ROS-Industrial

From Open-Source Repositories to Applications on the Floor

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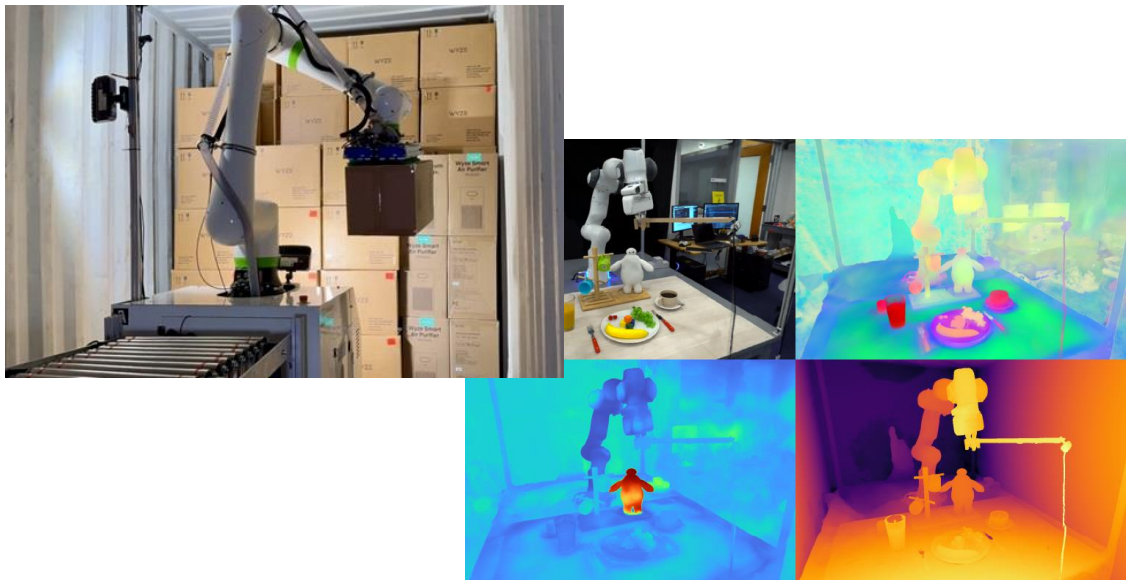
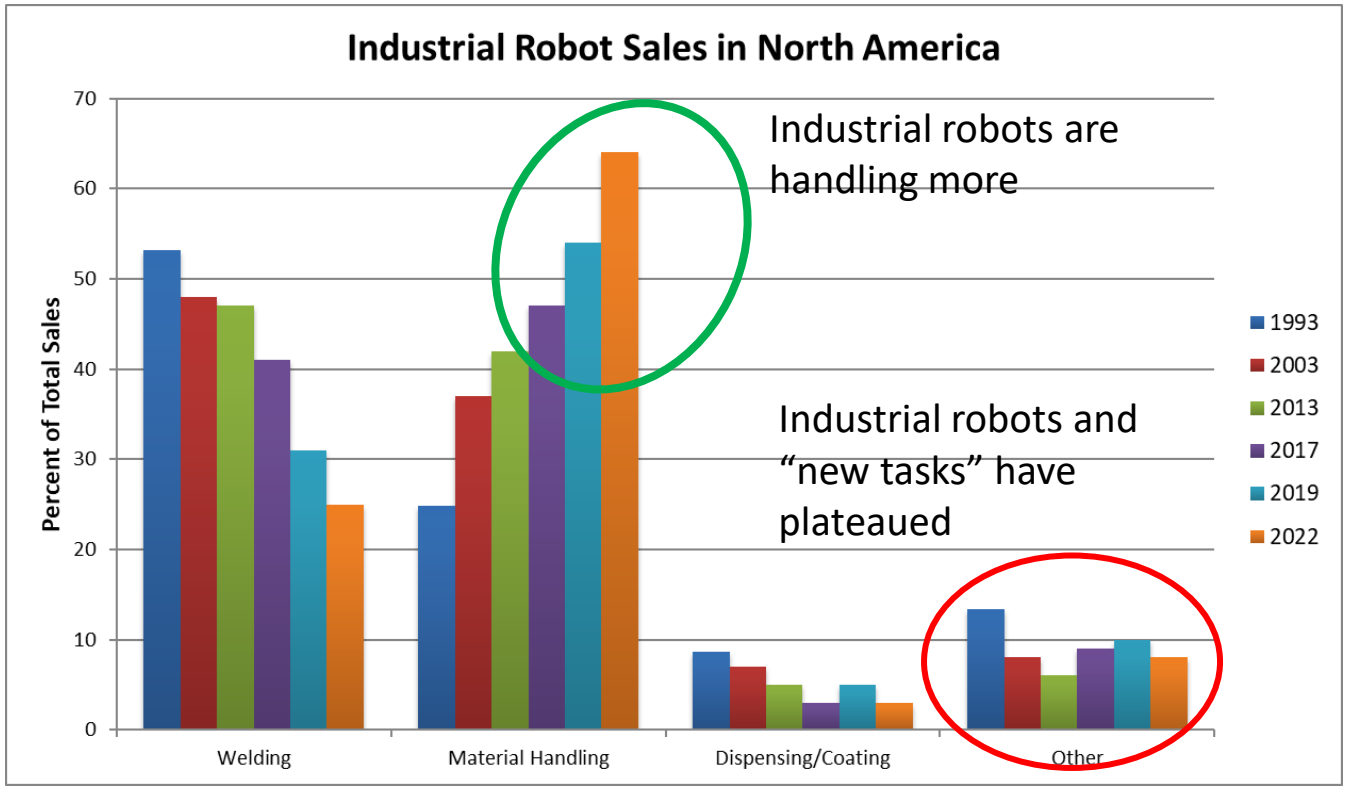
State of Industrial Robotics

- Strong investment in industrial robotics
- Through 2022 driven by material handling
- Focus on Agility
- Advances in machine vision leveraging AI





Courtesy of: A3-robotics-statistics

More than 10 years in robotics innovation

ROS – Robot Operating System

- Open Source
- Established to prevent re-inventing the wheel
- Maintained by Open Source Robotics Foundation
- Reusable Software Components
- >1,000,000 user downloads/mo

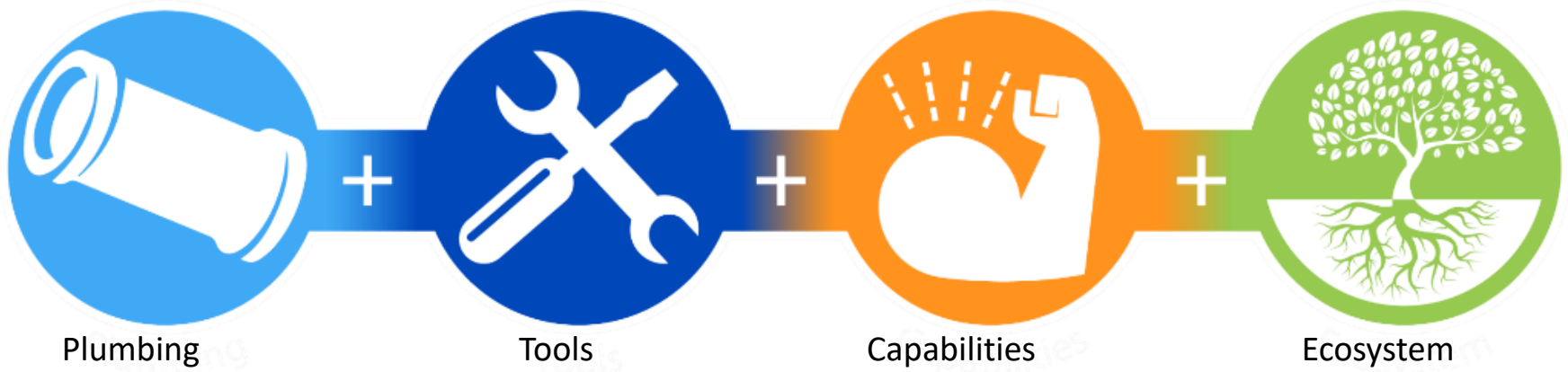
ROS

is...

A **Middleware** Framework

An International **Open-source** Project

A Library of **Free Software and Tools** for Robotic Development



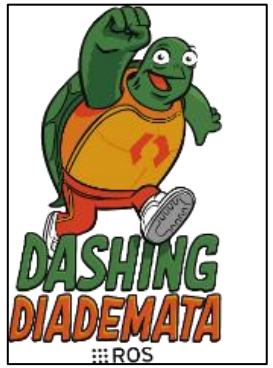
ROS Releases and Journey to Industry

2008
- PR2 and ROS start at a research platform for universities and research institutes

Jan 2010
- ROS 1.0 is released with tutorials
- 12 releases between 2010-2018

Dec 2017
- First Beta release of ROS 2.0 for general use

Dec 2018
- Actions support
- Navigation package



May 2019
- Multi-axis robot motion planning

Jun 2022
- Latest LTS release

Jazzy Jalisco (LTS) 5/2024

10 Year Development Cycle

ROS 2.0 Industrial Use

Start using for next generation platform development

What is ROS-I?

- Foundational libraries to enable interfacing with industrial hardware
- Utilities for calibration in industrial settings
- Development Interfaces and Application Toolsets
- Bridges and interoperability bridges

Roles SwRI plays…

- Independent steward of open source tool development for industry
- Assist entities in leveraging open source, where appropriate to develop and implement IP more efficiently
- Deliver first of a kind solutions into new operational environments
- Assist in tech transition
- Teach clients to be self sufficient to enable growth of developed solutions
- Develop in a way to ensure leverage/scalability

Challenges


high barrier to entry
industry adoption
lots of pieces
proprietary software
various capabilities
Qt
Developer Tools
ROS Qt Creator Plug-in
CAD to ROS
Applications
Mobile Manipulator
Sorting
Scan-N-Plan
Hardware Interfaces
Yaskawa
Universal Robots
ABB
Fanu
Staubli
various capabilities
Industrial 3D Sensors
Intel® RealSense™
IFM
Pepperl & Fuchs
IDS® Ensenso
Photoneo
Sick
ROS industrial
Bridges
CANopen®
EtherCAT®
Ethernet/IP™
PROFINET®
many flavors
sometimes proprietary
Human Interfaces
ROS/2
Calibration
complicated setup
reliability
trust with open-source
longevity

Solutions


OEM outreach
community building
documentation
training
examples
multiple languages
cross-platform
code quality
define common behavior
Qt
Developer Tools
ROS Qt Creator Plug-in
CAD to ROS
Applications
Mobile Manipulator
Sorting
Scan-N-Plan
Hardware Interfaces
Yaskawa
Universal Robots
ABB
Fanu
Staubli
define common behavior
Industrial 3D Sensors
Intel® RealSense™
IFM
Pepperl & Fuchs
IDS® Ensenso
Photoneo
Sick
ROS industrial
Bridges
CANopen®
EtherCAT®
EtherNet/IP™
PROFINET®
translation to ROS
Human Interfaces
ROS/2
Calibration
improve capabilities
global community
focus on performance
continuous improvement

Tech Vision Supported by Industry

- **ROS-Industrial Consortium** acts as an ecosystem where different players – end-users, equipment providers, system integrators, institutes of research and training partners **come together to advance and proliferate Open Source robotics**

Strategy for Development

MoveIt

TESSERACT

DART
Dynamic Animation and Robotics Toolkit

DRAKE
Model-Based Design and Verification for Robotics

Environment Layer (MoveIt, Tesseract, Dart, etc.)

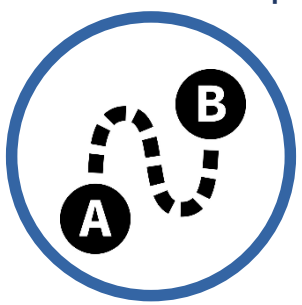
Messages, Topics

ROS 1 / ROS 2 / Middleware Layer

Build ROS1 or ROS2, these are independent

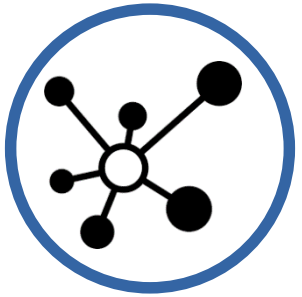
Independent of ROS

Collision Detection



Motion Planners

Kinematic Solvers



Connectivity Structure

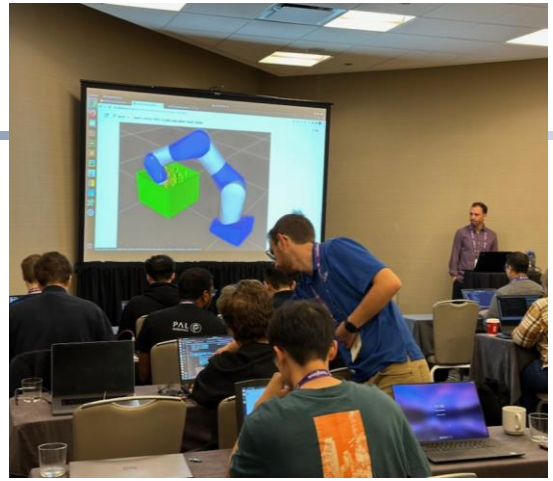
Continue to support deployed end-user ROS1 systems with new capabilities as they are developed even if for a ROS 2 solution

Network and Foster Collaboration

- In person conferences, training events, meetups
- Write ups and additional broader reach collaborative initiatives beyond the ROS community
  - American Welding Society
  - Founders' Society of Americas
  - Coaters' Association
  - Remanufacturing Industries Council
  - Manufacturing Innovation Institutes

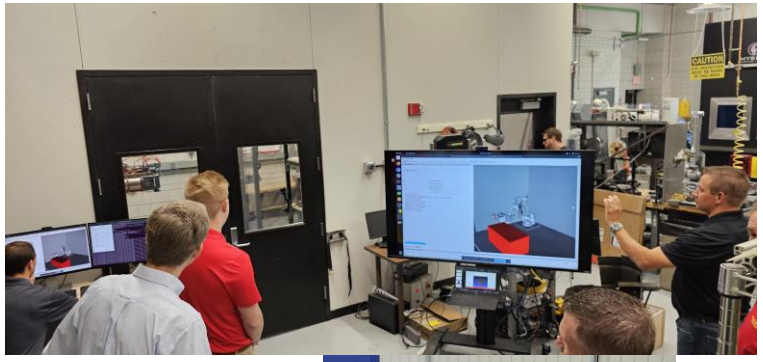
Training & Educational Resources

- Workshops
- Training
  - ROS-I Training Events
    - Member hosted
    - Rotating special topics
    - Labs
  - Reference Resources
  - Example Applications



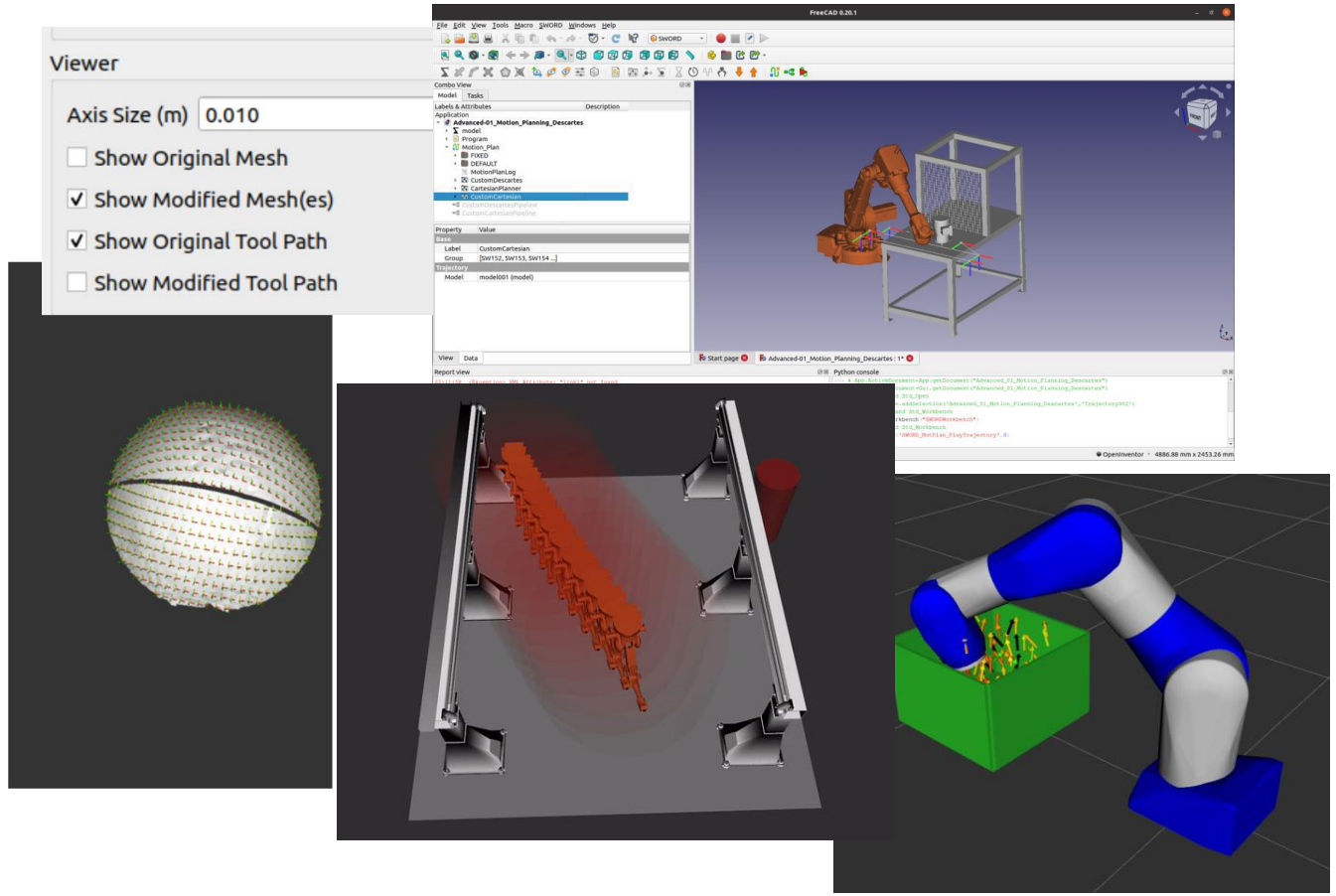
Collaborative Projects

- Focused Technical Projects – Members joint a team to work on a core technical challenge manifesting in an application example
  - Robotic Blending – now on Milestone 5 championed by the Steel Founders' Society of America
  - Delivering capability with contributions from a partner University into a working foundry
  - Delivering capability back to the Scan-N-Plan workshop
    - https://github.com/ros-industrial-consortium/scan_n_plan_workshop
  - Enable students to get exposed to delivering software contributions in a way that is leverageable
  - Benefit to the entire ROS-I Community

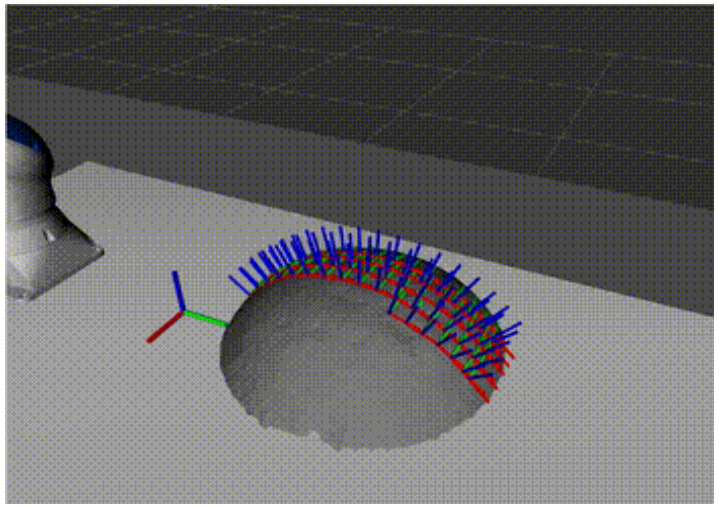


Tools built on member voice

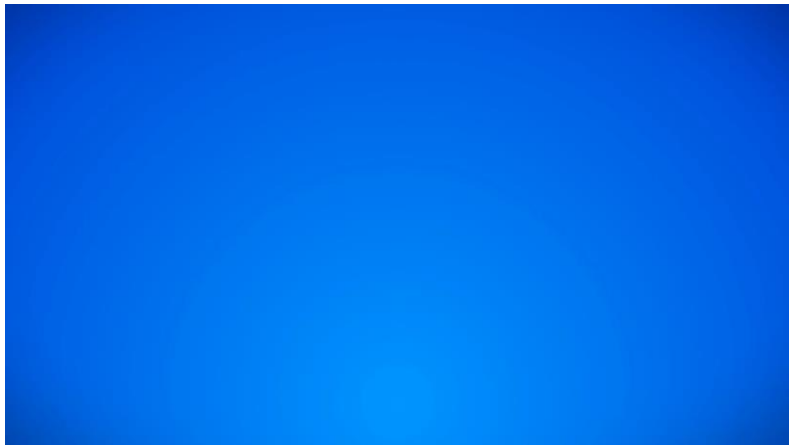
- SWORD
- REACH
- Coordinated Motion
- Optimization-based motion planning
- Improvements to tool path planning



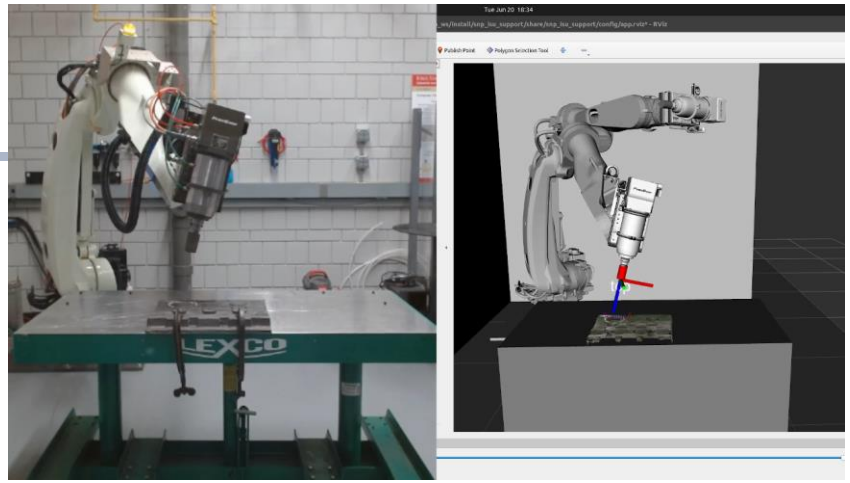
ROS-I Capabilities & Modules



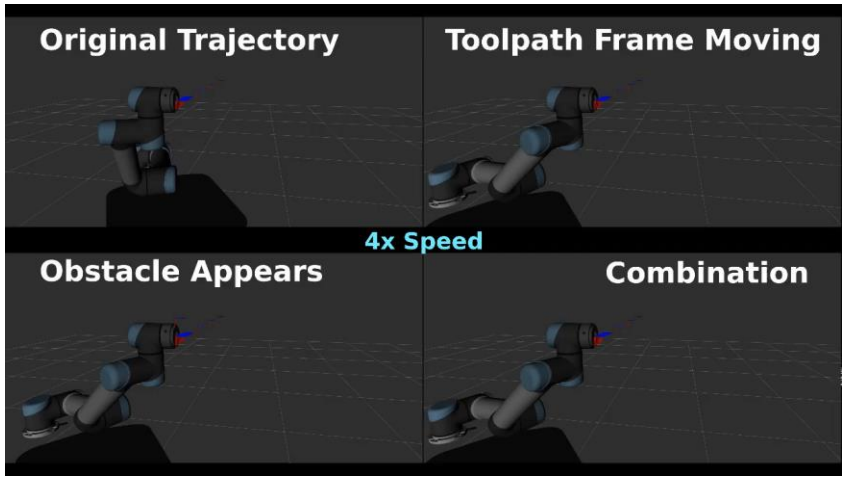
Cartesian Tolerance Waypoints



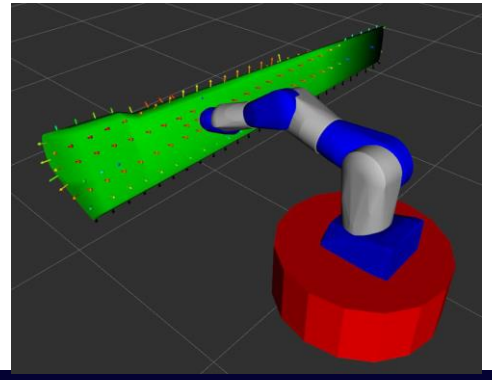
https://youtu.be/-6yAk05et1Q



Robotic Blending Milestone 5



Coordinated Motion



REACH

Resources for the Community

- ROS-Industrial
  - Home: rosindustrial.org
  - Documentation: wiki.ros.org/industrial
  - Code: https://github.com/ros-industrial; https://github.com/ros-industrial-consortium
  - Training: http://ros-industrial.github.io/industrial_training/
  - Training Docs: https://industrial-training-dev.readthedocs.io/en/latest/
  - Tesseract: https://github.com/tesseract-robotics
  - Upcoming Events (https://rosindustrial.org/events-summary/)