

ROS-Industrial Consortium & Community 2022 End of Year

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ROS-Industrial Consortium Program Manager

December 13, 2022

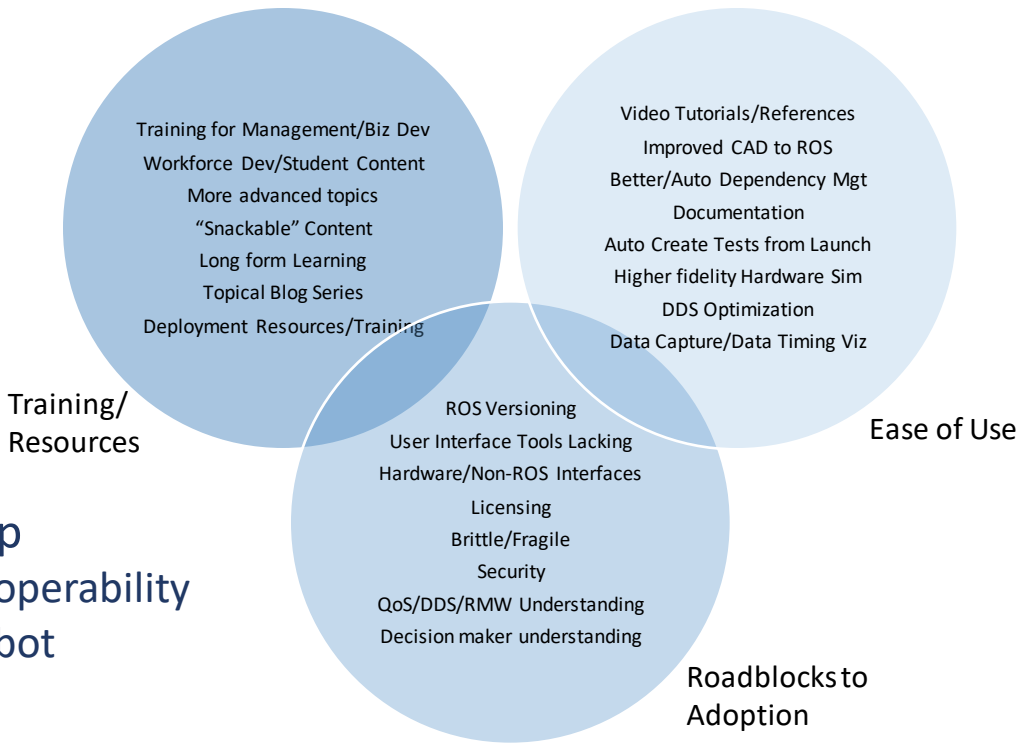
End of Year 2022

Agenda

- 10:00 – Welcome
- 10:05 – ROS-Industrial Consortium Activities
 - Member Feedback & Actions
 - Training Update
 - Workshop Planning
 - ROS Workbench (SWORD)
 - COMOT
 - FTP – Collaboration Project Updates
- 10:30 – Tesseract Review and Update
- 10:55 – AWS the latest
- 11:20 – Open Forum

Shaping a Roadmap - Feedback

- Workshops over last handful of years providing feedback
- Long list of challenges
 - Developers
 - Decision Makers
 - Mfg Engineers
 - Tech Stewards
- Feedback on various areas
- Affinitize and update roadmap
 - Capture ROS 2/Version/Interoperability
 - Reference back to roles in robot ecosystem

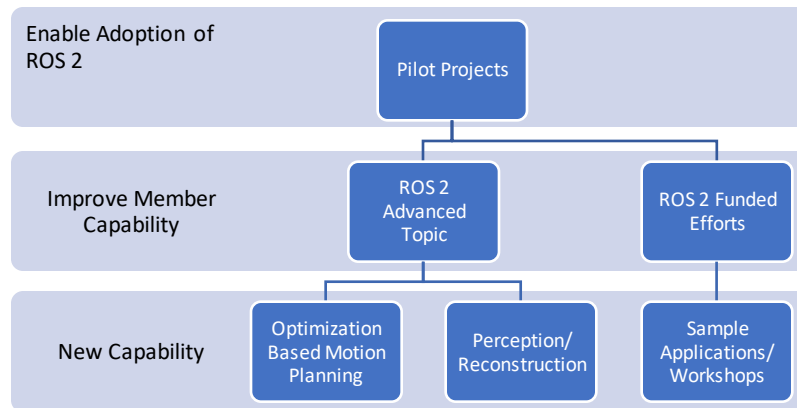


Actions

- Series of short videos on feedback topics
 - Setting up the ROS bridge
 - ROS 2
 - Environment
- Workshop
 - Setting up and configuration of a Scan-N-Plan System
 - ROSCon Workshop – topic pending
- Write Ups/References
 - Series of documents to assist in management understanding of ROS, why it is used, value cases, and more
- Documentation

Technical Themes

- Simplified snap shot of the core themes that ROS-I pursues
- Overtime and with the rise of ROS 2 a formal roadmap was set aside as best practices developed
- Currently working to accelerate resources in the 4 themes while responding to member/user feedback



Strategy for Development



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

Messages,
Topics

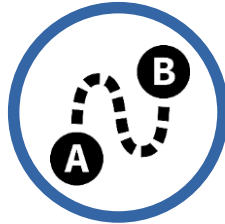
ROS 1 / ROS 2 / Middleware Layer



Independent of ROS



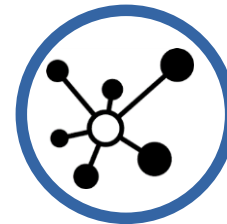
Collision
Detection



Motion
Planners



Kinematic
Solvers

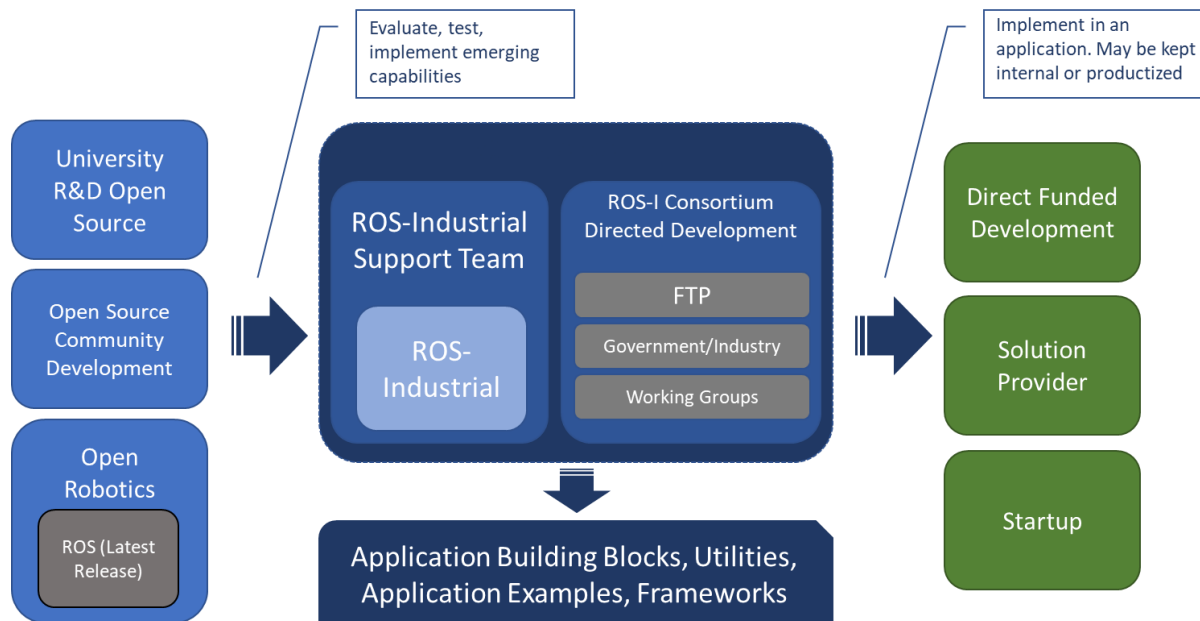


Connectivity
Structure

Build ROS1
or ROS2,
these are
independent

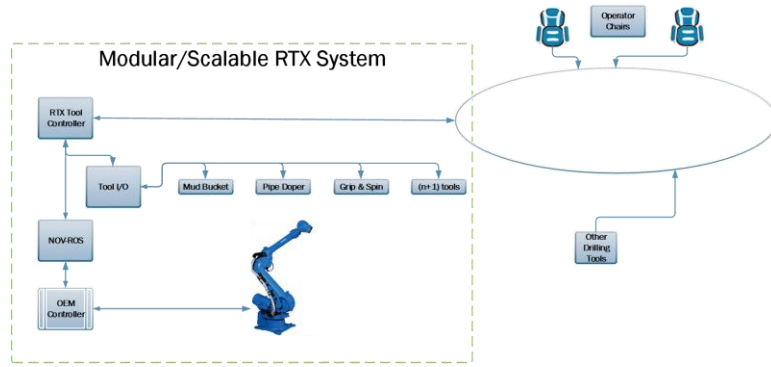
Continue to support deployed end-user ROS1 systems with new capabilities as they are developed even if for a ROS2 solution

How to get capability on the floor



- Continued opportunity to leverage MII network for tech transition
- Many examples of Government/Industry partnerships that refine capabilities
- Startups can leverage for de-risking/scaling

Delivering new products



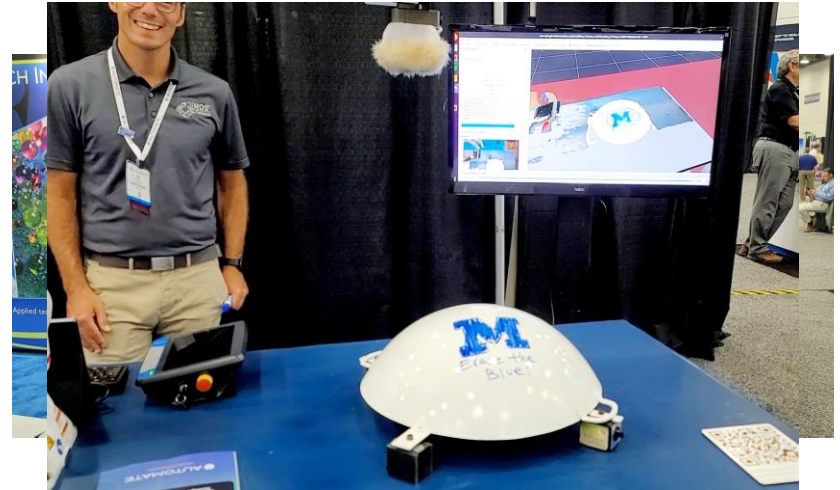
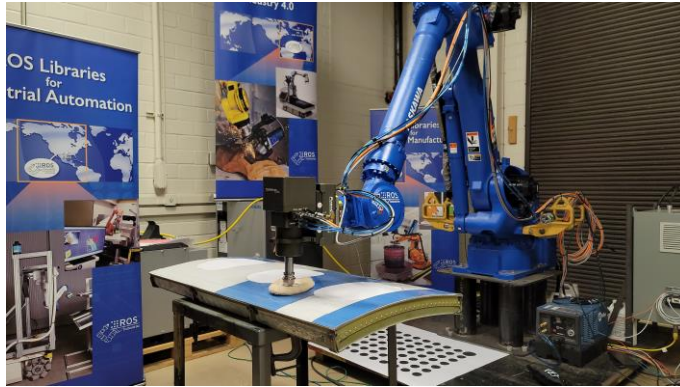
NOV RTX Productized

- modular and scalable system that can be put on any rig network
- Framework for all path planning and collision avoidance is NOV-ROS
- Prototype integration of scene awareness and people detection into RTX system
- Productization of all end effectors nearly complete
- Roadmap for other functions/end effectors ongoing

NOV Keynote from RICA 2022 Annual Meeting:

<https://youtu.be/WQZInv5BR48?list=PLXUpEXjGC63weFXogyQrAOS45a62nVM8L>

Teaching Application



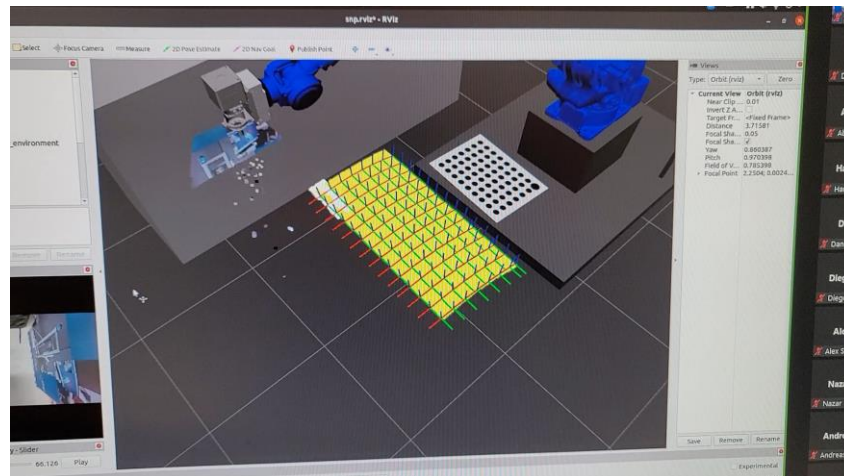
https://github.com/ros-industrial-consortium/scan_n_plan_workshop
Developers' Meeting Overview: <https://youtu.be/GgTxvlaekjE>

Training for 2023

- Planning three training events
 - [Feb 2023](#) – registration opening soon!, San Antonio
 - Advanced Topic: Motion Planning Pipeline
 - July 2023 – Seeking a member host site
 - If interested in hosting a training, contact Matt Robinson, RIC Americas PM
 - October 2023 – San Antonio, TX
 - Advanced Topic: TBD – please submit suggestions
- Will offer a single virtual only training – timing TBD.
 - Feedback was hybrid was not working for the students online
 - Will bring more lab exercises to Day 3 in ROS 2
- Bite Size Learning – recorded educational on a smaller topic – targeting 3-6 minutes in length – stay tuned
 - Submit topics to Matt Robinson, RIC Americas PM

Workshop

- Seeking to set up a Scan-N-Plan workshop
- Held a workshop as part of ROSCon 2021 virtual
- Seeking a hands on opportunity with hardware and students to get into all the facets of a working system
- Current locations considered:
 - Columbus, OH
 - Pittsburgh, PA
 - Other? – interested in hosting?
Ping the PM!



ROSCon 2023

- ROSCon 2023 will be in New Orleans in October!
- Will propose a workshop
- These are larger group workshops, but we will seek to have hardware for testing and step through an application of interest
 - Submit suggestions for something of interest



Supporting the community

- ROS 2 Technical Steering Committee (TSC)
 - Represent industry/consortium for core ROS 2 topics/roadmap etc
 - Garner support for working groups that are important to industry
- (Hardware) Interfaces Working Group
 - Working group to identify interfaces that include the semantics
 - Identify industrial standards that have good references
 - Open to everyone: <https://discourse.ros.org/t/hardware-interfaces-working-group-recurring-meeting/24847/1>
- Acting on Roadmapping from Industry Members & Broader Industry
 - Inform future capability development & tools to support adoption

Continue to 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



Focused Technical Projects

- 2 active collaboration opportunities
- Require a member champion
- Send suggestions to your friendly Consortium Manager

Robotic Blending M5

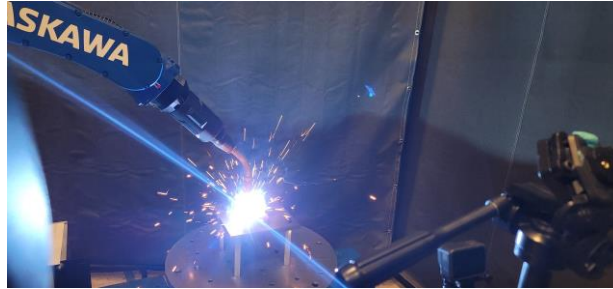
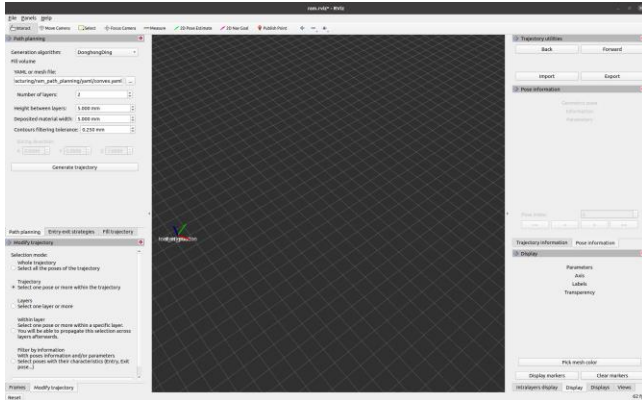


- Champion: Steel Founders' Society of America
- Targeting an end-user site
- Team comprised of
 - Yaskawa
 - PushCorp
 - Iowa State
 - EWI
 - ARIS Technology
- Mid 2023 foundry demonstration
 - Merging work from Godel plus recent Scan-N-Plan collaborative workshops
 - ROS 2
 - Multiple replications on hardware

Based on: https://github.com/ros-industrial-consortium/scan_n_plan_workshop

Open Additive Framework

- Open Flexible Additive Framework
- Merging of computational physics-based analysis with planning



Write Up: <https://rosindustrial.org/news/2022/8/23/an-open-framework-for-additive-manufacturing> Video: <https://youtu.be/rxkLyYaazII>

Resources for the Community

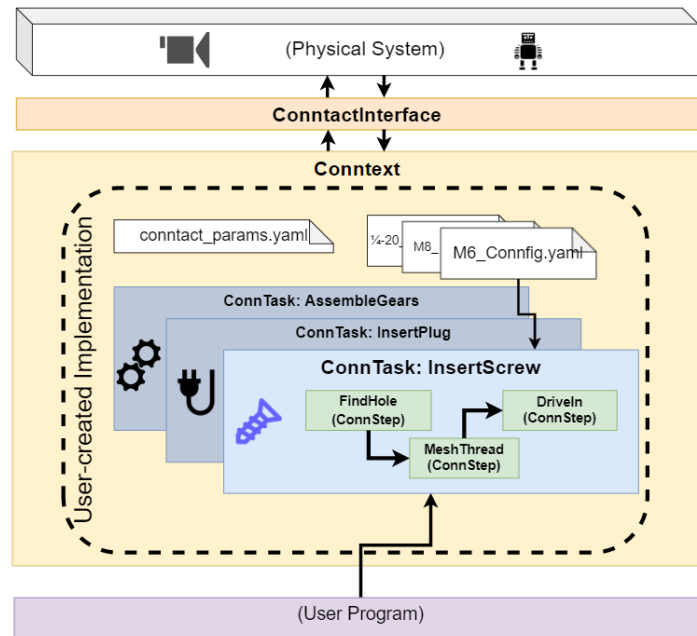
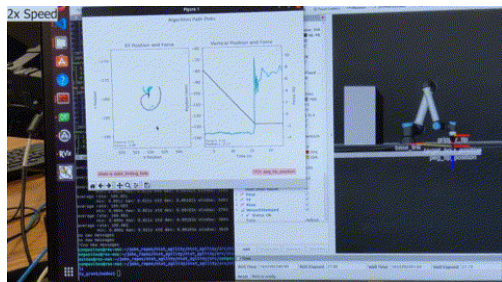
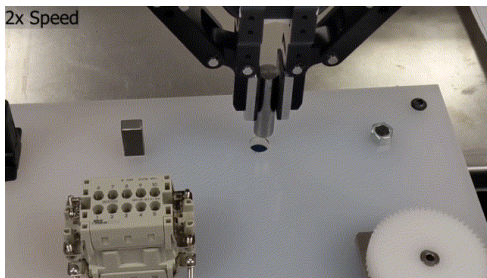
- ROS-Industrial
 - Home: rosindustrial.org
 - Documentation: wiki.ros.org/industrial
 - Code: <https://github.com/ros-industrial>;
<https://github.com/ros-industrial-consortium>
 - Training: http://ros-industrial.github.io/industrial_training/
 - ROSin: <http://rosin-project.eu/>
- Upcoming Events (<https://rosindustrial.org/events-summary/>)

Events on the horizon

- Training
 - February 2023- ROS2/Advanced Topic – In Person, San Antonio, TX
- ROS-I EU [Conference](#) – December 15-16, Stuttgart
- ROS-I Developers' Meeting – Americas January
- ROS-I Americas Community Meeting
 - March 2023
- 2023 Annual Meeting – targeting co-located with Automate, Detroit
 - May 25, 2023 – Thursday!

Agility in advanced assembly applications

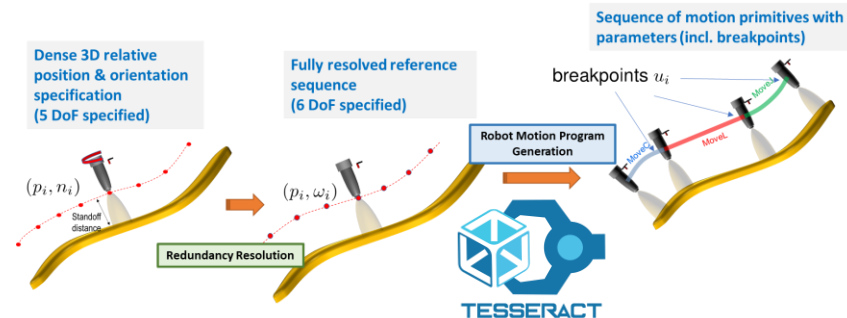
- The ConnTact Assembly Framework
 - Ability to enable researches to simply implement and test learning algorithms to test extensibility
 - Supported by NIST and the Agility Working Group



<https://github.com/swri-robotics/ConnTact>

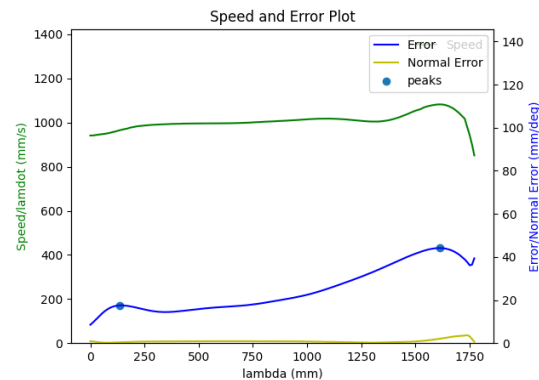
Optimized tool path for tracking accuracy and velocity

- ARM Institute project led by Rensselaer Polytechnic Institute (RPI) with GE, SwRI, and Yaskawa
 - Realized through pose optimization with redundancy resolution
 - Greedy motion primitive fitting (MoveL to MoveC)
 - Adjust blending zones and waypoint position based on trajectory error
 - Outputs for consumption into motion planner – plug-in to Tesseract



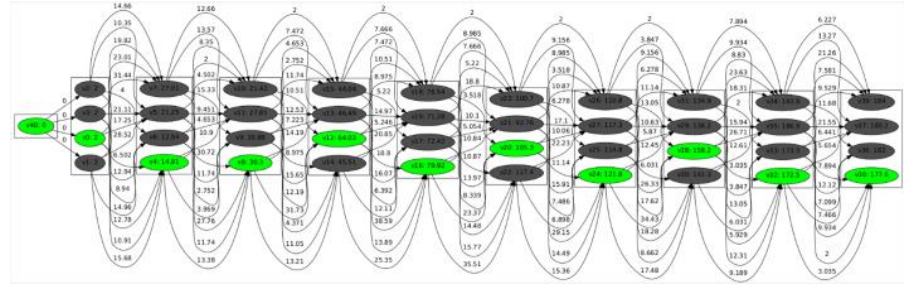
Error Stats	Avg Error (mm)	Max Error (mm)	Min Error (mm)	Std Error (mm)	Avg Angle (rad)	Max Angle (rad)	Min Angle (rad)	Std Angle (rad)
Curve 1	0.0021	0.163	0.00038	0.03	0.0016	0.0061	0.00008	0.0014
Curve 2	0.094	0.436	0.0054	0.073	0.0027	0.0117	0.0005	0.0023

<https://arminstitute.org/projects/optimized-robot-motion-program-for-tracking-complex-geometric-paths/>



Improving Large Volume Motion Planning

- Extra degrees of freedom in large robots like rail systems or mobile bases increase work volume
- Intros challenges in process planning; the limitation of the “useful” motion of a robotic system that is constrained by the application at hand
- The new improvements in process planning allow for branching “depth first” searches, which will quickly find a solution for every position in the trajectory, instead of search “breadth first” to find the optimal configuration at each pose



Full Dijkstra graph find the optimal path through the graph by exploring every edge

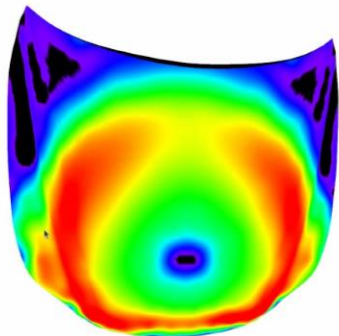
Typical rail based system with large volume

https://github.com/swri-robotics/descartes_light

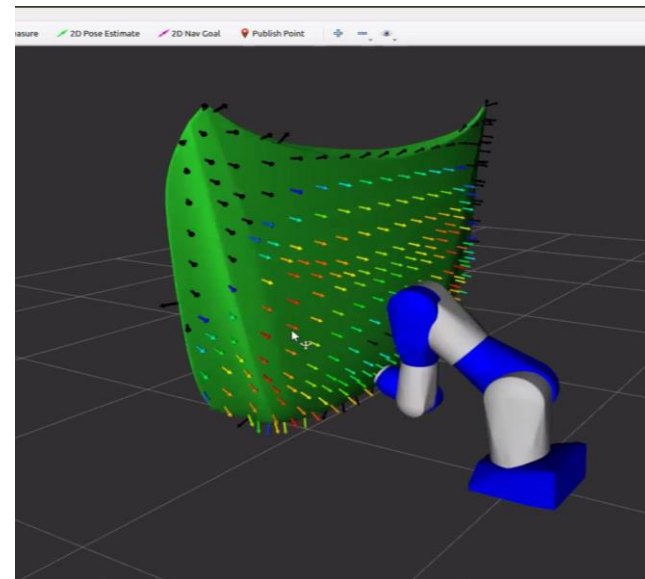


Quantitative Robot Reach Analysis

Updates on the Reach Repository - The REACH repository is a tool that allows users to visualize and quantitatively evaluate the reach capability of a robot system at a given base position for a given workpiece. See the ROSCon 2019 [presentation](#) and [video](#) for a more detailed explanation of the reach study concept and approach.



Heat map for reachability – coming soon!



Heat map scoring of waypoints on a mesh – pose quality – new metrics! – available now!

<https://github.com/ros-industrial/reach>

Thank You!

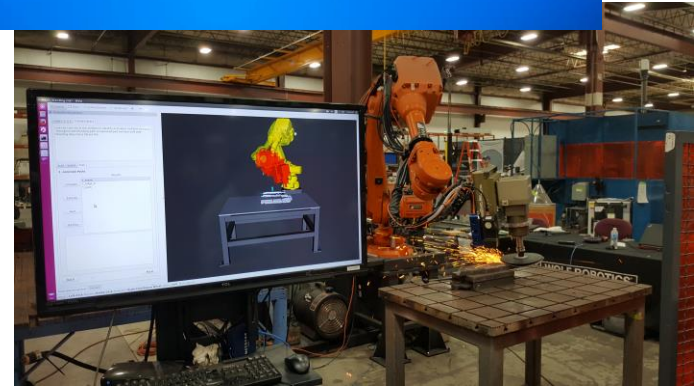
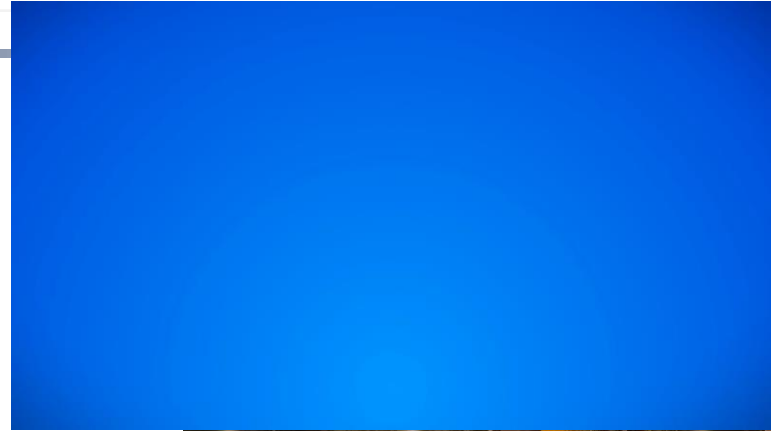
- Provide feedback
- Seek out ways to collaborate
- Engage your supplier/partners on ROS use
- Reach out if you need help

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Project Updates

- ROS Workbench (SWORD)
- Coordinated Motion of Manipulators and Mobile Bases (CoMOT)

Tesseract Update

- Levi Armstrong