Bringing ROS to the factory floor: the ROS-Industrial initiative

Why ROS-Industrial?
- Part of the ROS-Industrial initiative (ROS-I) to bring ROS to the factory floor
- Industrialization of ROS

How?
- Starting with the launch of ROSCon 2013 in Japan
- Community meetings and workshops

Ecosystem
- ROSCon 2015
- ROS-Industrial Consortium

Technical
- First ROS-I Demonstration
- Dual Arm Interfaces
- Calibration Tools
- Mobile Manipulator
- Path Planning
- IO Network Support

ROSCon 2015
Bringing ROS to the factory floor: the ROS-Industrial initiative

Ecosystem

Technical

2011
2012
2013
2014
2015
2016

ROSCon 2015
Why ROS-Industrial?

push industrial robotics from PREPROGRAMMED motions to PERCEPTION in the loop & DYNAMICALLY GENERATED trajectories

plus debugging/visualization/simulation tools, hw independence, ...
How?

starting from the intuition of a Research Engineer to two Consortia of over 30 members!
Bringing ROS to the factory floor: the ROS-Industrial initiative

Ecosystem

Technical

ROSCon 2015
19th Annual Robotics Industry Forum

ROS-Industrial - Accelerating Research to Applications
Shaun Edwards
Senior Research Engineer, Southwest Research Institute®
Bringing ROS to the factory floor: the ROS-Industrial initiative

**Why ROS-Industrial?**
- Why is ROS a good fit for industry?
- It's open-source, flexible, and easy to use.
- It supports a wide range of applications.

**How?**
- Starting from the initiative of a Research Engineer to a Consortium of over 30 members.

**Ecosystem**
- ROSCon 2015

**Technical**
- First ROS-I Demonstration
- Dual Arm Interfaces
- Calibration Toolbox
- Mobile Manipulator
- Path Planning
- IO Network Support

**ROSCon 2015**
- ROS and industrial automation
- ROS-Industrial initiative

**Growth**
- The number of ROS-Industrial members continues to grow.
- The focus is on integrating ROS into industrial applications.

**Focused Technical Projects**
- Developing ROS-integrated systems for industrial environments
- Enhancing collaboration between researchers and industry partners

**ROS-Industrial Launch**
- Launching the ROS-Industrial Consortium
- Supporting industrial development and innovation

**It's training time!**
- ROS training sessions for industrial professionals
- Workshops and seminars on ROS-Industrial applications

**Current FIP proposals & candidate topics**
- ROS in industrial processes & settings
- ROS for collaborative robots
- ROS in autonomous vehicles

**ROS in Industrial Products & Settings**
- ROS can be integrated into various industrial products and settings, including:
  - Autonomous vehicles
  - Collaborative robots
  - Industrial automation systems

**ROS-Industrial Consortium**
- A collaborative platform for industrial developers and researchers
- Fostering innovation and knowledge sharing in the ROS-Industrial domain

**Scan & Plan**
- Using ROS for 3D scanning and planning
- Developing advanced robotics solutions for industrial applications

**Robot Support**
- ROS-supported robots in industrial settings
- Enhancing robot control and communication with ROS

**ROS in Industrial Automation**
- Integrating ROS into industrial automation systems
- Enhancing efficiency and flexibility in industrial processes
RIC-Americas Launches

- 25 people from 14 organizations
- ROS-Industrial project backed by a Consortium complementing its Community w/ financial and managerial support
Focused Technical Projects

blending the community-driven, bottom-up approach with the industrial "contracted work", top-down one

reduce unnecessary parallels by sharing infrastructure once (which is _not_ your core)
Focused Technical Projects

blending the community-driven, bottom-up approach with the industrial "contracted work", top-down one

reduce unnecessary parallel work by sharing infrastructure costs (which is _not_ your core IP!)

<table>
<thead>
<tr>
<th>Path Planner Optimization and Planning Request Adptr.</th>
<th>Robotic Blending</th>
<th>CMM-Enabled Robotic Routing</th>
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<tbody>
<tr>
<td>Minimize cycle time for pick &amp; place applications.</td>
<td>Macro-scan simple work pieces and plan tool paths</td>
<td>Scan the perimeter of legacy tooling; auto-gen paths</td>
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<tr>
<td>Complete</td>
<td>Complete</td>
<td>April Install</td>
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</tbody>
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(examples of the first FTPs)
Bringing ROS to the factory floor: the ROS-Industrial initiative

Why ROS-Industrial?

- Why ROS-Industrial? from the Pre-Programmes to the European Commission on ROS-Industrial to break the dependency of Graham and independent.

How?

- Starting from the initiative of a Research Engineer to two Consortia of over 30 members.

Ecosystem

- Pre-Programmes on ROS-Industrial
- ROS-Industrial Launch
- ROS-I Europe Launches
- Community Meetings etc.

Technical

- First ROS-I Demonstration
- Robotic Arm Interfaces
- Calibration Toolbox
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- IO Network Support

ROSCon 2015
RIC-Europe Launches

- ROS-I Conference, Fraunhofer IPA, June 26, 2014
- RIC-EU Kickoff, June 27, 2014
- ROS trainings at IPA, October 2014, March 2015
- ICRA / ROSCon in Karlsruhe / Stuttgart, Germany, May 2013
- Roadmapping Workshop at European Robotics Forum, Lyon, March 20, 2013
it's training time!

- training sessions held regularly at SwRI (USA) and IPA (Germany)
- other outreach events, like the ROS-Industrial Conference at IPA
- part of the Consortia's mission
Bringing ROS to the factory floor: the ROS-Industrial initiative

Ecosystem

2011
- First ROS-I Demonstration

2012
- Focused Technical Projects
- Robot Support

2013
- ROS-Africa Launches
- ROS-Europe Launches
- Community Meetings L.A.

2014
- ROS in Industrial products & settings

2015
- Current FTP proposals & candidate topics
- ROS Con 2015

2016
- Scan & Plan
- IO Network Support

Technical

ROSCon 2015

Why ROS-Industrial?
- Why industrial robotics needs a ROS
- ROS-Industrial turns ROS into an industrial-grade platform

How?
- Starting with the initiative of a Research Engineer
- Growing to a Consortium of over 30 members

 ROS industrial consortium

ROS is alive and well!
ROS in industrial products & settings

Robox uRmc2: motion controller running cROS

https://github.com/it-robotics/cros

cROS used as the middleware to "glue" the modules of a leather processing plant in Italy

IT+Robotics

ROS on AGVs operating at a major car manufacturing plant in Germany

Fraunhofer IPA

Plus Intermodalics, magazino and many more!
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Community Meetings x4

(Example topics)

Join us today during the Birds of a Feather session!
Bringing ROS to the factory floor: the ROS-Industrial initiative

Why ROS-Industrial?
- Reduced installation time
- Easier to install and maintain
- Distributed architecture
- Code reuse
- Supports ROS

How?
- Starting from the initiative of a Research Engineer
- 2 Consortia of 30 members

Ecosystem

Technical

ROSCon 2015
current FTP proposals & candidate topics

CAD to ROS Workbench

- URDF GUI editor with CAD import plugins (milestone 1)
- process planning, work cell planning, sensor configuration and calibration, 3D point cloud importer (future milestones)
- source access only for RIC members during the first two years UNLESS a threshold is met through crowdfunding, in which case the source is made public earlier
- FTP proposal at rosindustrial.org, RIC member committed to fund 1st milestone

cROS on PLCs

- including PLCs in the ROS ecosystem through cROS
- IT+Robotics just started a proof-of-concept port in collaboration with major PLC manufacturer

ROS w/ OPC-UA

- Industrie 4.0 communication standard
- pilot project: ROS 2.0 with OPC-UA
current FTP proposals & candidate topics

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Growth

31 members in the two consortia as of Sept 30, 2015
rosindustrial.org
First ROS-I Demonstration

- PR2 pick & place performed with industrial hardware
- Cooperative effort between SwRI, Yaskawa Motoman, & Willow Garage
- Demonstrated software portability
Bringing ROS to the factory floor: the ROS-Industrial initiative

Ecosystem

Technical

ROSCon 2015
Robot Support

- ABB, Adept, Fanuc, Motoman, Universal
- Maintained by SwRI, TU Delft, & Fraunhofer IPA
- Future additions
  - Kuka, Epson, Staubli, Ragnar(BlueWorkforce)
Dual Arm Interfaces

- Dual arm Motoman SDA10F (Fraunhofer IPA & Motoman)
- Dual arm UR - Hilgendorf (SwRI & NIST)
Bringing ROS to the factory floor: the ROS-Industrial initiative

**Why ROS-Industrial?**
- Low-cost and flexible tools for industrial automation
- Open-source software with a large community
- Compatibility with various hardware and software platforms
- Support for real-time control and safety-critical applications

**How?**
- Starting from the initiative of a Research Engineer
- Growing to a Consortium of over 30 members

**Ecosystem**

**Technical**

**ROSCon 2015**
Calibration Toolbox

- General purpose calibration library (SwRI & NIST)
- Addresses
  - Robot to camera (fixed)
  - Robot to camera (arm mounted)
  - Camera to camera (many)
- Latest additions
  - Streamlined intrinsic/extrinsic calibration
  - Templates for common use cases
Bringing ROS to the factory floor: the ROS-Industrial initiative

Ecosystem

Technical

ROSCon 2015
Path Planning

- Develop path planners for industrial application
  - Repeatable
  - Scalable
  - Common sense plans
- Descartes semi-constrained cartesian path planner
- Resurrected STOMP planner
Semi-Constrained (5DOF) Trajectory Planning
Bringing ROS to the factory floor: the ROS-Industrial initiative

Ecosystem

Technical

ROSCon 2015
Mobile Manipulator

- Developed mobile manipulation platform for order fulfillment
- Standardized platform (Euler)
Bringing ROS to the factory floor: the ROS-Industrial initiative

Why ROS-Industrial?

- re-use of modules from PRECAROM initive to
  make ROS the new OSGi for automation
- focus on debug/visualization/in-plant tools, fast
  integration

How?

- start with the initiative of a Research Engineer
  to two Consortia of over 30 members

2011

First ROS-1 Demonstration

- Dual Arm Interfaces
  - Dual arm M600
  - MX600 (Fanuc 600iB, Hitachi R-2000iA, Hyundai H7, Yaskawa)

2012

ROS-1 American Launches

- Dual arm Motoman
  - KUKA
  - Fanuc 600iB

2013

Focused Technical Projects

- Mobile Manipulation
  - Mobile arm

2014

ROS-1 Europe Launches

- Mobile Manipulation
  - Mobile arm

It's training time!

- ROS-Industrial Workshops

2015

Current FTP proposals & candidate topics

- C4O to ROS Workbench
  - ROS on PLCs

2016

Scan & Plan

- Use 3D sensors to scan objects and
  intelligent planner to perform collision
  detection of objects

IO Network Support

- With support from the LCC/CMC services,
  C4O/ROS
- Support to standardize SOF, data, and
  communication methods

Path Planning

- Develop path planner for
  industrial applications

ROSCon 2015

ROS is the best basis for

IO Network Support

- ROS support for CANOpen devices (Fruanhofer IPA)
  - Support for device profile for drives and motion control
  - Integrated in the ros-control framework
    - joint_state_controller
    - joint_trajectory_controller
    - position_controllers
    - velocity_controllers
- ROS ProfiNet coming soon
Bringing ROS to the factory floor: the ROS-Industrial initiative

Why ROS-Industrial?
- Reduces duplication from different origins
- Portability from ROS-Industrial to ROS
- Faster development, better debugging, similarity in test results, but independence

How?
- Starting from the initiative of a Research Engineer to two Consortia of over 30 members

Ecosystem

Technical

ROSCon 2015
Scan & Plan

- Use 3D sensors to scan objects and intelligent planner to perform operations
- Utilizes multiple core technologies
Bringing ROS to the factory floor: the ROS-Industrial initiative

Ecosystem

Technical

ROSCon 2015
ROS-I: We've been busy!