ROS-Industrial Consortium Americas Annual Meeting 2019

Batch Picking Mobile Robot, Courtesy of Bastian Solutions

ROS-Industrial Consortium Americas Annual Meeting Program

Overview & Introduction

It has been an exciting year for ROS, and open-source development more broadly. ROS, a middleware that provide a common framework for robotics applications, recently celebrated its 10-year anniversary, and ROS2, has truly emerged as a new and exciting framework, with a number of tangible benefits that are poised to be leveraged to develop new applications that before didn't seem possible.

As we know, within ROS, and the complimenting open-source ecosystem, there have existed a number of packages that enable intelligent application development that include 2D/3D point cloud processing, robot motion planning and navigation, off-line visualization and planning tools, and more. Companies continue to emerge offering innovative solutions that either directly leverage ROS, or have had their roots in ROS development. The vibrancy of the ecosystem has never been stronger, and that the trend trend is expected to continue.

ROS-Industrial, which now is entering its 7th year as an open-source project, seeks to bring these advanced capabilities, that ROS has brought to the robotics community, to industry-relevant hardware and applications. There are exciting developments to discuss, a number of strategic decisions to be made, and of course tools and capabilities to be developed, to maintain the momentum that has been established to this point.

As evidenced by the activity and the sheer number of entrants into the order fulfillment/warehouse and logistics space, this area has proven that ROS-based solutions can survive and even thrive in manufacturing environments where uptime and reliability of performance are critical.

It has been established, that an open-source approach enables a rising tide to benefit not just the entities that seek to leverage new capability, but to grow a community of passion around the development, improvement, and deployment of exciting new capabilities. In the most ideal form, there can be a continuum of development talent and capability, that starts early, with a passion to solving these challenges due to a rich level of engagement through the education pipeline, universities & Non-profit entities, and our for-profit industrial stakeholders, which include small start-ups through multi-national corporations.

The ROS-Industrial Consortium Americas, and the sister Consortia in Europe and Asia-Pacific, seek to bring these entities together in a way to set the strategy to realize the promise of ROS-Industrial. These goals include:

1. Provide a one-stop location for manufacturing-related ROS software.
2. Strive towards software robustness and reliability that meets the needs of industrial applications.
3. Combines the relative strengths of ROS and existing technology, combining ROS high-level functionality with the low-level reliability and safety of an industrial robot controller, as opposed to replacing any one technology entirely.
4. Stimulates the development of hardware-agnostic software by standardizing interfaces.
5. Provides an "easy" path to apply cutting-edge research to industrial applications by using a common ROS architecture, while navigating and putting forth guidance relative to developments such as the emergence of ROS2.
6. Provides simple, easy-to-use, well-documented application programming interfaces.

The Consortia and their respective membership have a chance to influence this strategy by providing guidance and direction for the areas that need addressed.

As you consider the evolving robotics technological landscape, and the momentum around open-source, in parallel with your own organization's needs, new capabilities to enable improved business performance and quality of operations, remember that what differentiates these solutions, is the ecosystem, including the people that contribute.

The ROS-Industrial concept is the idea that a community can be fostered, and leveraged, to not just deliver capability but also people with a passion for industrial and manufacturing use cases, making manufacturing accessible and exciting for the next generation of solution developers.

We look forward to your engagement and hope that you find the discussion and proposed opportunities for collaboration to be a benefit to the Consortium, your organization, and to the broader open-source ecosystem.

Regards,

Matt Robinson

ROS-Industrial Consortium Americas

Objectives

The intent of the ROS-Industrial Consortium Americas Annual Meeting is to convene the Consortium membership to review the latest in developments, stakeholder and partner initiatives, sister Consortia activities, as well as review and provide input into the vision and strategic direction of ROS-Industrial.

At the most recent ROS-Industrial Americas Annual Meeting in San Antonio, Texas, the membership provided their top challenges, or problems, as they have seen in the ROS community relative to industrial use cases, and also highlighted capabilities that are needed. The high-level outputs are outlined below and weighted by how often they were voted by members that participated.

The intent here is to provide direction and highlight gaps, in where ROS-Industrial can improve to meet the needs of industry, while highlighting either in-flight programs, that are addressing issues/needs, or where there are opportunities to develop something as a Consortium, deliver new foundational capabilities that can manifest into new applications for the membership, and industry as a whole. This influences the technical direction of the Consortium, and of ROS-Industrial as a whole. Drives what becomes a focus, and leads to proposals either within the Consortium, or elements of proposals that may manifest in the many regional consortia.

Beyond learning and providing feedback about the roadmap outputs from the membership and how this influences the technical vision, this event seeks to enable attendees to:

1. Understand where ROS-Industrial is, technically, and sustainably, and what has happened in the last year, what is proposed moving forward.
2. Learn about the latest strategic non-technical initiatives that seek to move the ball forward in growing use, adoption, and support of ROS-Industrial
3. Communicate and share what has been beneficial and what has been a challenge during workshops and networking sessions.
4. Consider the provided roadmap outputs and provide feedback based on recent developments since the last roadmap considerations.
5. Review proposals for Consortium-led projects, or Focused Technical Project (FTPs), or offer new ideas that may not have been presented that align with the technical vision.
6. Take what has been learned and share it with your organizations. Provide feedback, and continue to participate in these events, as well as the other meetings that take place throughout the year and in the various regions. Without the engagement of the membership and community, ROS-Industrial will not realize its potential.

Member submitted challenges, and votes for the priority of the challenge from 2018 ROS-I Americas Roadmapping

Votes	General Problems	Current Active Development	Votes	Capabilities Needed	Current Active Development
14	Community Transition/Growth (ROS1->ROS2, ROS->ROS-I)	Proposed ROS-I Strategy for ROS2 Leverage	12	Tools for Simulation of Process	Area of Opportunity
13	Ownership (Packages & Code/Support-Deployment, After Deployment, Long-Term	Joint effort across ROS-I regions and Government-backed Consortia	10	ROS 2 Enabled Hardware	ROSin
12	Synergy Across Global Projects, ROS2 & ROS-I plan	Communication Plan Refinement/Cadence	10	Standard Hardware Interface	ROSin
11	Standard Interfaces (Hardware and Software)	ROSin	9	Programming task intent	Area of Opportunity
10	User-Friendly Diagnostics	ROSin	8	Force/Torque control	Work to be leveraged/Opportunity
10	Fault Recovery (Pick-Up & Continue)	Benefit of certain elements of ROS2	8	OEM Spec Participation (ROS1, ROS 2)	Area of Opportunity
7	Outdated Documentation	Area for Improvement	7	Voice Control/Programming/Multi-Modal/Asymmetric Comms	Work to be leveraged/Opportunity

Chairs

Matt Robinson – ROS-Industrial Consortium Americas Program Manager

Paul Evans – SwRI Manufacturing and Robotics Technologies Department Director

Levi Armstrong – ROS-Industrial Consortium Americas Technical Lead

About Southwest Research Institute® (SwRI®) – President's Message

"Innovation in science and technology has been a hallmark of Southwest Research Institute since its earliest days. It's no exaggeration to say we are committed to advancing science and applying technology to benefit government, industry, and all of humankind. That is our mission. Our multidisciplinary, collaborative approach allows us to successfully solve clients' most challenging problems.

Our staff is just as committed today as our founder Thomas Baker Slick Jr. was in 1947 when he proposed that the betterment of mankind depends on the use of advanced science and technology. His dream of building an internationally respected institution working in research and development has, I believe, been more than realized.

Today, we are a leader among independent, nonprofit research and development organizations. Our staff of 2,574 scientists, engineers, analysts, and support staff members continues to accomplish outstanding fundamental and applied engineering and research for clients from diverse segments of government and industry. And we will continue to strive to be the first choice for clients seeking solutions for their most complex problems."

Adam L. Hamilton, President & CEO, Southwest Research Institute

Agenda

Time	Title	Speaker	Organization
7:45	Registration & Light Breakfast		
8:00	Welcome & Introductions	Matt Robinson	ROS-I
8:10	ROS-I Americas Highlights & Upcoming Developments	Matt Robinson & Levi Armstrong	ROS-I Americas/Southwest Research Institute
8:30	Platformed Verticals, Polarized Offerings: Rethinking Robotics and Automation in 2020	Mirko Bordignon	ROS-I EU/Fraunhofer IPA
8:50	Concepts on Dynamic Grasping and an Update on ROS-I Asia-Pacific	Erik Unemyr	ROS-I Asia Pacific/ Advanced Remanufacturing Technology Center
9:10	Break		
9:25	Roadmapping Workshop - An on-your-feet moderated exercise that will influence technical direction of ROS-I development for the Americas building on prior workshop outputs	ROS-I Team Moderated	
10:40	Robotic Assembly of Large Structures using Vision and Force Guidance	Dr. John Wen	Rensselaer Polytechnic Institute
11:10	Leveraging ROS for Industrial R&D Projects	Eugen Solowjow	Siemens
11:40	Lunch		
12:10	KEYNOTE - ROS… Common platform to Competitive Edge	Chris Morgan	Bastian Solutions/Toyota Advanced Logistics
12:40	Focused Technical Project Brainstorming - Presentation of a handful of project topics and opportunity to offer additional topics of interest	ROS-I Team Moderated	
13:25	Standards and Open Source Software for Industrial Automation	Fred Proctor	U.S. National Institute of Standards and Technology (NIST)
13:55	Operationalizing Robotics: or how I learned to stop worrying and love IT	Lou Amadio	Microsoft
14:30	ROS2 Roundtable - "Is ROS2 ready for the factory floor?"	Jerry Towler, Southwest Research Institute; Dave Coleman, PickNik; Matt Hansen, Intel; and Chris Lalancette, Open Robotics	
15:00	Break		
15:15	ROS and the Machinekit Hardware Abstraction Layer	Daniel Rogge	Tormach
15:45	OEM Partner Spotlight	Roger Christian & Andrew Lonsberry	Yaskawa & Path Robotics
16:15	Reducing Operator Burden for Robotics and Remote Systems in Hazardous Environments	Mitch Pryor	University of Texas, Austin, Nuclear Robotics Group
16:45	Wrap Up & Adjourn		

Talks April 12th

RIC-Americas – A Year of Learning and Growth

An overview of the last year related to the ROS-Industrial Consortium – Americas including a review of the roadmap, changes to the technical direction and recent developments and proposed strategies to manage the changing landscape of open-source robotics development. Matt Robinson will review developments that benefitted ROS-Industrial and the Americas Consortium, including overview of feedback and proposed strategic approaches to address the feedback. Levi Armstrong will share the latest technical developments including new optimized path planning, ROS2 migration challenges, and other technical updates of interest.

Matt Robinson & Levi Armstrong, **ROS-Industrial Consortium Americas**

Matt Robinson is the Program Manager for the ROS-Industrial Consortium Americas. In this role, Mr. 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.

Levi Armstrong is the Technical Lead for the ROS-Industrial Consortium Americas and the group leader of the Collaborative Systems Section at SwRI. Armstrong has developed technical knowledge in the areas of optimization-based motion planning, meshing, collision detection and calibration to develop custom automation solution for industry. Prior to his current role, Armstrong was an Engineer at Bell Helicopter focused on low-cost composite manufacturing leveraging automation in the areas of drilling, routing, deburring, machining, and heat treat to meet aerospace engineering specifications. He holds a B.S. and M.E. in Aerospace Engineering from the University of Texas at Arlington.

Platformed Verticals, Polarized Offerings: Rethinking Robotics and Automation in 2020

A new technological context, diversified points of sales, and sunsetting legacies. Intertwined factors which are both cause and effect of the shifts undergoing in robotics and automation, of which open-source platforms such as ROS-Industrial are a distinctive trait. How to surf this wave rather than being submerged by it? The talk will offer some thoughts both on technical aspects and on the general outlook for stakeholders in the field. It will draw inspiration from current trends in industrial automation, and make reference to undergoing initiatives, both public and private, which suggest what the future might hold.

Dr. Mirko Bordignon, **ROS-Industrial Consortium – European Union Program Manager, Fraunhofer IPA**

Dr. Mirko Bordignon leads the Software Engineering and System Integration Group within the Robotics Department of Fraunhofer IPA in Stuttgart, Germany. Since 2015 he also serves as the ROS-Industrial liaison for Europe, leading the growth of the ROS-I Consortium in the EU region. An academic turned software practitioner and then engineering manager, he believes that breaking vertically integrated solutions through platforms built on open hardware and software stacks will be key to unlock the full potential of robotics and automation. He hold degrees from the University of Padova, Italy, and the University of Southern Denmark, and held visiting positions at Orebro University, Sweden, and Harvard University, USA.

Concepts on Dynamic Grasping - ROS-Industrial Consortium Asia Pacific Update

ROS-Industrial in Asia Pacific awareness is key. The use of ROS in universities in the region is growing; however, many are unaware of ROS-Industrial capabilities or features that can be tapped, contributed and open-sourced by universities and industries in the region. The presentation will highlight our objectives and strategy towards understanding the region's needs in software development, hardware integration, ROS2 requirements and how we plan to advance ROS-Industrial software adoption in the Asia Pacific and ensuring community continued growth in terms of users and contributors for ROS-Industrial.

Erik Unemyr, Program Manager, ROS-Industrial Program Manager Asia-Pacific, Advanced Remanufacturing Technology Centre

Mr. Unemyr manages the ROS-Industrial Consortium Asia Pacific, where he aims to proliferate ROS adoption and advanced robotic applications to be successfully deployed in industry and commercial applications.

He received his Master of Science degree from Chalmers University of Technology, Sweden. Prior to ROS-Industrial, he spent majority of his career in industrial MNCs delivering software and hardware products all the way from concept to mass-production. Erik holds 7 patents within the fields of printing applications and image processing.

Robotic Assembly of Large Structures using Vision and Force Guidance

This talk will present the design and results of robotic assembly of a large segmented structure. The aim of the project is to demonstrate the potential of robotic technology to reduce cycle time, enhance assembly quality, and improve worker ergonomics, as compared to the current manual or fixture-based approaches. Our approach involves the ROS-based integration of an ABB IRB-6640 industrial robot, human operator input, stationary and robot mounted cameras, and force/torque sensor. The overall operation is coordinated through a user interface that allows the user step through the process and interrupt and continue at any point. A useful feature of this implementation is the use of the ABB dynamic simulator, RobotStudio, to test and tune the software architecture and control logic with simulated camera and force/torque sensors. The exact same code runs on the physical system simply by replacing the virtual sensors with real sensors.

John T. Wen; Professor and Head; Electrical, Computer, and Systems Engineering; Rensselaer Polytechnic Institute

Dr. Wen is the Head of Industrial and Systems Engineering and a Professor in the Department of Electrical, Computer, and Systems Engineering with a joint appointment in the Department of Mechanical, Aerospace, and Nuclear Engineering at Rensselaer Polytechnic Institute. Dr. Wen's research interest lies in the modeling and control of dynamical systems with applications to precision motion, robot manipulation, thermal management, lighting systems and materials processing.

Leveraging ROS for Industrial R&D Projects

This talk will discuss how ROS is used within Siemens in various projects. ROS is an important tool for advancing capabilities of autonomous machines. We will present the integration of ROS into our R&D workflow. Moreover, examples will be provided for interfacing ROS with other tools. Different projects will be shown, which use ROS functionality. Finally, we will conclude with an outlook and our opinion on how ROS could become even more relevant in the future.

Dr. Eugen Solowjow, **Research Scientist, Siemens**

Dr. Eugen Solowjow is a Research Scientist at Siemens' central research division, Corporate Technology, located in Berkeley, CA, USA. His research interests cover topics in the area of Machine Autonomy, e.g. robot learning, perception, controls, as well as Edge and Embedded AI. Eugen serves as PI and PM for Siemens internal and US Government funded research. Prior to joining Siemens, he received a Ph.D. from TU Hamburg, Germany and was a visiting scholar at U.C. Berkeley.

Keynote - ROS… Common platform to Competitive Edge

ROS has emerged as an exciting framework and set of tools to enable rapid innovation and capability development from an idea to a product in a way that enables businesses to disrupt. In this talk Chris Morgan will share his insights in how his organization has leveraged ROS to bring innovative ideas to market, both pleasing their clients, and differentiating themselves in the marketplace versus the competition.

Chris Morgan, **Chief Innovation Officer, Toyota Advanced Logistics; Managing Director, Bastian Laboratories**

He is a material handling system innovator providing automated solutions for distribution, manufacturing and order fulfillment centers around the world. Chris is best known for being a passionate leader, innovator, futurist, and a visionary. Chris spends most of his time developing new technologies and evangelizing robotics, augmented reality, AI, IOT and immersive technologies in the worldwide marketspace. Prior to working at Bastian Solutions, Chris spent 14 years at HP where he led the Reliability and Hardware Development Labs.

Standards and Open Source Software for Industrial Automation

Standards play an important role in expanding the deployment of new technologies for manufacturing, ensuring that a company's investments will persist over the long-term and helping to integrate different units of the organization. As de facto standards for robotics, ROS and ROS-Industrial have accelerated the pace of research and provided an avenue for commercialization.

At the National Institute of Standards and Technology, the speaker and his colleagues have used ROS and ROS-Industrial in their work to automate the programming of robots to handle changes in production requirements and uncertainty in their environment, accompanied by a series of prize competitions. NIST has also sponsored efforts to integrate ROS-I with another manufacturing standard, MTConnect. This talk will describe these efforts, their results, and what can be done to expand open-source software in the industrial market.

Fred Proctor, Group Leader: Networked Control Systems, National Institute of Standards and Technology (NIST)

Frederick M. Proctor is the Group Leader of the Networked Control Systems group at the U.S. National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, and manages the Robot Agility project of NIST's Engineering Laboratory. He received a B.S. in electrical engineering from the University of Maryland in 1986, and an M.S. in computer science from the Johns Hopkins University in 1993.

Operationalizing Robotics: or how I learned to stop worrying and love IT

Building a Robot is hard. Building and Managing a fleet is more difficult. Connecting them to the network and ultimately the cloud is downright scary.
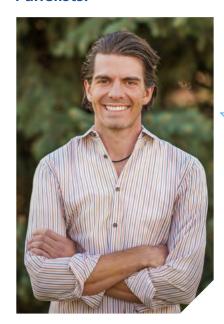
In this talk, we'll cover options for local and cloud based compilation, unit testing, and simulation; how to integrate your robots into IT infrastructure, manage OS, app, ML and driver updates; how to secure your robot – both compartmentalizing on robot, between robots, using Edge technologies – and connecting to the cloud using secure gateways, trusted execution environments, and secure enclaves.

Vincent Tam, Software Engineering Lead Core Operating System & Intelligent Edge, Microsoft

Vincent Tam is a software engineering lead in the Core Operating System & Intelligent Edge group within the Azure organization. His team is responsible for features for Windows IoT, including enabling ROS on Windows.

ROS2 Roundtable – Is ROS2 Ready for the Factory Floor?

Panelists:

Dr. Dave Coleman is CEO of PickNik Consulting, the company behind the ROS MoveIt! project. Dave has 13 years experience working in the field of robotics automation and is a leader in the open source ROS community. His insights into robot-agnostic platforms that work for different morphologies, different theoretical approaches, and different end-user technical requirements give him a well-rounded understanding of the needs of powerful robotic software. He has worked for all types of robotics companies including Google Robotics, Open Robotics, and Willow Garage.

Chris Lalancette is a software developer at Open Robotics with many years experience developing reliable, low-level software. He has worked in High Performance Computing, Linux kernel development, embedded systems development, and on several robotics platforms. He attended Lehigh University in Pennsylvania where he received his BS and MS in Computer Science. Chris Lalancette lives in Boston, Massachussetts.

Matt Hansen is a Sr. Robotics Software Architect at Intel Corporation. Matt has been at Intel for over 20 years, during which time he has done both hardware design and software development across multiple products and business groups. Matt has been developing in ROS since 2015 as part of the Open Source Technology Center at Intel. He is leading the Navigation2 project and is Intel's designated member of the ROS2 Technical Steering Committee (TSC).

Jerry Towler has been designing and building ROS-based automated ground vehicle systems for eight years at Southwest Research Institute. Systems he has helped design have operated on-road and off-road across many different vehicle platforms, environments, and use cases, from prototype to deployment. Mr. Towler helped start and remains the SwRI lead for ROS-Military, a ROS-based common software ecosystem for US military robotic and automated systems.

ROS and the Machinekit Hardware Abstraction Layer

ROS helps people creating complex and robust robot behavior across a wide variety of robotic platforms. Available interfaces between ROS and physical hardware are somewhat limited, especially if the hardware to be controlled has real-time constraints. The open-source MachineKit project's crown jewel is a hardware abstraction layer (HAL) that allows a number of building blocks to be loaded and interconnected to assemble a complex system. Many of these building blocks are drivers for hardware devices like stepping motors, PWM generators, encoders, PID loops, and more. As part of our development of a ROS-controlled industrial robot, Tormach has connected ROS's high level control capabilities with HAL's low-level hardware interfaces for both real-time and non-real-time signals/components.

Daniel Rogge, CEO, Tormach, Inc

Daniel Rogge, CEO Tormach Inc, has a diverse background that includes experience as a professional metal fabricator, educator, motion control engineer, and software developer. Mr. Rogge holds a BA from Grinnell College, and an MS in Industrial Engineering with a focus on manufacturing from the University of Iowa. He continues to focus professionally on what he spent his time doing as a teaching assistant at the University of Iowa: helping people make things.

OEM Partner Spotlight – Yaskawa and Path Robotics

From market study to operational startup, Path Robotics was created out of a need in the market and leveraged Yaskawa and ROS to turn an idea into a business. Path Robotics focuses on developing and implementing bleeding edge research in computer vision and machine learning, to give robotic systems the ability to handle flexible operations in the manufacturing industry, starting with welding.

Andrew Lonsberry, CEO, Path Robotics

Andrew Lonsberry is the Co-founder, CEO, and PhD candidate in the biologically inspired robotics laboratory at CWRU. I have experience in robotics, controls, and reinforcement learning. Following the completion of my undergraduate degree in mechanical engineering at Ohio State University I proceeded to CWRU for my graduate work. As a graduate student my work focused on dramatically improving deep reinforcement learning techniques, by focusing on what biological learning systems were doing to be able to generalize rapidly.

Reducing Operator Burden for Robotics and Remote Systems in Hazardous Environments

Teleoperated mobile robots equipped with object manipulation capabilities provide a safe option for executing dangerous tasks in hazardous environments without putting humans at direct risk. However, mainly due to communication delay, complex operator interfaces, and insufficient Situational Awareness (SA), the task productivity of telerobots remains inferior to human workers. The TeMoto interface developed at the University of Texas at Austin addresses these shortcomings through a (i) scalable and intuitive operator interface using gestural and verbal inputs, (ii) improved Situational Awareness (SA) through well-balanced sensor fusion according to documented best practices, and (iii) improved semiautonomous behaviors which reduce task completion times, human error, and the impact of communication delays.

Mobile systems using TeMoto have been deployed by in the nuclear and oil/gas industries for evaluation including both nuclear and Liquid Natural Gas (LNG) facilities to perform routine visual inspection as well as contact tasks including valve manipulation and interacting with high voltage switches. This presentation will summarize the TeMoto interface, its implementation, and feedback from on-site personnel who have used the system.

Dr. Mitch Pryor, Research Scientist, University of Texas
Nuclear Robotics Group

Dr. Pryor earned is BSME at Southern Methodist University in 1993. After graduating, he taught math and science courses at St. James School in St. James Maryland before returning to Texas. He completed is Masters (1999) and PhD (2002) at UT Austin with an emphasis on the modeling, simulation, and operation of redundant manipulators. Since earning his PhD, Dr. Pryor has taught graduate and undergraduate courses in the mechanical and electrical engineering departments as well as led and conducted research in the area of robotics and automation in Mechanical Engineering, Petroleum Engineering and the Nuclear Engineering Teaching Laboratory.

The Meeting Venue and Welcome Dinner

This year's meeting will be held at the **Hyatt Regency McCormick Place**, which is conveniently located adjacent to McCormick Place. Registration and light breakfast refreshments will start at 7:45 AM. A number of members are exhibiting at Automate 2019, so please consider visiting them should you travel in to visit the Automate 2019 exhibition ahead of the annual meeting. The full list of members exhibiting is listed below.

Hotel Address:

2233 S Martin Luther King Dr D, Chicago, IL 60616

The Welcome Dinner will be held at **The Oyster House**, located within walking distance of McCormick Place, will be at 7:00 PM the night of April 11th. This dinner is open to all attendees. Please RSVP via the registration link for the meeting for the dinner, or contact Matt Robinson (*matt.robinson@swri.org*), to ensure your spot. This is always a great chance to meet other ROS/ROS-Industrial and other manufacturing technology enthusiasts and thinkers ahead of the event.

Restaurant Address:

1933 S Indiana Ave, Chicago, IL 60616

ROS-Industrial Consortium Americas Annual Meeting 2019

Thank you to our Members

ROS-I is supported by an international Consortium of industry and research members. The ROS-Industrial Consortium-Americas Annual Meeting is supported by the Membership. Thank you to all of the members for their continued support of ROS-Industrial and the open source industrial robotics community!

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