TRINA workshop

Jane Li

Assistant Professor

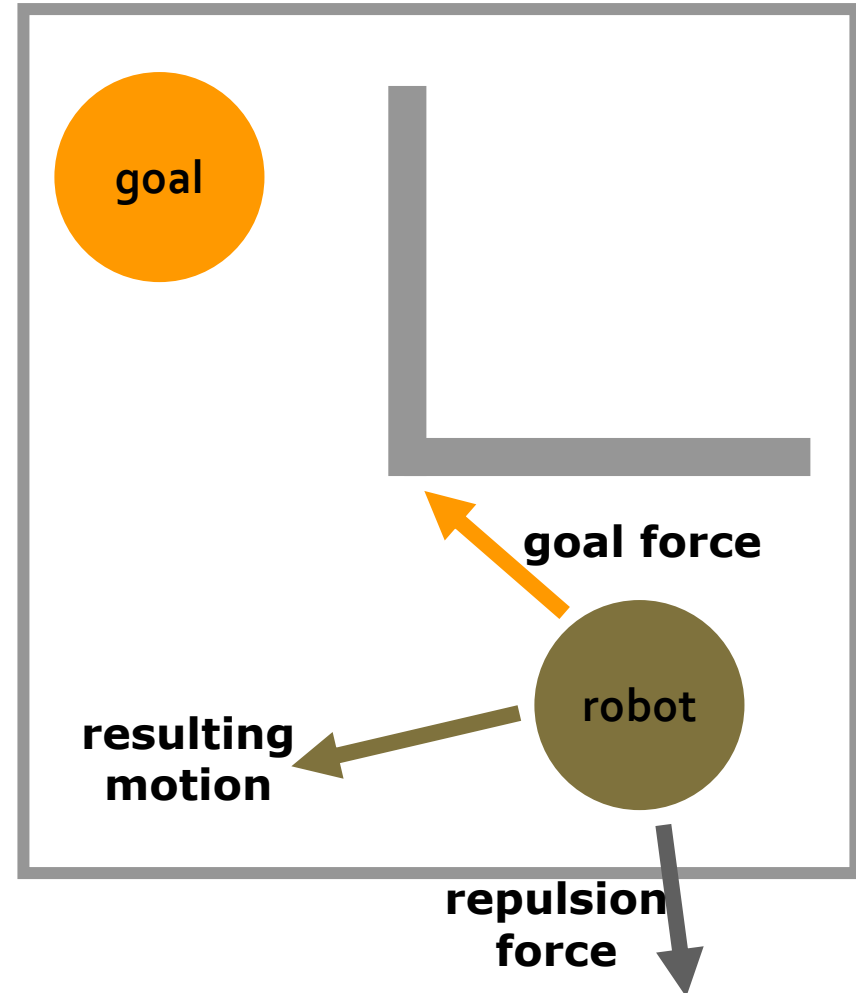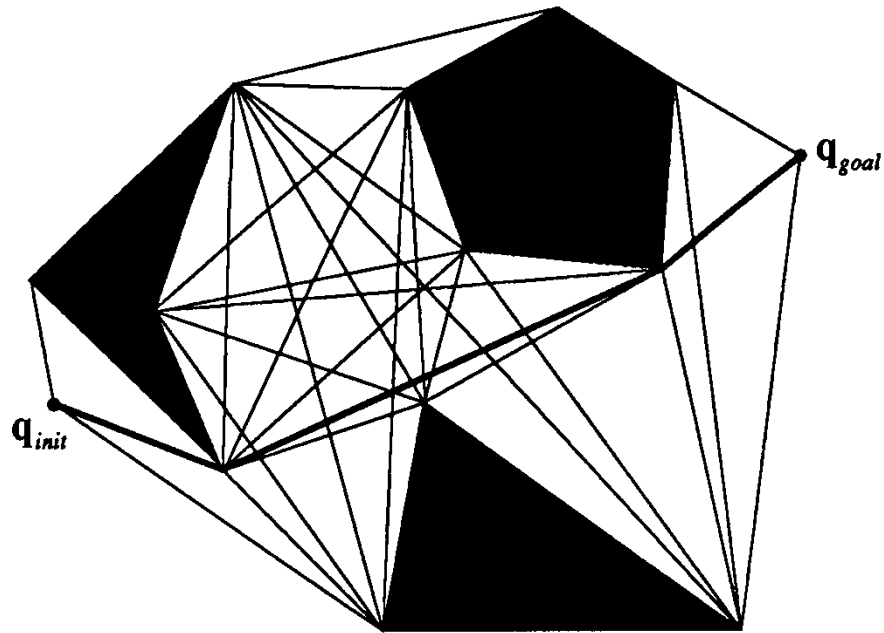Mechanical Engineering Department, Robotic Engineering Program

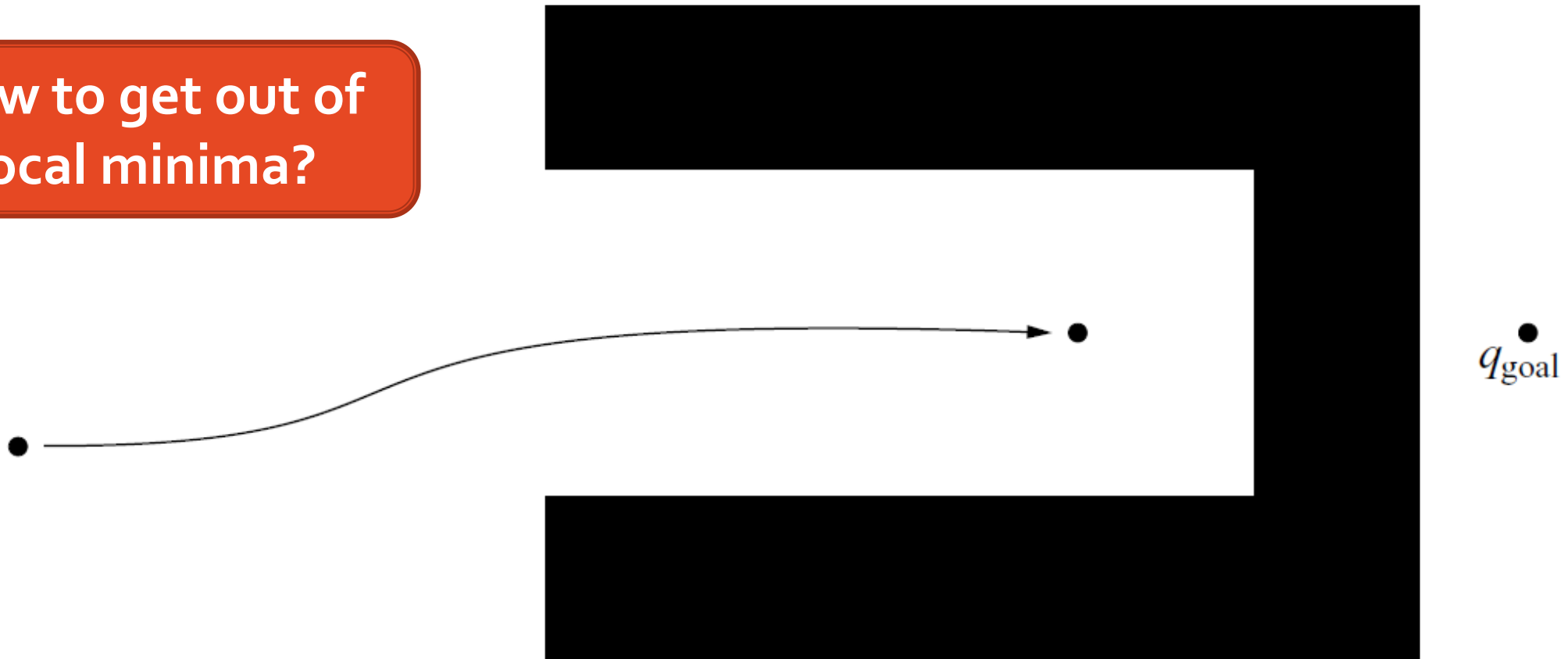Worcester Polytechnic Institute

Quiz (10 pts)

- (3 pts) Explain the difference between navigation using visibility map and potential filed?

- (3 pts) How to avoid local minima? List at least two methods

- (4 pts) Is a navigation planer using potential field complete? Why?

Potential field vs roadmap

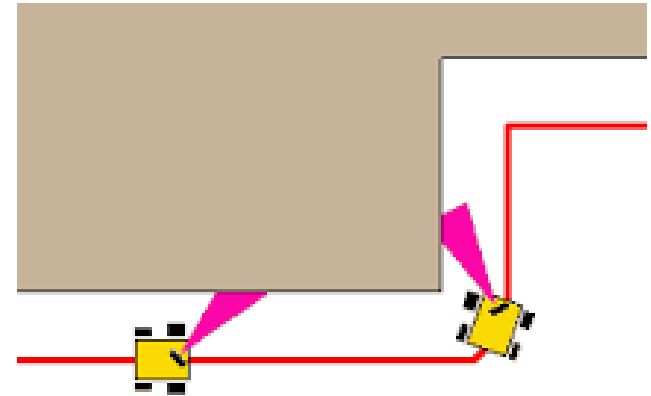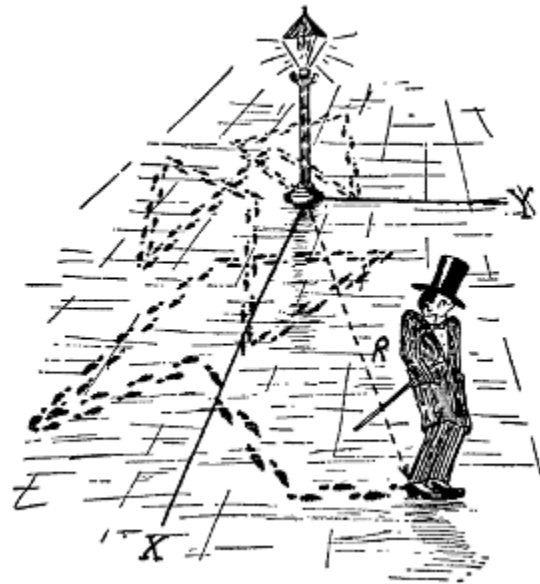# Local minima

How to get out of local minima?

q_goal

How to get out of local minima

Completeness

- A **complete** motion planner

  - Always returns a solution when one exists

  - Indicates that no such solution exists otherwise
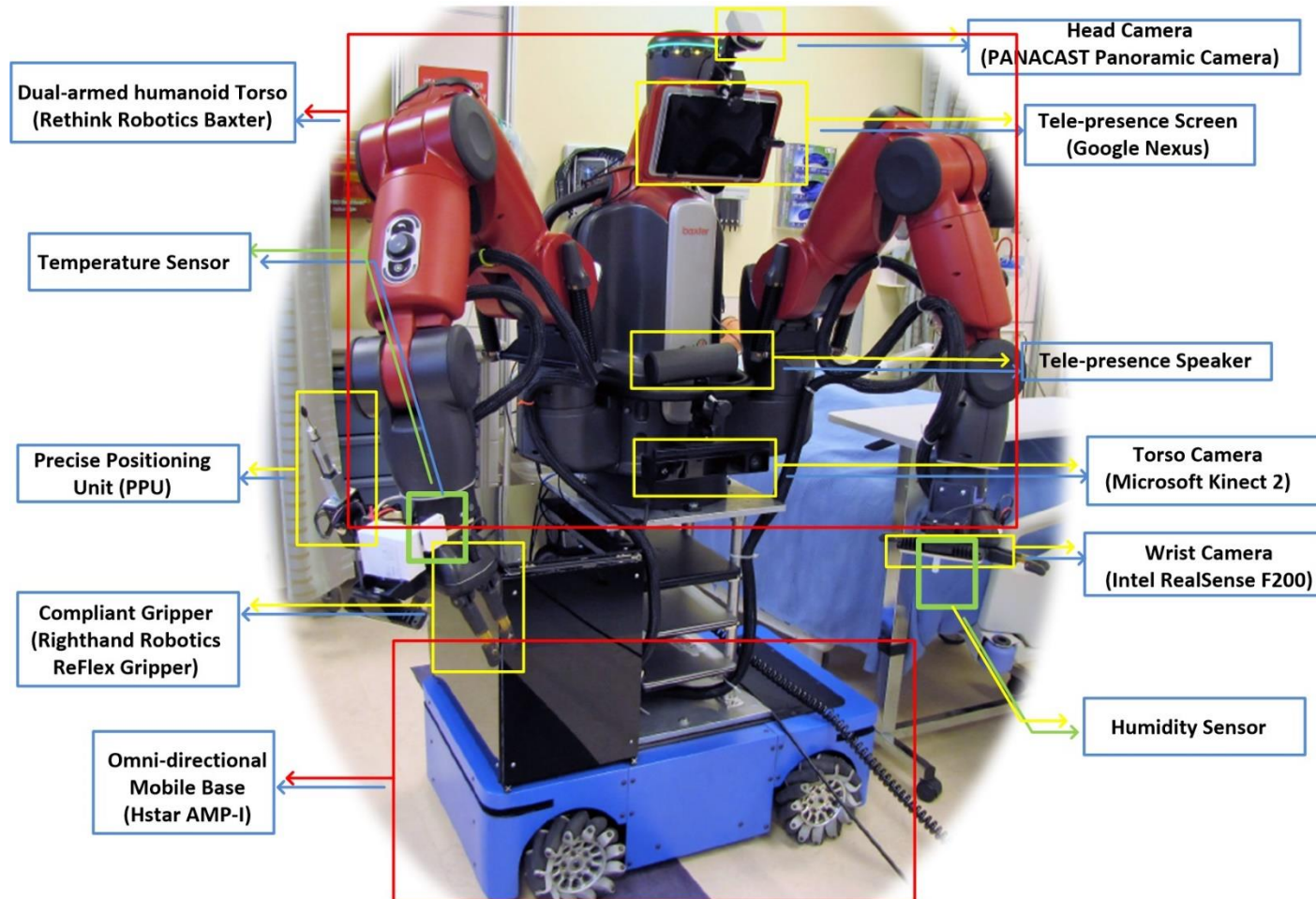
Student talk: Samruddhi Kadam
Sweep-line algorithm

TRINA Workshop

Overview

- Hardware
  - Robot components
  - Camera, LIDAR sensor

- User interfaces
  - Multi-input devices

- Software architecture
  - Need to know about codes

TRINA – Tele-Robotic Intelligent Nursing Assistance

Baxter robot

- Features
  - Mechanical compliance, intrinsic safety, low precision
  - ROS compatible
  - Embedded cameras (head and wrist)
  - Most popular platform for imitation learning and pHRI

- Resources
  - Baxter setup: http://sdk.rethinkrobotics.com/wiki/Baxter_Setup
  - Documentation: http://sdk.rethinkrobotics.com/wiki/Learning

ReFlex SF from Righthand robotics

- Features
  - Mutli-fingered compliant gripper
  - ROS compatible
  - Under-actuated hand

- Resources
  - GitRepo: https://github.com/RightHandRobotics/reflex-ros-pkg

Hstar AMP mobile base

- Features
  - Omni-directional mobile base
  - ROS compatible
  - Switch between external/on-board computer

- Resources:
  - https://drive.google.com/open?id=1v3FPtLjg1rvbWG2fclIWhkrfL9dY_kG6

Max Payload	400 lbs.
Top Speed	4 mph
Climbing	15° (w/o payload)
	5° (max payload)
Run Time	2 hours continuous operation
Main voltage	24v
Weight	200 lbs.
Terrain	Paved, tiled, carpeted surfaces
Acceleration time	<2s
Braking time	1s
Dimension L x W x H	41.5" x 25.7" x 11"

RGBD cameras – Kinect v2

- ## Features
  - RGB image resolution: SD, quad-HD, HD
  - Point cloud: 30 fps at SD quality

- ## Resources
  - ROS package for kinect = iai-kinect (refer to https://github.com/code-iai/iai_kinect2 for installation and calibration)
  - Additional packages
    - Position tracking by color segmentation
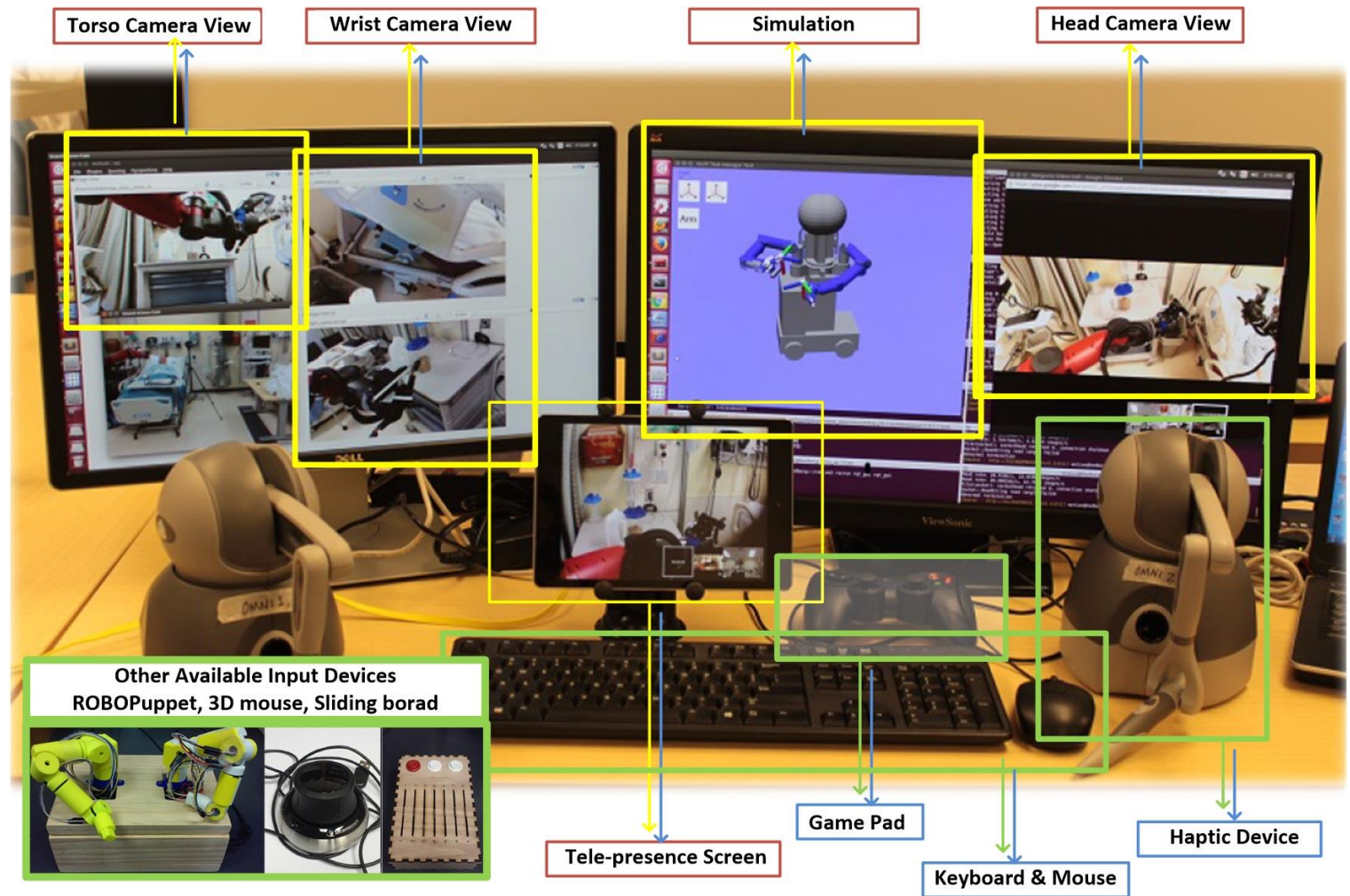   - Human skeleton tracking Ni-mate (https://ni-mate.com/)

RGBD camera – Realsense SR 300

- Features
  - Wrist camera
  - Driver support multi-camera streaming

- Resources
  - ROS packages – librealsence
    https://github.com/IntelRealSense/librealsense

Operator consoles

- ## Control modes
  - ### Haptic device
  - ### Gamepad
  - ### SimpleUI
  - ### Keyboard
  - ### MousePoser

Torso Camera View

Wrist Camera View

Simulation

Head Camera View

Other Available Input Devices
ROBOPuppet, 3D mouse, Sliding borad

Tele-presence Screen

Game Pad

Keyboard & Mouse

Haptic Device

Haptic device – Geomagic touch

- Features
  - 6-DOF (position active, orientation passive)
  - Accurate, but limited power
  - Virtual fixture, motion-guiding assistance
  - Stream from haptic device server on Windows platform (SSPP)

- Resources
  - Manual available if you need

New features to be added

- New teleoperation modes
  - Mocap, Kinect, CaptoGlove

- New autonomous modes

- Your motion planning projects

Vicon Mocap

- Feature
  - Capture human/object motion
  - Steam maker position to application platform
  - Support imitation learning via teleoperation

- Resources
  - Vicon tutorial:
   https://www.youtube.com/channel/UCMJ8Y9oiMhuBUlTbo9LhAFw

CaptoGlove

- Features
  - Individual finger control
  - Steam from windows platform
  - Linux driver under development
  - Data rate = 5 fps;
  - MQP team – new hardware with improved frequency
  - Can be used for grasp control and learning

Software architecture

- Operator console

- System state service

- Controller Dispatcher

- Motion Server

- Robot/Simulation

- ROS sensing channel
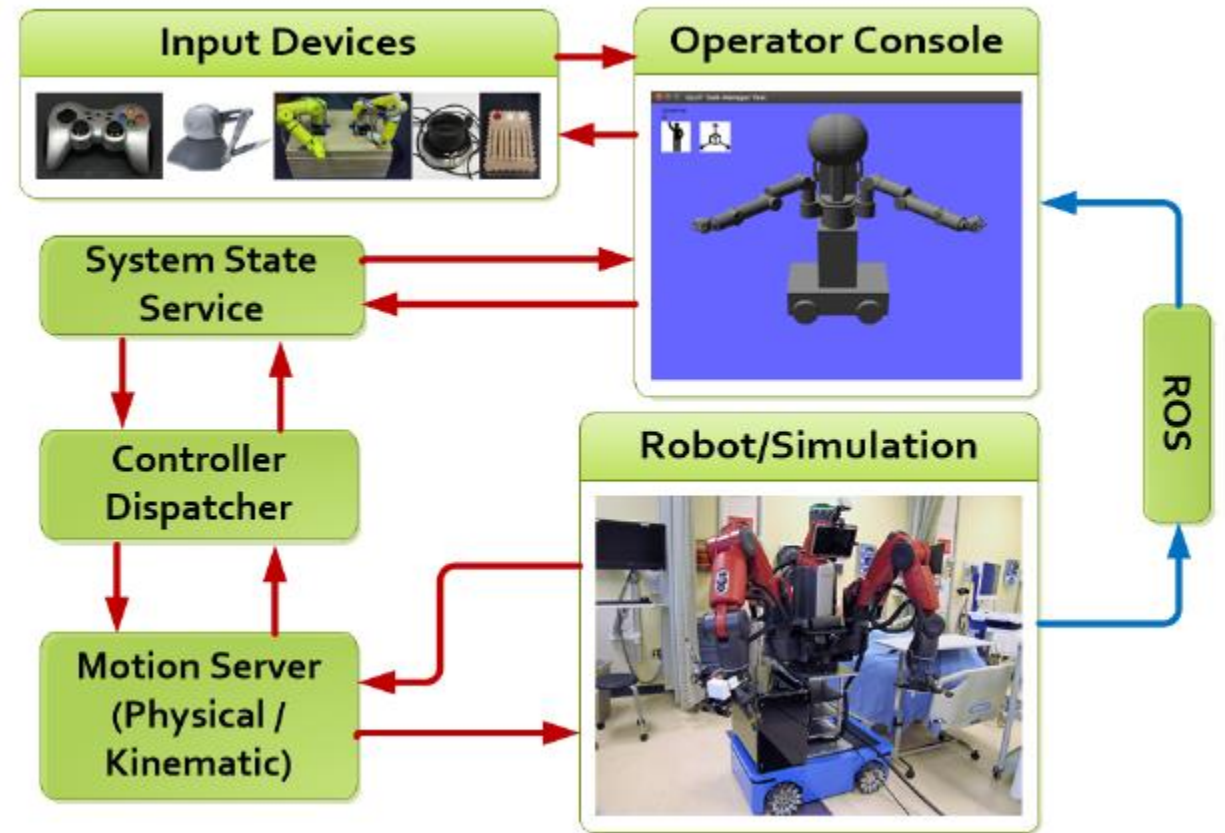
Code structure

- ## Primary workspace

  - iml-internal/Ebolabot

- ## Controllable Task

  - UI/TaskGenerators

  - Controller/Task

To work on TRINA, you need to know ...

- ROS Kinetic
  - Installation: http://wiki.ros.org/kinetic/Installation/Ubuntu
  - Must go through beginner tutorial

- Klampt – motion planning software
  - http://motion.pratt.duke.edu/klampt/
  - Installation
  - Go through tutorial

Klampt – Integrate motion planning with robot, environment, and sensors

Sitting on a sensed chair
Captured by Microsoft Kinect (>150,000 tris)

Klampt – Plan coordinated motion
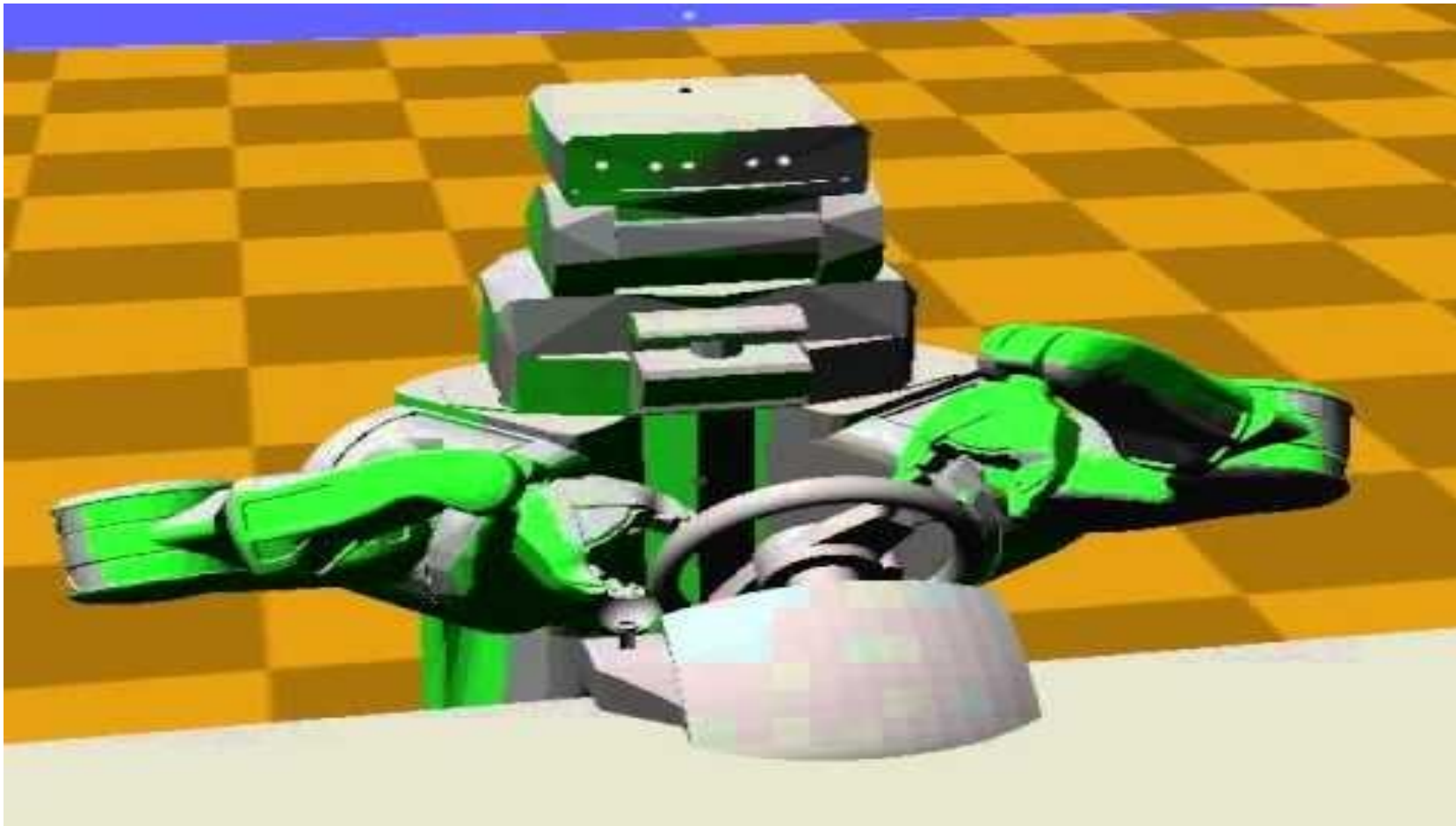
Klampt – Plan dexterous manipulation

Klampt – Plan locomotion

RobotSim with Hubo-Ach: Walking Example
Jingru Luo and Daniel M. Lofaro
2013-04-24

Reference

- [1] Zhi Li, Peter Moran, Qingyuan Dong, Ryan Shaw, Kris Hauser, "Development of a Tele-Nursing Mobile Manipulator for Remote Care-giving in Quarantine Areas", ICRA 2017

TA's instruction

Overview

- Lab Rules
- HiRo lab repository
- Documentation
- Installation Free-For-All

Lab Rules

- Be a good person

Lab Rules (continued)

- ## Cleanliness
  - Don't leave your belongings in the lab or projects set up when you aren't there. The lab is a shared space, and there is finite space.
  - If you bring food, be reasonable. If you're not sure what this means, don't bring food.
- ## Breaking things
  - Don't
  - If you don't know how to use it, get help
  - If you *do* break something, let someone (important) know
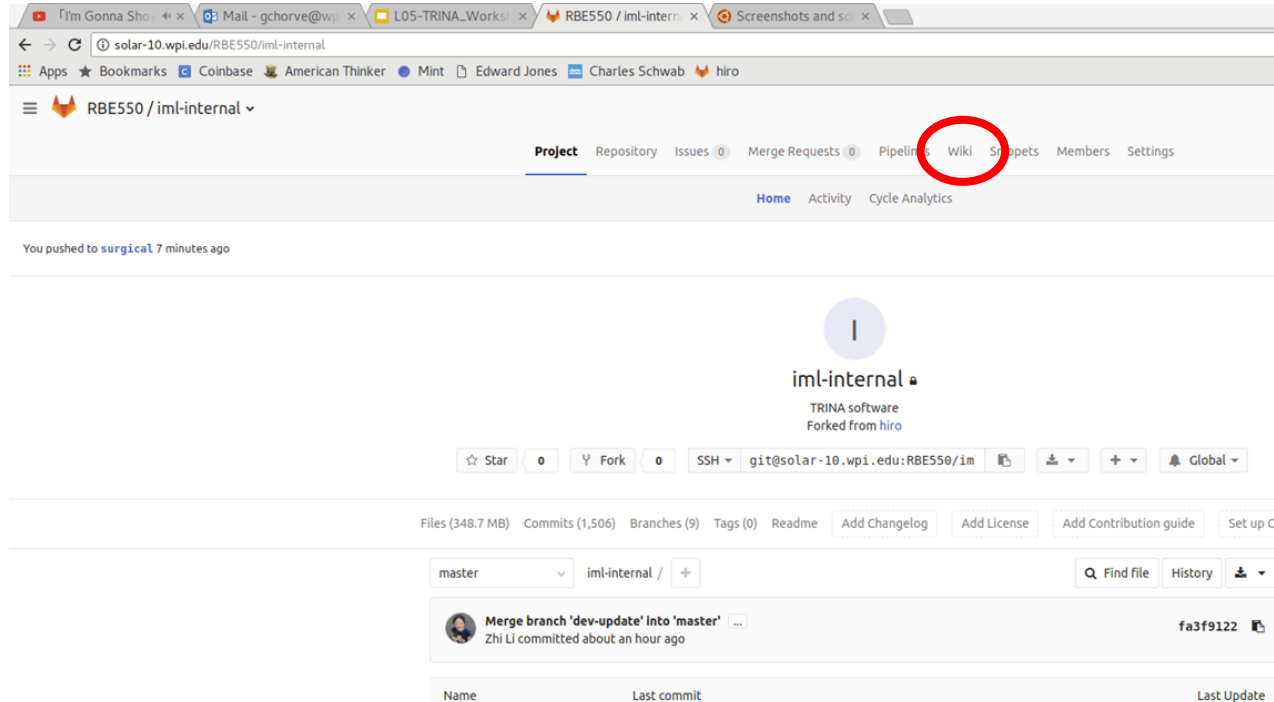
Lab Rules (continued)

- Noise
  - Music only iff everyone present in lab agrees
  - Shut up if someone asks you to
- Organization
  - Try to put things back where you found them
- No stealing
- No smelling
  - Shower, please

Class Repository (a.k.a., Ebolobot; a.k.a, TRINA; a.k.a., iml-internal; a.k.a....)

- You have access to a FORK of the Ebolabot stack at http://solar-10.wpi.edu/RBE550/iml-internal.
- Each team has its own branch
  - Never push to master, or I'll **delete your commits**.
  - You probably don't have permission, but still
- Code documentation ranges from o.k. to mediocre

Where *is* the [documentation?](#)

Installation Free For All

Good luck. Jane and I will be here.

End