

Post-lecture Notes on Improvisational Lecture

Discussion about ROS

Who has used it?

Students' opinions about it

- Communication pipeline
- Good for simulation and real robot work
- Difficult for Python versions
- Hard to install
- A lot to learn
- Requires more powerful machines
- It seems like 15 years of paradigms
- Burn it all down

Origins of ROS

Willow Garage & PR2

What is ROS? What does it do?

What problems did ROS solve? What needs did it meet?

Why did ROS become the de facto standard?

What is happening with ROS now?

Why did Willow Garage die? Why do robotics companies die so frequently?

The many good things that came out of Willow Garage's brief time

Example of using ROS with screen sharing

Launch stretch_body

Use rqt_graph (visualize all nodes)

Launch keyboard_teleop

Refresh rqt_graph

Look at simplified class keyboard_teleop code (see subscribe statement and callback)

rostopic echo /stretch/joint_states

rostopic hz /stretch/joint_states

Discussion of update rates (real-time motor control vs. high-level vision, hierarchies of update rates) What is fast enough?

Calibration as model fitting

Look at stretch calibration GitHub repository

Discuss calibration data collection and look at yaml calibration data file

Think of it as supervised learning or optimization

Fit model that when given joint state as input predicts where the camera will see the ArUco markers attached to the robot's body

Use a strong model : kinematic model represented by a URDF (white box not black box)

Use CMA-ES to optimize the model : slow, but very flexible and easy to use

look at CMA-ES Python GitHub repository and visualization on Wikipedia page

Discuss gravimetric calibration

Discuss kinematic model calibration

Look at the kinematic objective function part of the Stretch calibration code

Visualize the stretch kinematic fitting process with RViz

Brief discussion of the value of this process:

- discover manufacturing problems & variability
- produce an efficient standard kinematic model (a calibrated URDF file)