface machines and devices on the shop floor with your ROS based robot application.
Niels Jul Jacobsen has worked in the field of industrial robotics and automation for more than 25 years. He is the CTO and founding partner in MIR. Niels has worked at AMROSE A/S and Odense Steelship Yard as R&D manager. From 2007-2013 he was employed at the University of Southern Denmark, where he was head of the robot laboratory at the Faculty of Engineering.

He was in the board of Universal Robots from 2008-2015. He holds a MSc in Computer Science Technology and a Graduate Diploma in Finance, both from University of Southern Denmark.

Abstract

MiR is a company who produces mobile robot for all industries and areas in the global market.

The robots software are based on the ROS and is designed to work in environments with humans.

The robots from MiR are currently used in more than 100 factories and hospitals all over the world providing logistic capacity to its users.

The talk will cover an installation where several robots are used together with MiR Fleet. MiR Fleet is an order execution system, that controls the robots and receives orders from the factory ERP system.
Biography

Joachim Seidelmann obtained his diploma degree in mechanical engineering at the University of Stuttgart in 1996. Subsequently he worked as research assistant in the area of IT-Systems for High-Tech manufacturing industry at the Fraunhofer IPA. Since 2000 he was in charge of the research team „Logistics and Production-IT for the semiconductor industry“. In 2012 he started additionally building up the Competence Center „Digital Tools in production“ with a strong focus on Industry 4.0 concepts and solutions. He is co-author of the „Recommendations for implementing the strategic initiative INDUSTRY 4.0 – Final report of the Industry 4.0 Working Group“ and responsible for several large Industry 4.0- projects.

Abstract

To show different use cases of cloud computing in robotics, we present Virtual Fort Knox, a federative cloud platform for manufacturing. The platform allows for fast and effective implementation of cloud services with a special focus on the needs of industrial applications. One important component is the Manufacturing Service Bus. It allows the easy integration of cloud-based services with manufacturing hardware, such as ROS-enabled robots. Any communication from Websocket, REST-ful, MQTT or OPC-UA can be translated into ROS messages that can be received over ROS topics.

One opportunity offered by this system is to run ROS-based services in the cloud to enhance the functionality of the robot. For example a central multi-agent navigation server. A different opportunity lies within the connection of the robot to other infrastructure within the manufacturing environment. For example, a mobile robot may require communication to transfer stations or other mobile robots in its vicinity. In summary using Virtual Fort Knox with ROS allows the benefits of cloud robotics to be used in industrial applications.

Dejan Pangercic received a PhD from the University Of Bremen under the supervisory of prof. Michael Beetz. During his PhD he developed a comprehensive system for creation of semantic object maps of indoor environments that enable personal robots to e.g. robustly operate kitchen containers. He also developed a system for an interactive segmentation of objects of daily use in clutter where he leveraged robots’ manipulation skills to improve their perception skills (http://ias.cs.tum.edu/people/pangercic?redirect=1). After the PhD he joined Robert Bosch LLC where he worked on mobile manipulation and autonomous lawnmowers (https://www.bosch-garden.com/int/indego.html). Between 2014-2016 he was a CTO of Deepfield Robotics, an agricultural startup that created a robot for in-field plant scanning (https://www.deepfield-robotics.com/de/Automatisiertes Feldversuchswesen.html). Between 2016-2017 he lead perception and software group for autonomous driving at Faraday Future. Currently CTO of an AD startup and Autoware developer.

Abstract

Autoware is open-source software (OSS) for urban self-driving mobility, empowered by ROS. It provides complete modules of perception, decision making, and control, which enables drive-by-wire vehicles to drive autonomously in public road environments. The current maintainer of Autoware is Tier IV, a Japanese academic startup company comprising professors and students. Automotive makers and suppliers now often use Autoware to build their research and development prototypes of self-driving mobility. Autoware has also been partly ported to ROS2. This talk will be of interest to any researchers, developers, and practitioners who are looking for open-source solution of self-driving mobility.
Biography

Dipl.-Ing. Lydia Gauerhof completed her studies in the fields of mechanical engineering specializing in Artificial Intelligence and Mobile Machines in 2013. Starting from then she worked at the Chair of Automotive Technology of Technical University of Munich. In her research work Gauerhof concentrated on cooperative driving including manually driven and automated vehicles. In 2016 she started her research at Corporate Research of Robert Bosch GmbH. Currently, she focuses on safety for Machine Learning applied in the context of automated driving.

Abstract

Against the background of highly automated driving, arguing the safety of functions making use of machine learning techniques is challenging. In this paper an assurance case structure is used to emphasize the systems engineering and validation considerations when applying machine learning methods for highly automated driving. Functional insufficiencies in the perception functions based on convolutional neural networks are focused. Finally, possible types of evidence that can be used to mitigate against such risks are presented.

Biography

Dr. Kimberly Hambuchen is currently the Principal Technologist for Robotics in NASA's Space Technology Mission Directorate (STMD). As Principal Technologist, she serves as the technical expert and advocate for robotics across all NASA centers for STMD programs. She works with NASA program managers and field center leads to maintain and update STMD's portfolio of robotics projects across a range of Technology Readiness Levels. She has spent the last 20 years developing software and applications to advance the intelligence, usefulness and operational intuitiveness of robots. As a robotics engineer in the Software, Robotics and Simulation division of engineering at NASA Johnson Space Center, Dr. Hambuchen developed expertise in novel methods for remote supervision of space robots over intermediate time delays and has proven the validity of these methods on various NASA robots, including JSC’s Robonaut, Space Exploration Vehicle (SEV) and Valkyrie (R5). Dr. Hambuchen is currently a member of the International Space Exploration Coordination Group's (ISECG) Telerobotics Gap Assessment team, providing gap analysis in the field of operating space robots for the international space community, and in 2016 was named “One of the 25 Women in Robotics to Know” by RoboHub.

Abstract

Presentation Abstract: Dr. Kimberly Hambuchen will present information on how NASA is currently using ROS for robotic prototypes for future space exploration missions. ROS is integral to advancing autonomy in robots such as Robonaut 2 and Valkyrie (R5). This presentation will focus on how and why ROS is used in robotic prototypes and future avenues for ROS integration and development on flight-qualified NASA robots. This presentation will provide information to the greater ROS community on how future innovations could be integrated into NASA robots to enable manned missions beyond low-Earth orbit.
Biography

**Martin Azkarate**, Experienced robotics enthusiast exploring the boundaries of technology looking forward to the next breakthrough. Working hard to build sophisticated intelligent systems capable of performing more and more complex tasks and assist us in different areas such as common daily activities, industrial processes, hazardous zones or space exploration.

Abstract

The SARGON (Space Automation & Robotics General cONTroller) activity is devoted to the design of a Robot Control Operating Software (RCOS) based on the TASTE toolset and on existing open-source robotics software, with special care on its RAMS characteristics. ESA space robotics missions such as ExoMars or European Robotic Arm (ERA) require significant software engineering effort when compared with other satellite space missions, due to their complexity and low heritage. Moreover, the software engineering tools used are customized to such extent that a very little percentage of this software development, validation and verification effort becomes re-usable for future space robotics missions. One of SARGON’s main objectives is to reduce the cost of future software developments for space robotics missions. For this purpose, the TASTE framework provides a model-driven approach for the development of reusable and RAMS-compliant on-board software. The activity focuses on the analysis and definition of requirements for an RCOS and on identifying the building blocks to complement the current TASTE implementation for covering all needed RCOS functionalities. The aim of this TASTE RCOS is to be the base of future European space robotics applications, and in this context SARGON is a first step in that direction.

SARGON is an activity funded by the ESA Basic Technology Research Programme (TRP). The activity is ongoing but has already been successful in securing a continuation. The EC H2020 programme, within the Strategic Research Cluster in Space Robotics, has awarded an operational grant to the ESROCOS team for the further development of the aforementioned objectives.
How to find us

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By car
Take the A8 autobahn (the highway that runs from Karlsruhe to Munich) until you reach the Stuttgart autobahn intersection (Autobahnkreuz Stuttgart). Turn onto the A 81/A 831 and follow signs to »Stuttgart-Zentrum« until you reach the »Universität« exit. Turn left at this exit into the road »Universitätsstrasse«, which subsequently turns into »Nobelstrasse«.

By taxi
Distance from the airport to the Fraunhofer-Gesellschaft Institute Center: approx. 13 km.
Distance from the main railway station (Hauptbahnhof) to the Institute Center: approx. 12 km.

By public transport
From Stuttgart’s main railway station or Stuttgart airport, take the S-Bahn (suburban train) lines S1, S2 or S3 in the direction of Vaihingen. Exit the train at the »Universität« stop. Leave the station via the »Wohngebiet Schranne/Endelbang« exit and continue some 500 m on foot to reach the institute.
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