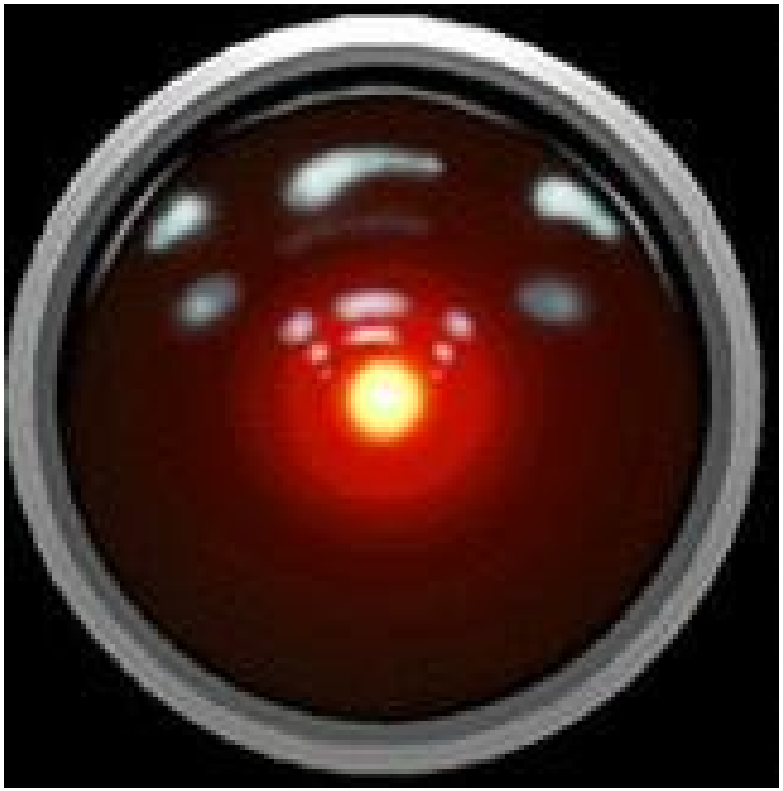
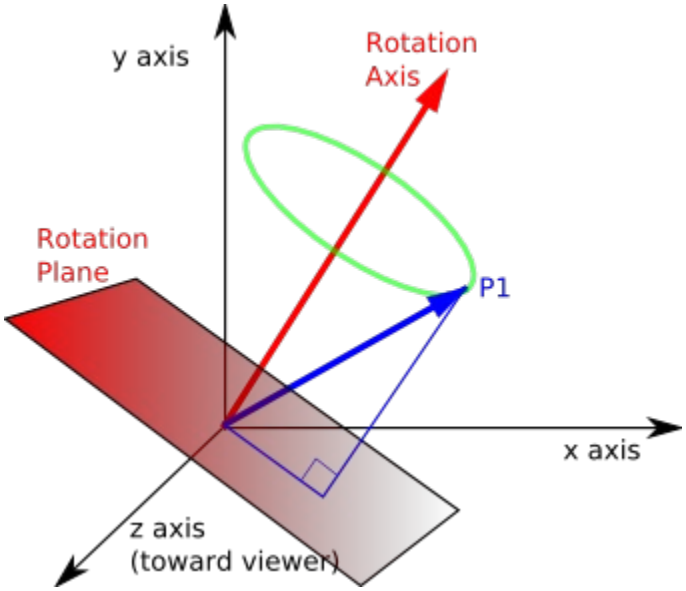


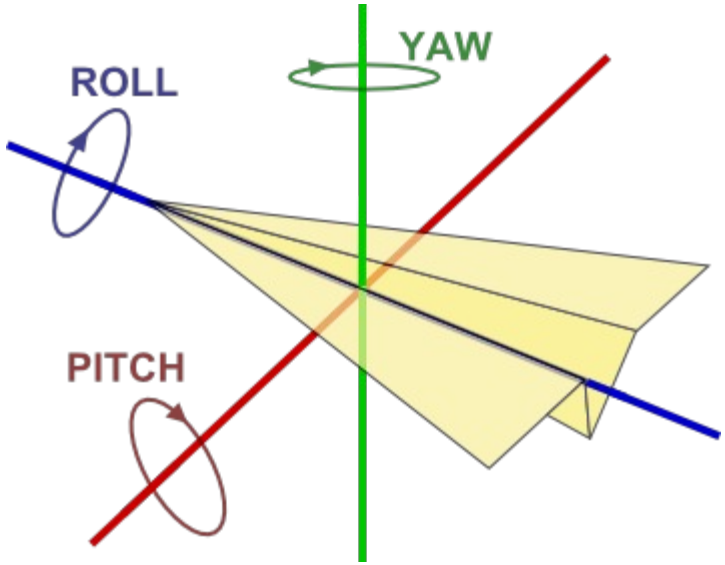
# CS 309: Autonomous Intelligent Robotics

Instructor: Jivko Sinapov

http://www.cs.utexas.edu/~jsinapov/teaching/cs309_spring2017/

# Position and Orientation (in 3D Space)



# Announcements

The University of Texas at Austin
College of Natural Sciences


**11 am – 3 pm, April 12, 2017**
**Shirley Bird Perry Ballroom, Texas Union**

# Homework 5

- If you have not evaluated your solution on the real robot, do so ASAP

# Readings For This Week

Bobick, Aaron F. "Movement, activity and action: the role of knowledge in the perception of motion." Philosophical Transactions of the Royal Society of London B: Biological Sciences 352.1358 (1997): 1257-1265.

Poppe, Ronald. "A survey on vision-based human action recognition." Image and vision computing 28.6 (2010): 976-990.

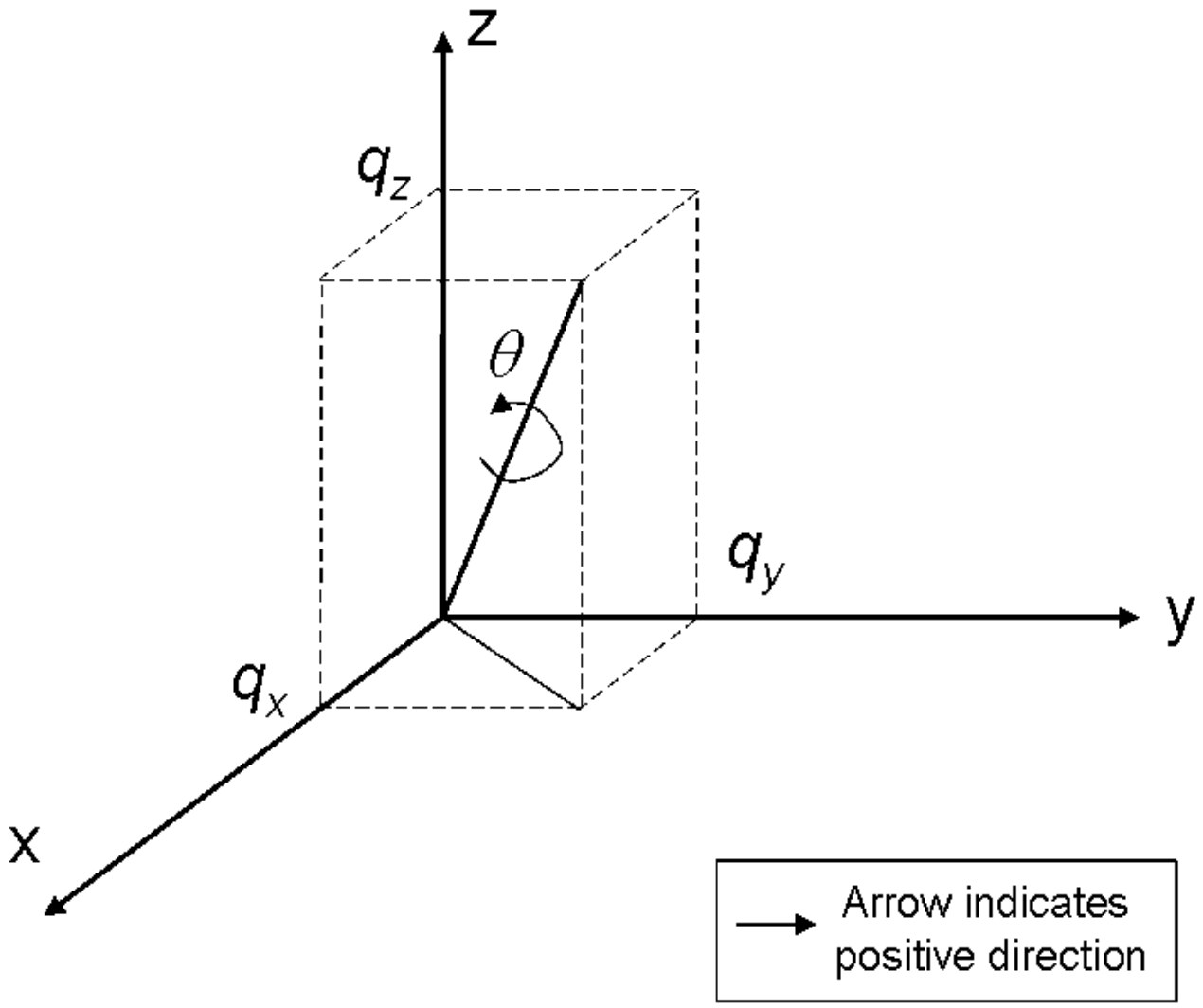
Frintrop, Simone, *et al.* "Computational visual attention systems and their cognitive foundations: A survey." ACM Transactions on Applied Perception (2010): 6.

# How does the robot represent its location in the world?

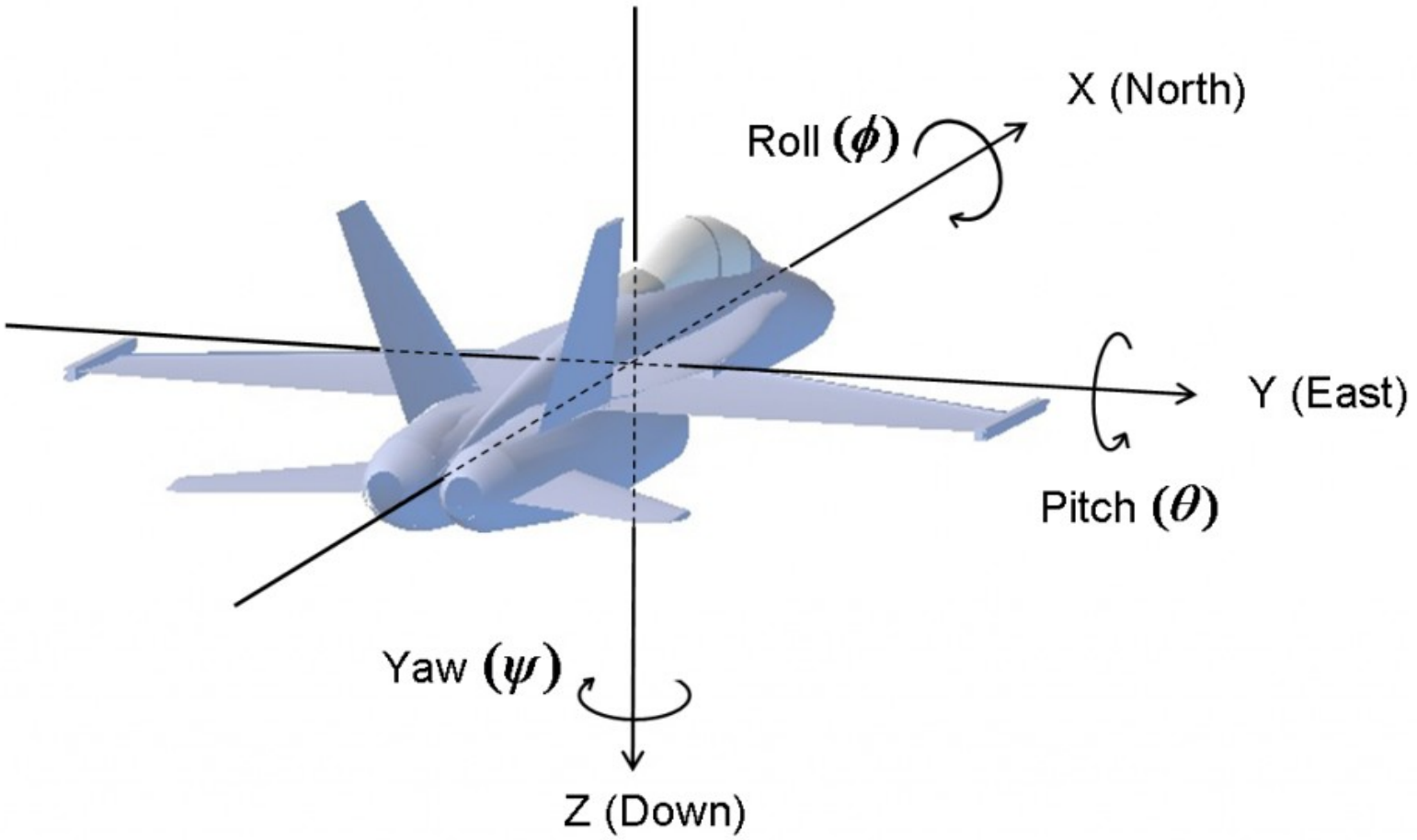
# ROS Pose API

- http://wiki.ros.org/geometry_msgs

# Quaternions

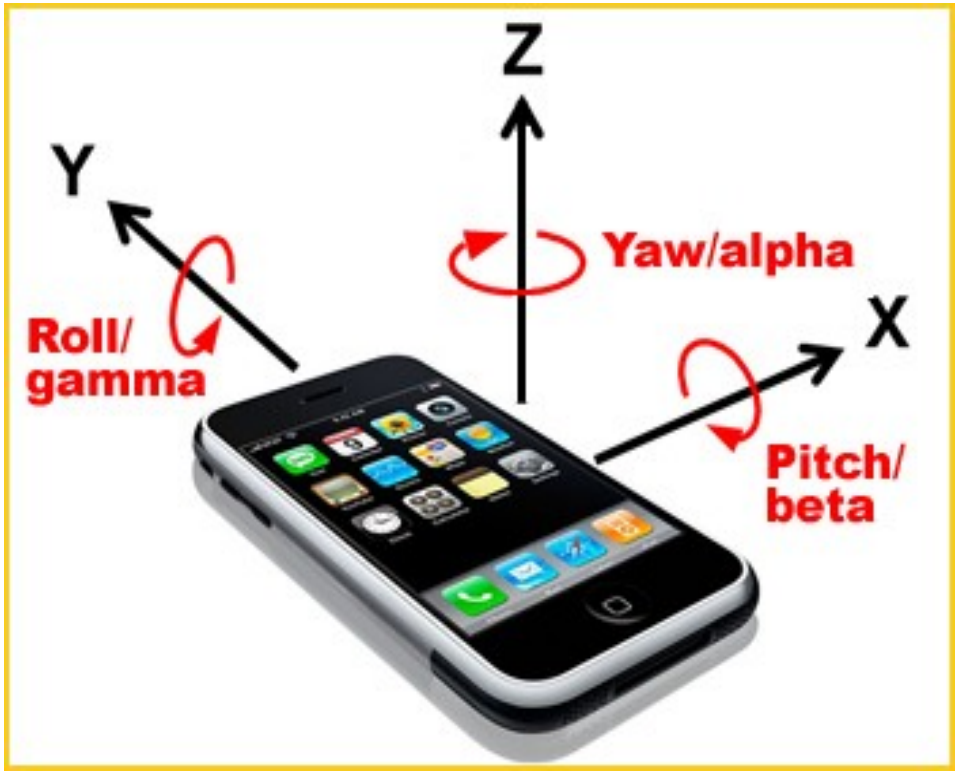


# Roll – Pitch – Yaw

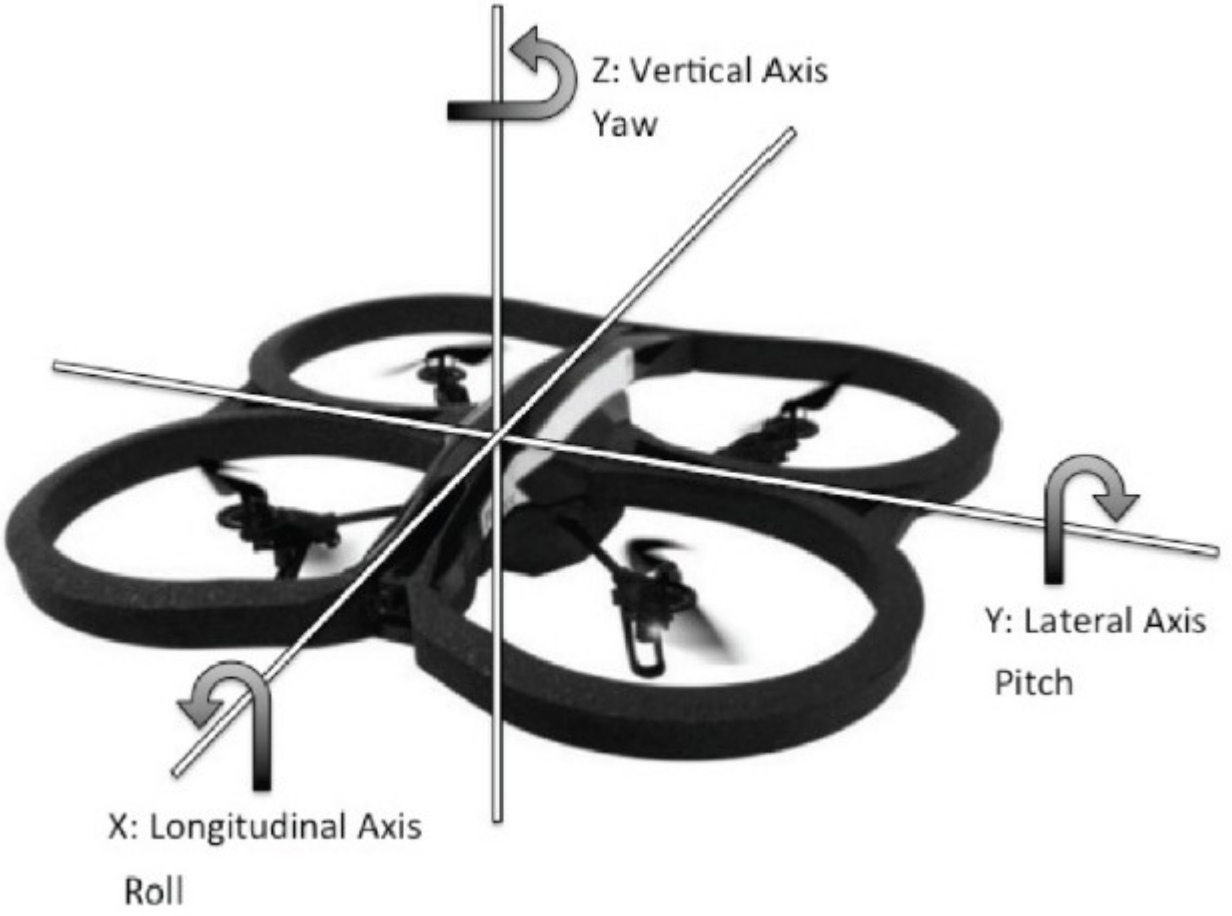



[http://www.chrobotics.com/library/understanding-quaternions]

# Roll – Pitch – Yaw



# Roll – Pitch – Yaw



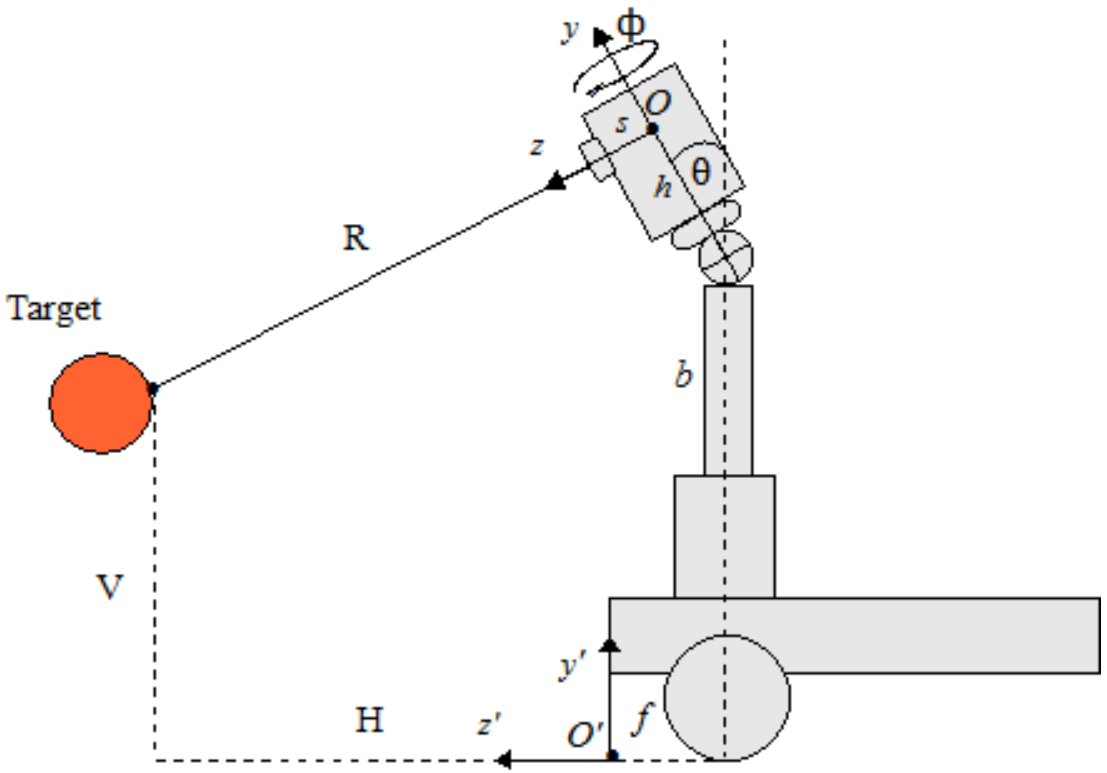
# Converting between Quaternions and RPY

$$\begin{bmatrix} \phi \\ \theta \\ \psi \end{bmatrix} = \begin{bmatrix} \arctan \frac{2(q_0 q_1 + q_2 q_3)}{1 - 2(q_1^2 + q_2^2)} \\ \arcsin(2(q_0 q_2 - q_3 q_1)) \\ \arctan \frac{2(q_0 q_3 + q_1 q_2)}{1 - 2(q_2^2 + q_3^2)} \end{bmatrix}$$

$$\mathbf{q} = \begin{bmatrix} \cos(\phi/2)\cos(\theta/2)\cos(\psi/2) + \sin(\phi/2)\sin(\theta/2)\sin(\psi/2) \\ \sin(\phi/2)\cos(\theta/2)\cos(\psi/2) - \cos(\phi/2)\sin(\theta/2)\sin(\psi/2) \\ \cos(\phi/2)\sin(\theta/2)\cos(\psi/2) + \sin(\phi/2)\cos(\theta/2)\sin(\psi/2) \\ \cos(\phi/2)\cos(\theta/2)\sin(\psi/2) - \sin(\phi/2)\sin(\theta/2)\cos(\psi/2) \end{bmatrix}$$

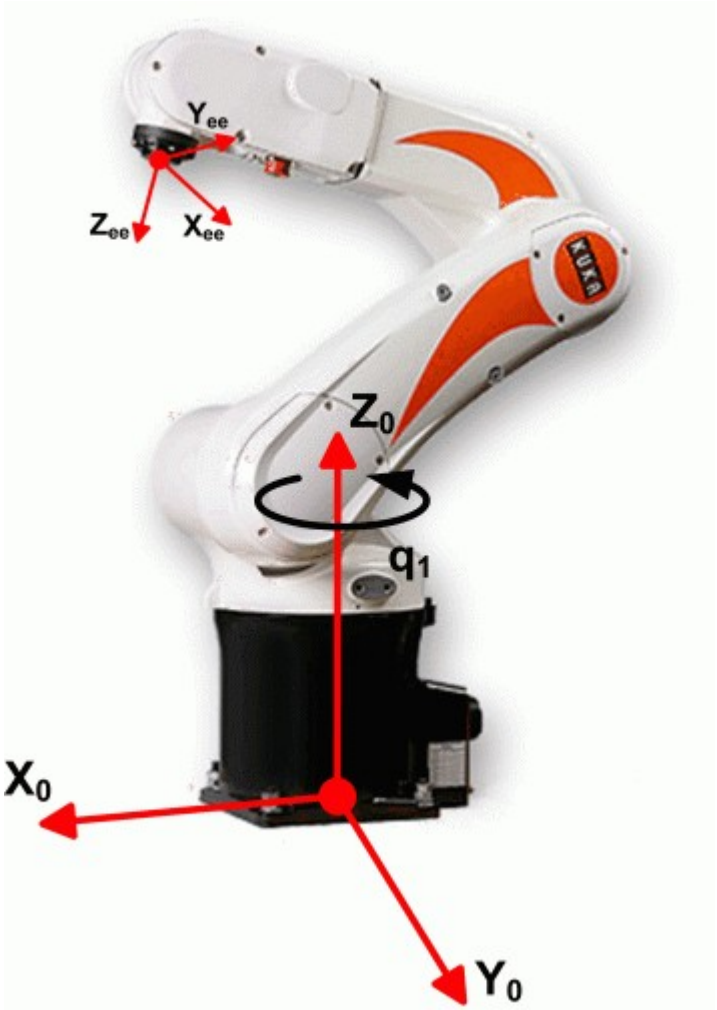
# Why Multiple Frames of Reference?

# Why Multiple Frames of Reference?



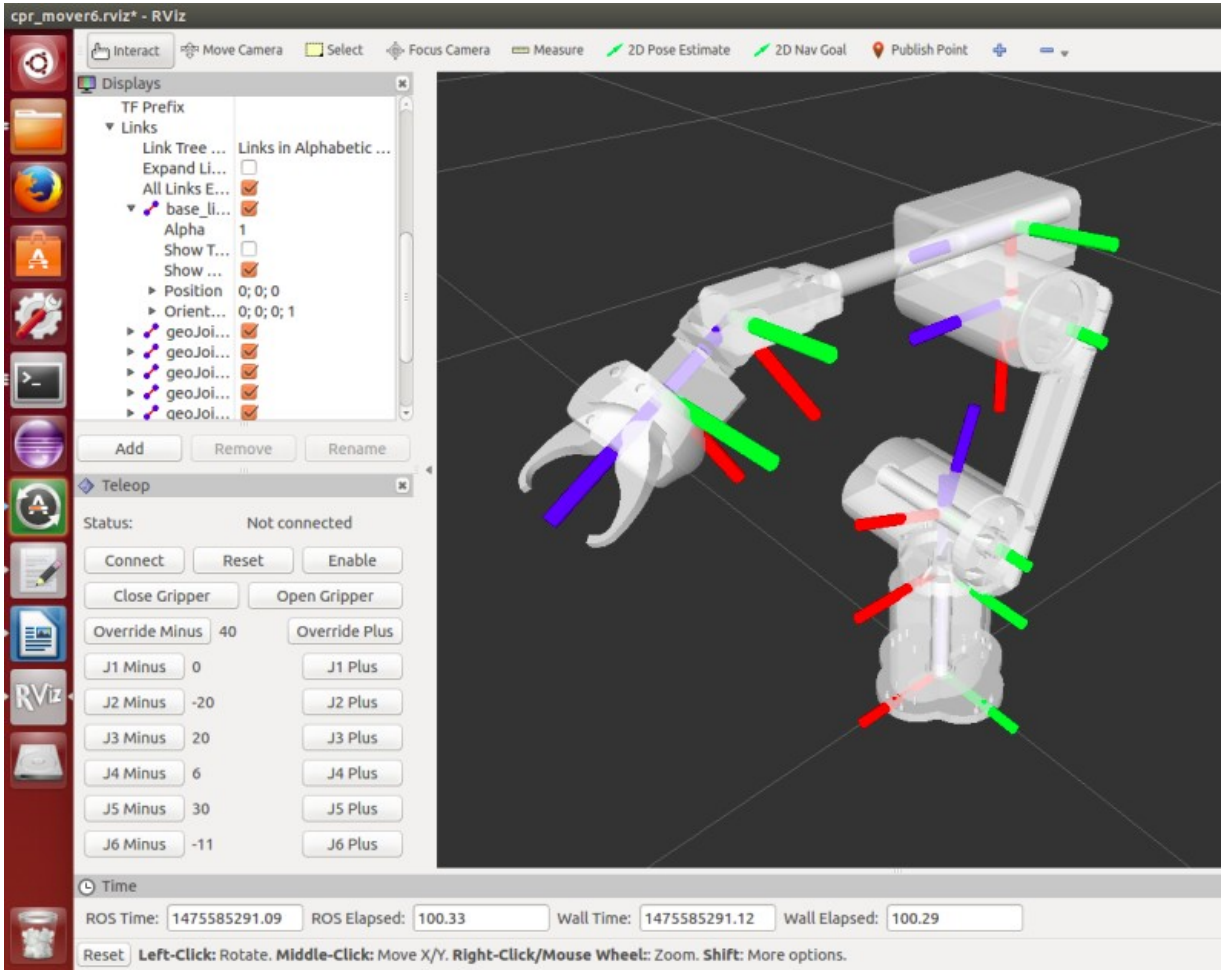

http://www.pirobot.org/blog/0011/Coordinate%20Frames%201_html_adf3112.gif

# Why Multiple Frames of Reference?




https://qph.ec.quoracdn.net/main-qimg-47a9c8cfec4f72167f3cb0cf2e0d950e

# The Transform Tree in ROS



# Project Group Breakout

- Scheduling – set aside weekly time for your group to meet and work on the project
- Take 5-10 minutes to come up with some questions about the robots that are useful for your project

THE END