



OBJECT MANAGEMENT GROUP

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
- paul.evans@swri.org





Agenda



- Overview of ROS
- Overview of ROS-Industrial
- Applications for ROS-Industrial
- ROS-Industrial Community Approach





ROS Overview





ROS Motivation



Research Robotics Challenges

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

ROS

ROS Solves These

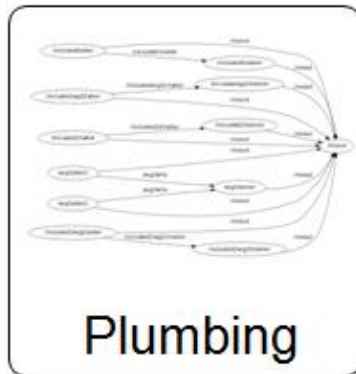




ROS: Robot Operating System



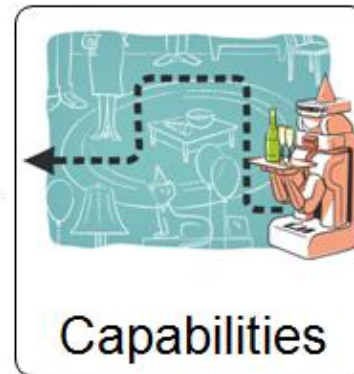
- Open source (BSD)
- Created by Willow Garage
- Maintained by Open Source Robotics Foundation (OSRF)



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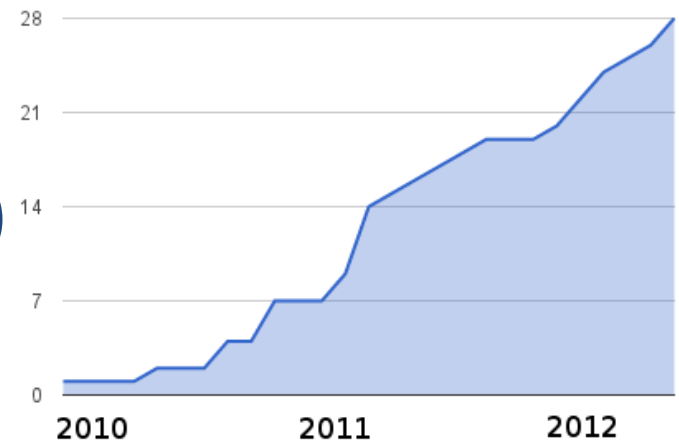
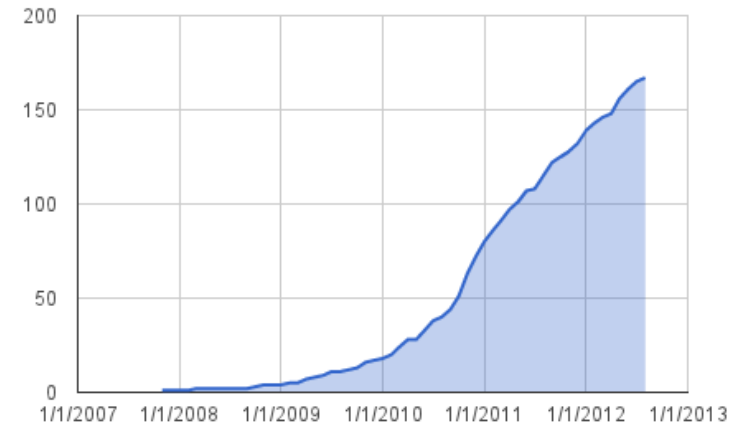




Statistics



- 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

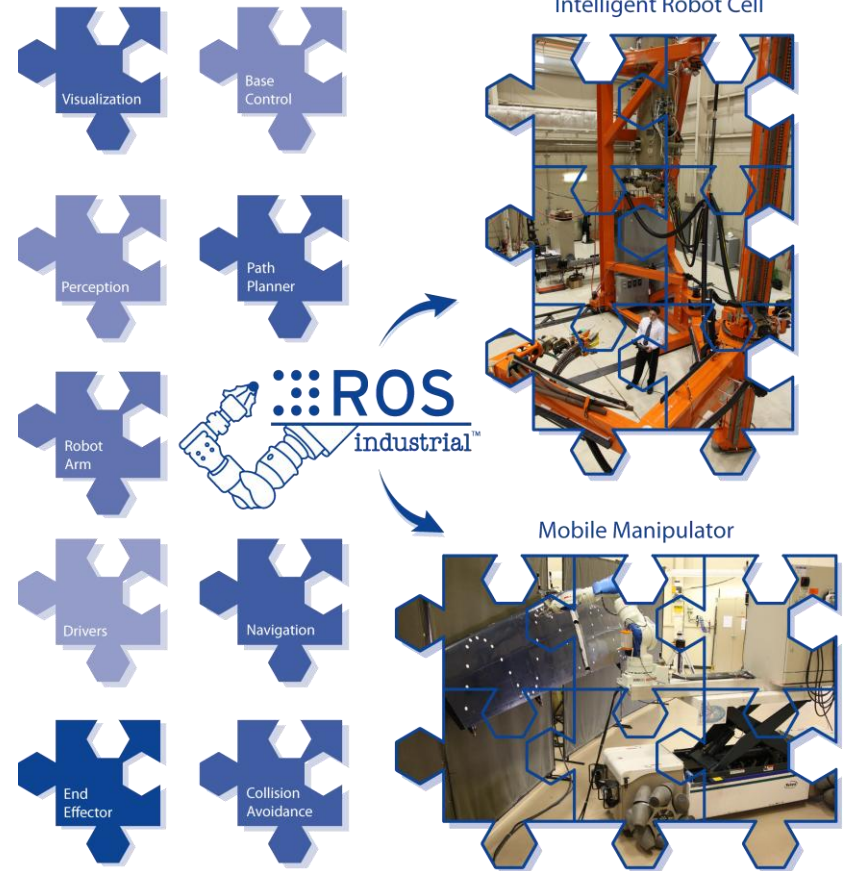




What is ROS-Industrial



- 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

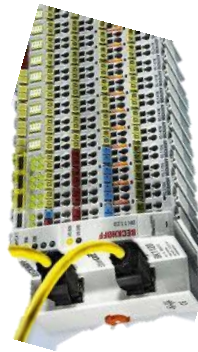




Hardware Drivers Examples



- 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

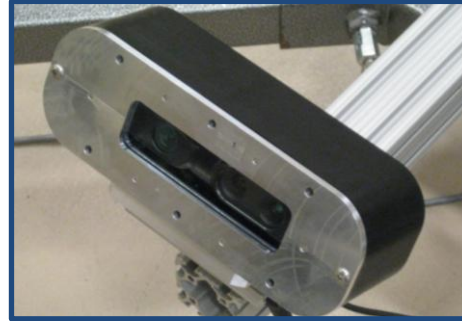




Solution: Automated Painting



- 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)





App: Robotic Sorting



- Random product sorting application
 - Value in waste streams
 - Labor intensive, worker fatigue
 - Increased sorting rate/quality
- Challenges
 - Waste stream variety
 - High speed
 - Close quarters



<http://www.smh.com.au/news/national/drastic-plastic-bag-ban-looms/2007/03/10/1173478729172.html>

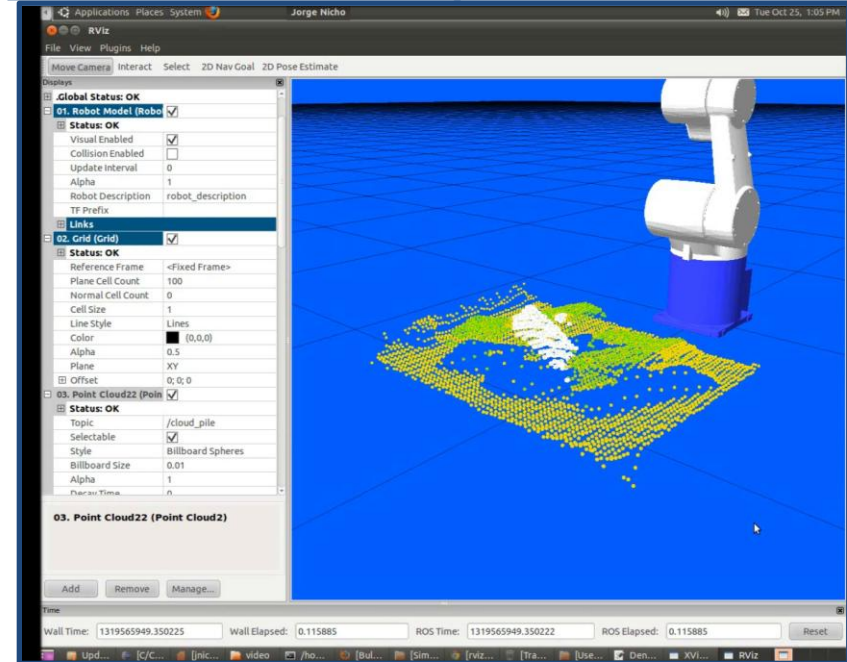
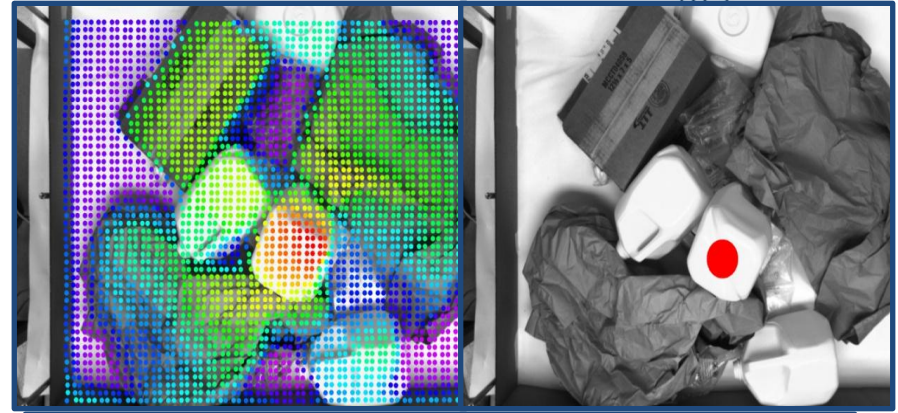




Solution: Robotic Sorting



- 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



Visualization and Path Planning: <http://youtu.be/qd76wAywZos>





Platform Independence



Adept Robot Demonstration: <http://youtu.be/awdTgpyOmxE>





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



Open Source Robotics Foundation



CZECH TECHNICAL UNIVERSITY IN PRAGUE



industrial perception, inc.





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...





ROS-Industrial Consortium



- 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

