TECHNICAL MEETING / Robotics Information Day

ROS-Industrial™
A Disruptive Community Approach to Industrial Robotics Software
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Biography

• Paul Evans
• Director of Research and Development for the Manufacturing Systems Department at SwRI
• Focused on solving real-world challenges through applied research and development
• Specialized in advanced industrial robotics and automation programs
• Graduated with a MSME from Iowa State University and a Professional Engineer

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Agenda

• Overview of ROS
• Overview of ROS-Industrial
• Applications for ROS-Industrial
• ROS-Industrial Community Approach
ROS Overview
Research Robotics Challenges

• Reinvention of the Wheel
• Little Commonality
• Short Lifespan
• Difficult to Compare Results

ROS Solves These
ROS: Robot Operating System

- Open source (BSD)
- Created by Willow Garage
- Maintained by Open Source Robotics Foundation (OSRF)

http://ros.org/wiki/Industrial
Statistics

- ROS Core statistics by: https://www.ohloh.net/p/ROSorg
- 11,146 commits
- 43 contributors
- 148,163 lines of code
- Long source history maintained by a large development team with stable year-over-year commits
- 38 years of effort (COCOMO model)
- Estimated cost $2,063,327
What Can ROS Do?

ROS 5 Year Video: http://youtu.be/zV48Pq0muEk
ROS-Industrial
ROS-Industrial Motivation

• Motivated by desire to solve industries toughest challenges using industrial robotics and automation

• Driven by application needs (i.e. real-world and challenging industrial needs)
  – Fixtureless automation
  – Dynamic pick and place
  – Flexible automation (many small & diverse part runs)
  – Sensor driven automation

• Reduction in integration cost by standardizing interfaces and enabling reuse
What is ROS-Industrial

- Open-Source (BSD) software distribution – extension of ROS
- Advanced development tools
- New and additional capabilities
- Software portability and flexibility for COTS hardware
- Technology compatibility and ease of integration
- Transition of basic research to applications
- A community of developers
Hardware Drivers Examples

• Robots
  – Motoman
  – Adept
  – Universal
  – ABB
  – Fanuc, Kuka (Coming soon)

• Peripherals
  – Robotiq
  – EtherCAT (Beckhoff Modules)
  – Serial
  – Ethernet
App: Automated Painting

- Automated spray paint processes
  - Reduce emissions (regulation)
  - Reduce exposure (personnel)
  - Reduce cost (materials)
  - Increase quality (consistency)

- Challenges
  - Unconstrained location
  - “Random” part order
  - Real time processing
  - Moving parts
Solution: Automated Painting

- 3D Sensing (ROS/OpenNI)
- 3D Processing (ROS/PCL)
- Process based path planning (SwRI)
- Robot IK solvers (ROS/MoveIt!)
- Robot workcell visualization (ROS/Rviz)
- Distributed system (ROS/Core)
- Data acquisition/playback (ROS/bag)
• Random product sorting application
  – Value in waste streams
  – Labor intensive, worker fatigue
  – Increased sorting rate/quality

• Challenges
  – Waste stream variety
  – High speed
  – Close quarters

Solution: Robotic Sorting

- 3D sensing (ROS/OpenCV, PCL)
- 3D processing (ROS/PCL)
- Pick selection (SwRI)
- Robot IK solvers (ROS/MoveIt!)
- Collision checkers (ROS/MoveIt!)
- Robot workcell visualization (ROS/Rviz)
More Capabilities
Leveraging ROS

Pick & Place Demonstration: http://youtu.be/_WG-45cZSUQ
Visualization and Path Planning: http://youtu.be/qd76wAywZos
Platform Independence

Future of ROS-Industrial

- Installed systems
- Process based path planners
- More hardware support
- Physics based simulation
- Incorporate external libraries
- Code analysis and statistics
- More tutorials and documentation
- Certified releases
ROS-Industrial Community Approach
Community

- Openness encourages participation and collaboration
- Many small, yet organized efforts result in more capable software
- Non-traditional approach for the industrial space
Partial View of the Community
Ways to Participate

• Independently Contribute/Participate:
  – Define interface standards
  – Develop software
  – Documentation

• OEMs – develop interfaces to your equipment

• Integrators - Use it for projects and customers

• Join the ROS-Industrial Consortium

• There are a number of other ways as well...
• Accelerate Code Development
  – Advanced Capabilities
  – Code Quality Standards/Enforcement
  – Testing, Reliability, Robustness
  – Training
  – Maintenance
• Build Community
  – Attract User-Generated Content
  – Maintain Open-Source Repository, Wiki, Roadmap
  – Ensure Code Reusability
How Will it Work?

• Membership fees first cover operational expenses
• Funds, over and above the operating expenses, will be appropriated toward research objectives.
• Focused technical projects will be formed and funded by full members
• Open source software:
  — All software developed under general funds
  — Project software at the discretion of the funding group
Conclusions

• ROS has proven to be disruptive to robotics research
• ROS architecture, capabilities, tools, and open source approach rival commercial options
• ROS-Industrial brings the power of ROS to the industrial robotics and automation market
• Support for ROS-Industrial is growing
• The ROS-Industrial Consortium will foster the continued development and maintain focus on industry needs
Questions?

Main site:  rosindustrial.org
Software site:  code.google.com/p/swri-ros-pkg/
Docs site:  ros.org/wiki/Industrial
Consortium site:  ric.swri.org