Course Kickoff

ECE 495/595 Lecture Slides

Winter 2017

Instructor: Micho Radovnikovich

Intelligent Ground Vehicle Competition

1996

▷ International robotics
competition held at Oakland
University (www.igvc.org).

▷ Oakland has participated every
single year since the first
competition in 1993.

2012

What is ROS?

▷ Robot Operating System (ROS) is designed to simplify the development of robust and complex robot software.

▷ Contains a large collection of software libraries and tools that provide the developer with a very flexible programming environment.

▷ Backed by an ever-growing open-source development community.

▷ Quickly becoming a widely-used standard in research and industrial applications.

What is ROS?

▷ The ROS website describes ROS as a combination of plumbing, tools, capabilities and ecosystem (http://www.ros.org/about-ros/).

> **Plumbing** – Core functionality that enables the modularity and flexibility of ROS.

> **Tools** – Built-in tools for 3D visualization, parameter adjustment, physics simulation, etc.

> **Capability** – High level software packages that implement common robotics systems.

> **Ecosystem** – The vast and rapidly growing community that maintains, develops and contributes to ROS.

ROS at Oakland

▷ Oakland won the IGVC in 2013 and 2014 using ROS-based software

    > Replicant on the 2013 IGVC basic course:

▷ I used ROS to implement the systems in my dissertation:

    > Simulation of a differential-drive vehicle navigating to a waypoint while avoiding obstacles:

    > Real-time experiment of waypoint navigation:

    > Simulation of multiple robots moving in formation:

Overview of ROS Tools

▷ Discussion of the motivation behind developing ROS, and an overview of its capabilities: ▶

▷ A nice, quick overview of the common ROS tools starts at the 10:18 point in the video: ▶

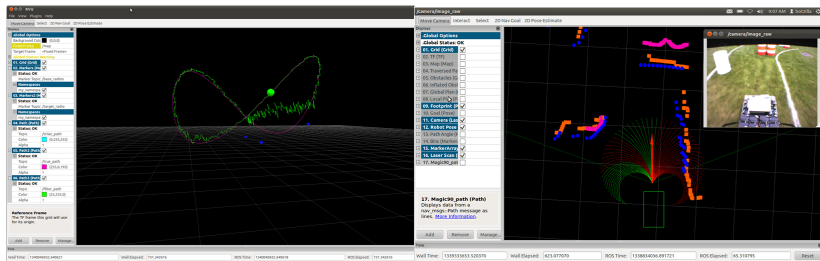# Overview of ROS Tools

rosbag, dynamic_reconfigure and image_view

▷ Data can be easily recorded and played back.

▷ Parameters can be adjusted at run-time.

▷ Image processing output can be visualized in real-time.
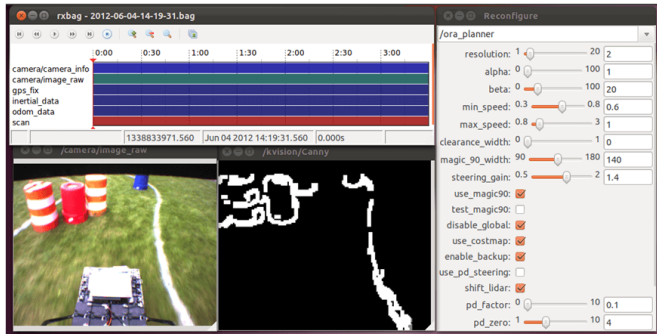
Overview of ROS Tools

Rviz

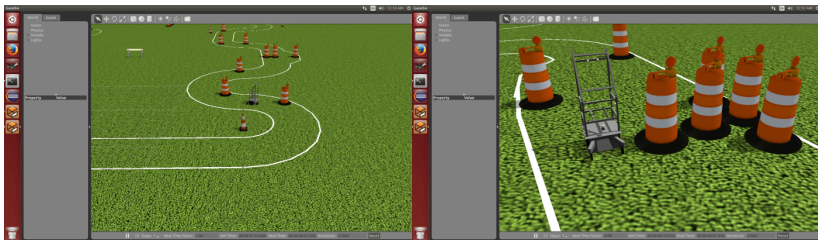▷ 3-D visualization tool for both simulated and real-time systems.

Overview of ROS Tools

Gazebo

▷ Open-source physics simulator that can be used to construct realistic simulation environments and sensor data.

Companies Using ROS

▷ Fraunhofer IPA

▷ Clearpath Robotics

▷ Shadow Robot Company

▷ Southwest Research Institute (SwRI)

▷ Rethink Robotics

▷ . . . and several more!

ROS at Dataspeed Inc.

 ▷ Omnidirectional base for Baxter

 ▷ First-person trainer for Baxter

 ▷ Amazon Picking Challenge

 ▷ 3-D mapping using a Velodyne LIDAR

 ▷ ADAS development kit