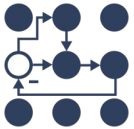
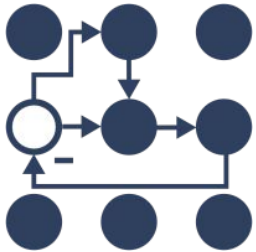


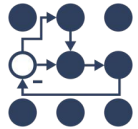
ros-controls project update



Bence Magyar

control.ros.org

The year in numbers



800+

pull requests merged
across the five core repos

124

people with
a merged change

18

releases in 11 months

5

distros in CI,
humble through rolling

+ Debian
+ RHEL
+ Windows

5

PMC members

18

PMC committers

14

Active repositories

160k+

Unique visitors to
control.ros.org / year

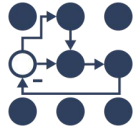
125

Pages of
LLM-optimized docs

? 10^4-10^5 ?

Robots worldwide

PMC members



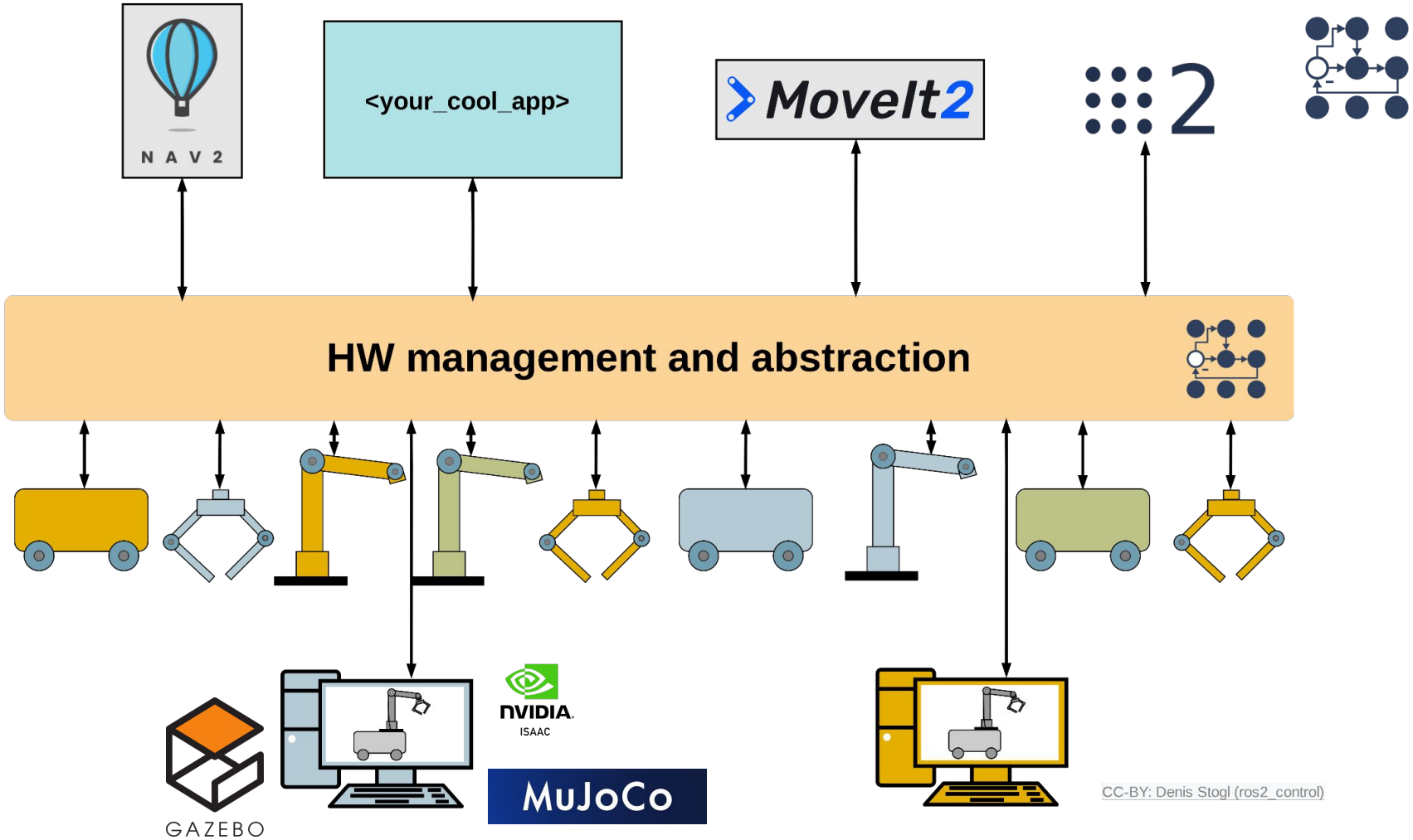
Bence Magyar [Bent'seh]
- PhD in Robotics
- Principal Software Engineer at Locus Robotics
- ros2_control PMC Leader

Christoph Fröhlich
- Research Engineer at AIT Austrian Institute of Technology
- Motion planning and system integration
- ros2_control PMC Member

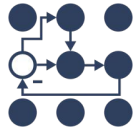
Sai Kishor Kothakota
- Experienced Roboticist
- Senior Robotics Engineer at PAL Robotics
- ros2_control PMC Member

Marq Rasmussen
- Software Engineer at Kuka Robotics
- Mobile manipulation and Planning
- ros2_control PMC Member

Denis Štogl [Dr. Denis]
- PhD, Control Engineer and Roboticist
- Owner at b-robotized
- ros2_control PMC Co-Leader



Standard Controllers



Mobile Robots - ***Nav2, cmd_vel***

- Steering Controllers
    - Bicycle – 1 drive joints, 1 steering joint
    - Tricycle – 2 drive joints, 1 steering joint
    - Ackerman – 2 drive joints, 2 steering joints
- Omni Wheel Drive
- Mecanum drive
- **Differential Drive (Diff drive)** / Skid steer

Not Controllers → Broadcasters

- Joint State Broadcaster – **nothing works without it!!!**
- Force Torque Sensor Broadcaster
    - Has funky stuff in it, like filtering – cool for using in chain ahead of Admittance Controller
- IMU, GPS, Battery, Magnetometer, Range Sensor Broadcaster
- Pose Broadcaster
- **State Interfaces Broadcaster**
    - Generates your observation data for policy training

Industrial Arms - ***RoboPlan, MoveIt, Tesseract, etc***

- **Joint Trajectory Controller (JTC)** - scaled, blending 🎊
    - The most used one - interface for planning frameworks
- Admittance Controller - force-position control in Cartesian space (using IK library from KDL)
- **(Industrial) Motion Primitives Controllers** - move LIN, PTP, CIRC

Grippers / Tools

- Parallel Gripper Controller - 1 DoF gripper with position and optionally max vel and max effort interfaces
- GPIO Tool Controller - generic tools and grippers (engaging, disengaging, and configuring)

Generics

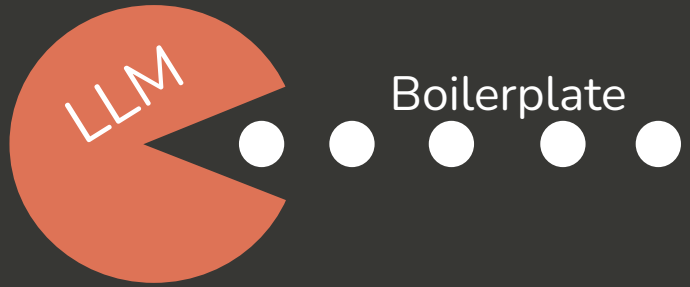
- PID Controller
- Forwarding Controller
    - Forward Command - multiple joints, one interface
    - Multi Interfaces Fwd. Cmd. - one joint, multiple interfaces
- GPIO Command Controller - sends values on set of GPIO interfaces
- Chained Filter Controller - relies on the filters library

https://control.ros.org/rolling/doc/ros2_controllers/doc/controllers_index.html

Hello 2026. What are we even doing here?

“A VLA policy will replace the stack.” “A model can write the controller.”
Maybe. Neither is the thing that makes it all run together.

- A policy emits intent at 30 Hz. A motor needs a command every millisecond.
- Learned components need somewhere to fail safely.
- Cheap code makes the interface more valuable.
- A documented **framework** is the best thing to point a model at.



Positions-only action chunks upsampling in JTC

By Vedhas Talnikar

The Challenge

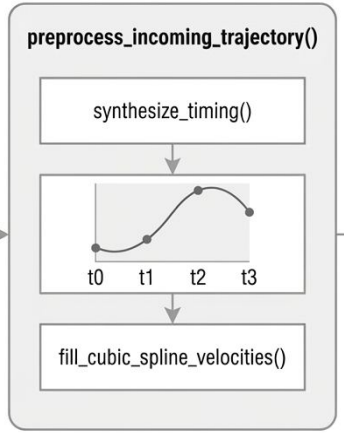
- AI policies yield low-frequency, position-only waypoints (e.g., 50Hz).
- The hardware expects a fresh command every control cycle at 1000 Hz
- Raw execution causes severe velocity steps.
- Infinite acceleration spikes damage real hardware.

The Solution: Upsampling

- Implements an O(n) tridiagonal velocity solver.
- Generates continuous cubic-spline trajectories.
- Eliminates discontinuities for smooth acceleration.
- Outputs safe, high-frequency commands (up to 2kHz).

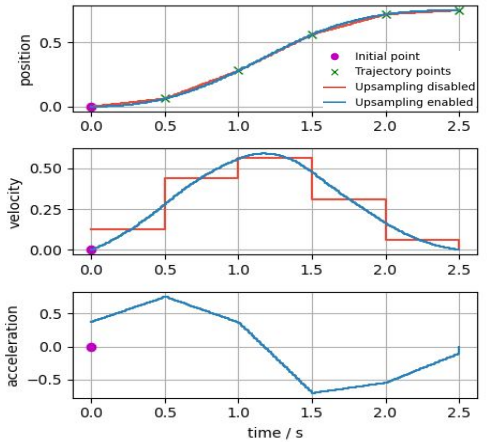
JointTrajectory (input)

```
header.stamp: 0
joint_names: [j1, j2]
points:
  positions: [0.1, 0.2]
  velocities: []
  time_from_start: 0
```



JointTrajectory (output)

```
header.stamp: 0
joint_names: [j1, j2]
points:
  positions: [0.1, 0.2]
  velocities: [v0, v1]
  time_from_start: 0.1
```

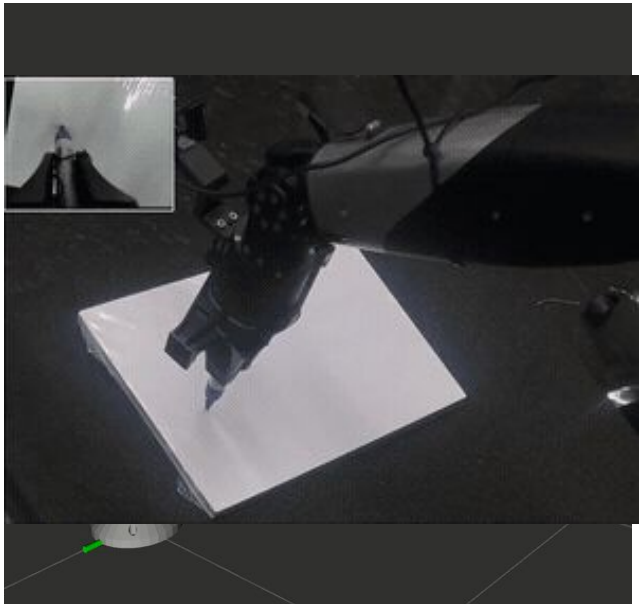


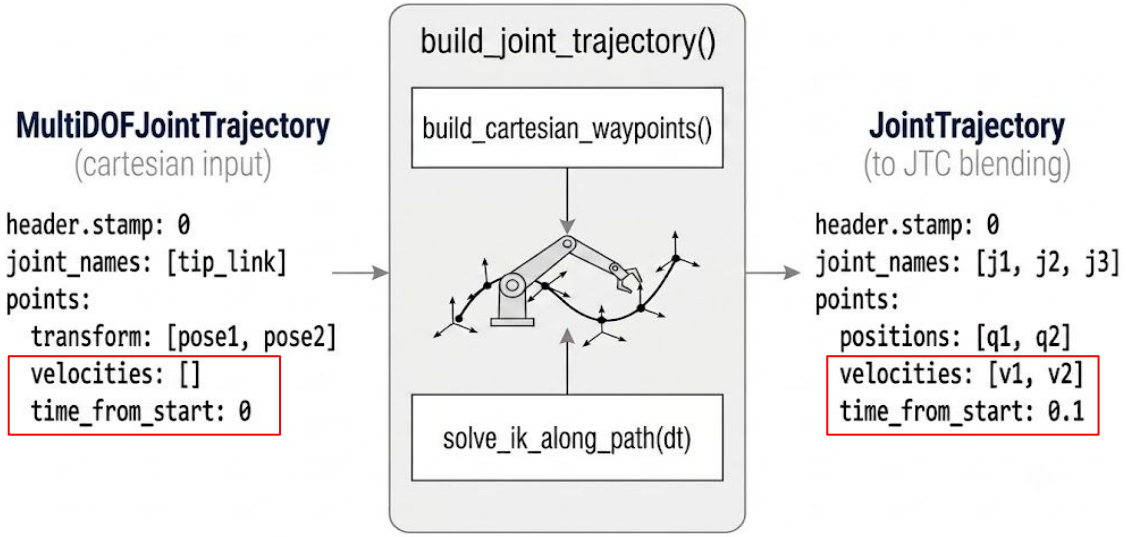
Cartesian trajectory controller

By Vedhas Talnikar

Joint-space interpolation does not move along a straight line
Several policy families (diffusion policies, OpenVLA, RT-2) emit end-effector poses rather than joint angles.

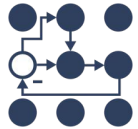
- **Input:** Multi-DOF trajectories on ~/cartesian_reference
- **Path interpolation:** Cubic Hermite (translation) + SLERP (rotation)
- **IK:** Differential Jacobian-based, default 100 Hz sampling
- **Output:** Joint trajectory passed on to base controller JTC





Zenbedded

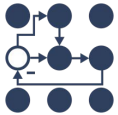
Eneji Peacemaker Ohieku, Shahazad Abdullah, Kamalkant Thangaraju



+

Zenoh

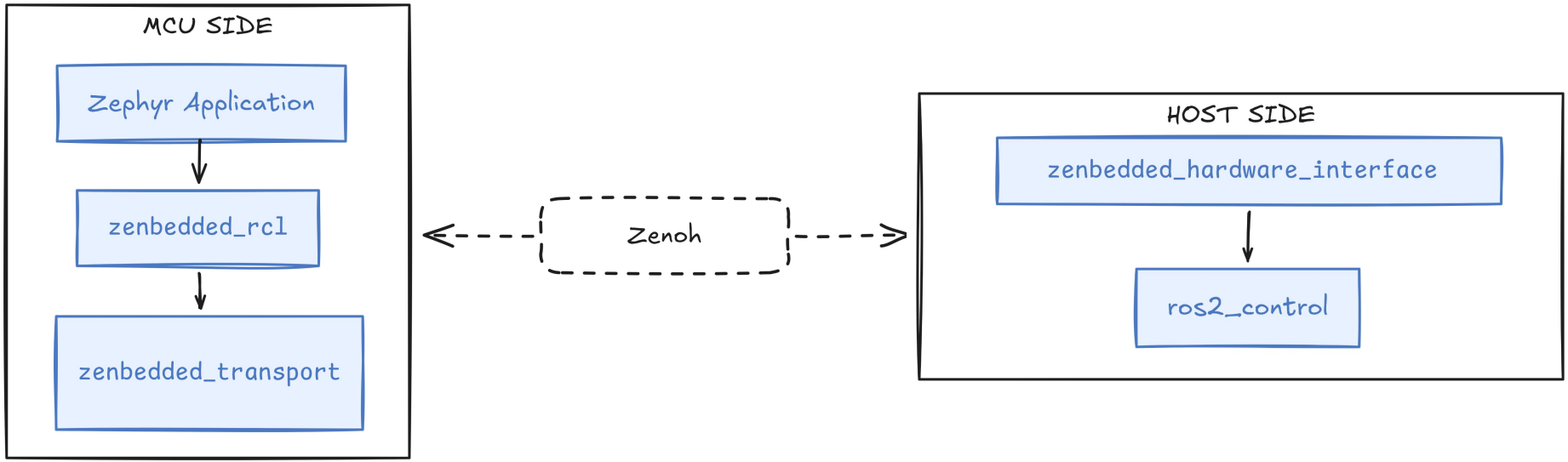
+



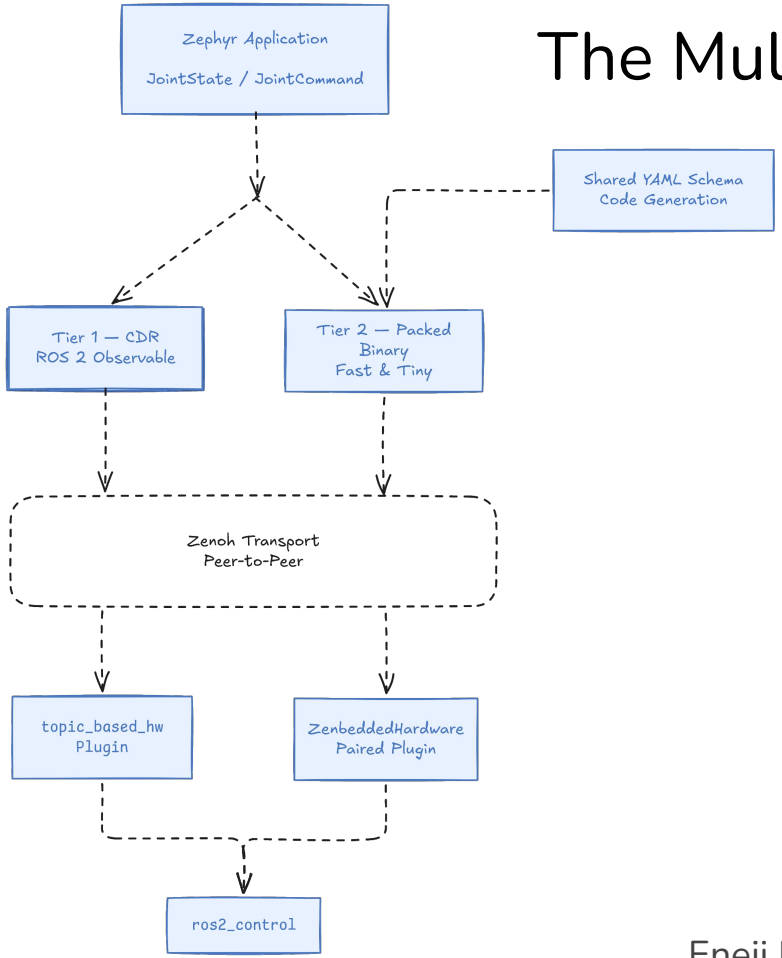
ros2_control

Zenbedded

Eneji Peacemaker Ohieku, Shahazad Abdullah, Kamalkant Thangaraju



The Multi-Tier Transport

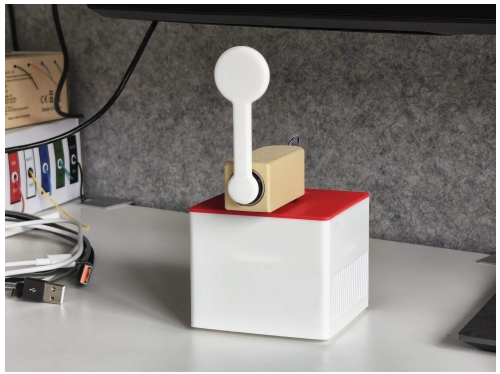


Core Idea

- ***One Application | Two Serialization Choices***
- ***Tier 1: CDR ROS 2***
  - *Interoperability and observability*
- ***Tier 2: Packed Binary***
  - *Compact data with zero runtime serialization*
- ***Common Transport***
  - *Both tiers leverage Zenoh*

Eneji Peacemaker Ohieku, Shahazad Abdullah, Kamalkant Thangaraju

Demo Project: Furuta Pendulum Robot



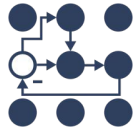
Project video by
Henrique Ferrolho @ Youtube

- **What is it?** Furuta pendulum
- **Hardware:**
  - **MCU Board:** ESP32-S3
  - **RTOS:** Zephyr 4.4.2.
  - **Actuator:** Nema17 stepper motor
  - **Sensor:** AS5600 Magnetic Encoder
- **Why this platform?** Requires high-frequency, low-latency control loops — a perfect stress test for Zenbedded's real-time capabilities.

Tier 1	Tier 2
160 Hz	1250 Hz

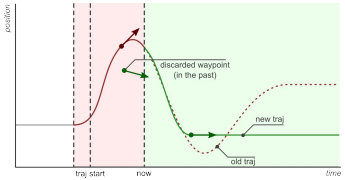
Eneji Peacemaker Ohieku, Shahazad Abdullah, Kamalkant Thangaraju

News flash!



joint_trajectory_controller

Trajectory blending is back!



max_deceleration_on_cancel

Cancel a trajectory and each joint now decelerates smoothly to a stop, instead of snapping to hold-position.

controller chaining improvements

one controller throws mid-update → the rest of the chain ran on stale references →
whole-chain deactivates

dynamic_joint_states

one topic for everything → became the dumping ground → purpose-built broadcasters →
battery, magnetometer, any state interface

diff drive and friends

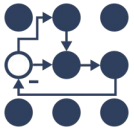
odometry fixed at startup → no way to reseed a lost pose → set_odometry service →
reseed at runtime, on all five base types

Industrial motion primitives

the only way to move an arm was streaming commands → fought the vendor motion planner → motion_primitives_controllers →
hand it MOVEJ / MOVEL / MOVEC instead

… and there’s more!

Join us!



- **If you are upgrading**: the Kilted to Lyrical release notes and migration guide are complete, and were written by the people who made the changes.
  - control.ros.org
- **If you want to contribute**: half the changes in this talk started as an issue someone else opened. You do not need to be a controls or real-time expert to make this framework better.
  - Contributor board, where help is most needed
    github.com/orgs/ros-controls/projects/11
  - ros2_control presentations and resources
    control.ros.org/.../resources.html
  - ros2_control_demos, runnable examples for every concept in this talk.
  - Become a reviewer!

PMC meetings

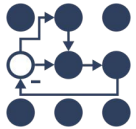
Every second Wednesday.
Next one: **7th October**

Chat with us on Zulip

Thank you!

Thank you to the 124 people who helped shipping this.

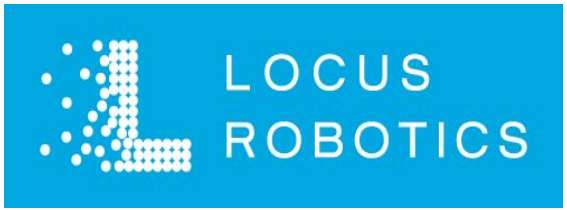
Program recommendations

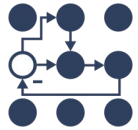


- Tuesday Workshop (too late)
- Wednesday 11:15 ros-controls Project Update
  - You are here!
- Wednesday 1:30 mujoco_ros2_control
- Wednesday 2:50 Evolution of URDF
- Wednesday 4:40 Tour de Hardware
- Thursday 4:00 Whole-body Mobile Manipulation with MoveIt 2 and ros2_control
- Thursday 4:40 Zephyr RTOS & Robotics: Will it Blend?

Zephyr Robotics Working Group

Zephyr®
Robotics WG





Christoph Fröhlich, Sai Kishor Kothakota, Marq Rasmussen, Bence Magyar, Denis Štogl, Erik Holum, Alejandro Hernández Cordero, Eneji Peacemaker Ohieku, Shahazad Abdullah, Kamalkant Thangaraju, Vedhas Talnikar, Ishan Pathak, Nikola Banović, Sahil Lakhmani, Christian Rauch, M. Ege Kural, Junius Santoso, Nathan Dunkelberger, Julia Jia, Soham Patil, Dennis Lanov, Sebastian Castro, Suryansh Singh, Tobias Fischer, Shlok Mehndiratta, José Luis Pérez Martín, Sergi de las Muelas, Krzysztof Pochwała, Shivam Maurya, Naitik Pahwa, Michele Cereda, Abdullah Theonewhomadethings, Felix Exner, Souri Rishik, Noel Jiménez García, Dhruv Patel ..... and many more!