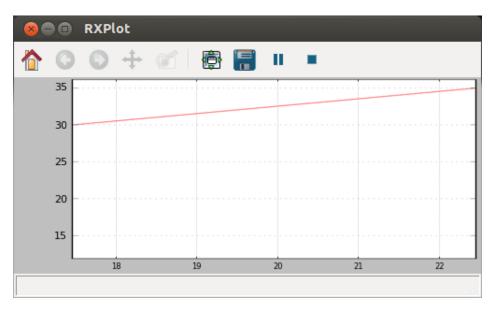
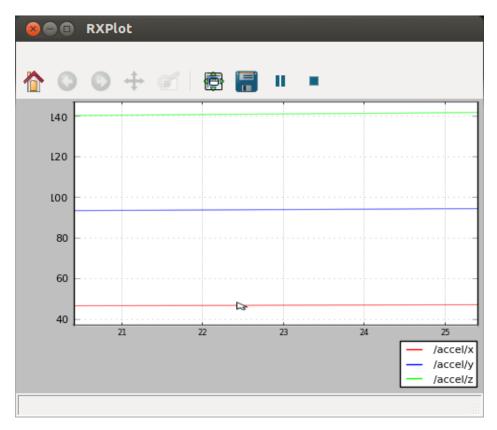
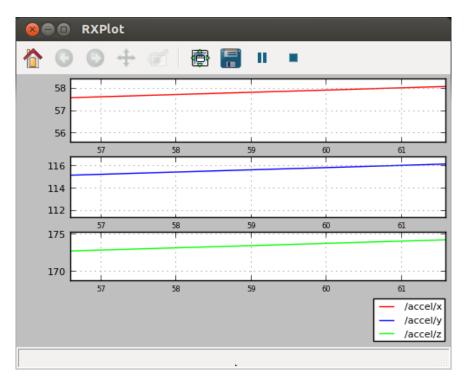
Chapter 3, Debugging and Visualization



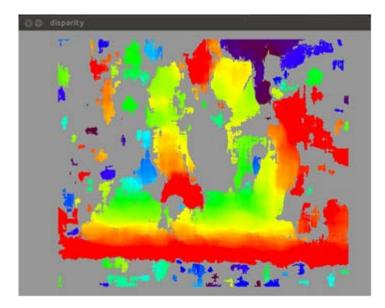
Plot that changes over time with incoming messages



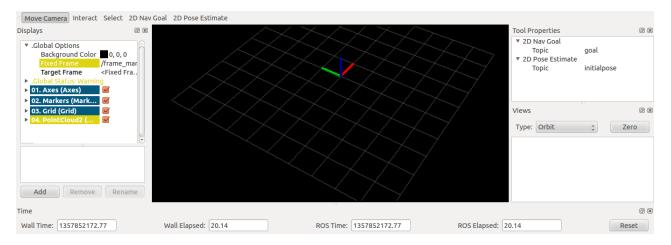
The rxplot /accel/x:y:z plot



The rxplot /accel/x /accel/y /accel/z plot

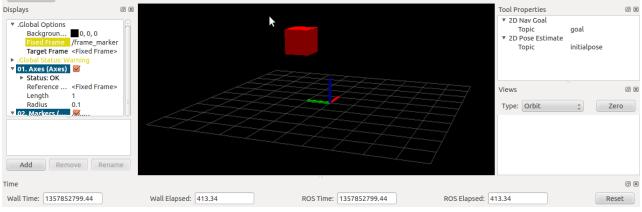


Disparity images

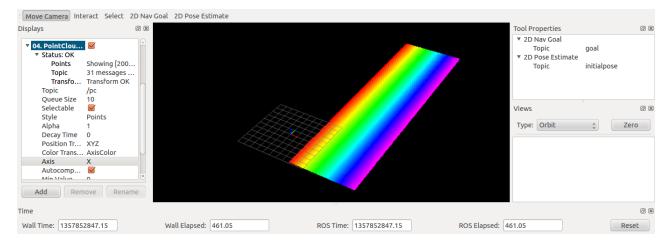


The rviz graphical interface

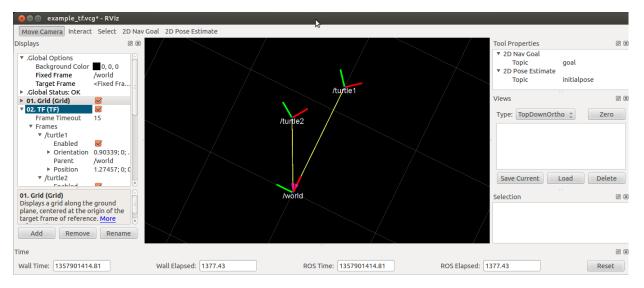
Move Camera Interact Select 2D Nav Goal 2D Pose Estimate



Setting the frame_id of the marker, that is frame_marker, in the fixed frame

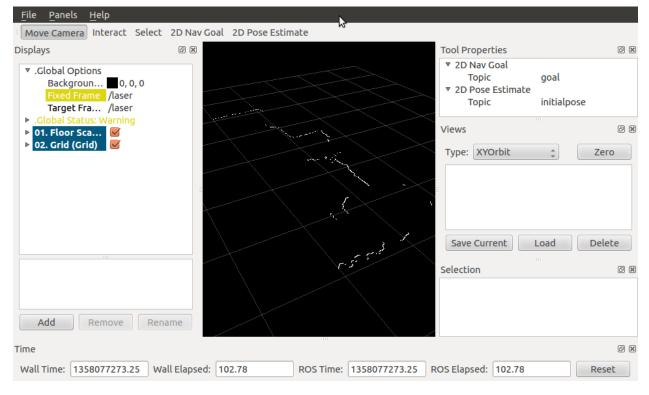


Setting the fixed frame to frame_pc



Two frames of each turtle are shown with respect to the /world frame

Chapter 4, Using Sensors and Actuators with ROS



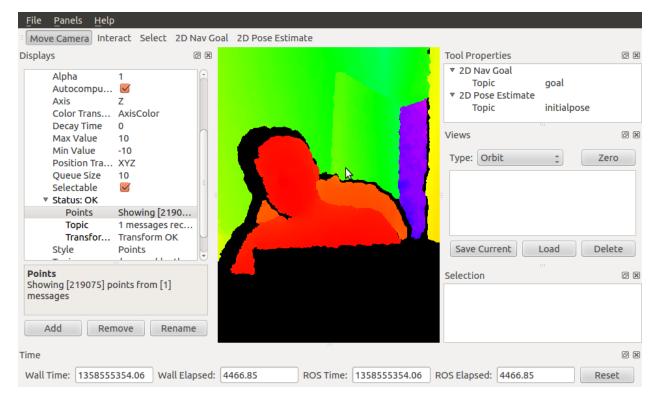
Laser sending in the data in ROS

<u>F</u> ile <u>P</u> anels <u>H</u> elp			
Move Camera Interact Select	2D Nav Goal	2D Pose Estimate	
Displays		Tool Prope	erties 🛛 🕅
 ▼.Global Options Backgroun ■ 0, 0, 0 Fixed Frame Target Frame /laser 		▼ 2D Nav Topi ▼ 2D Pos Topi	ic goal e Estimate
 .Global Status: Warning 01, Floor Sca 		Views	e x
 02. Grid (Grid) 03. LaserSca Status: OK Topic /scan2 Queue Size 10 		Type: X	'Orbit 🛟 Zero
Selectable Style Points Alpha 1 Decay Time 0	J	Save Cu	rrent Load Delete
8 90 T 1007		j ⁷ J Selection	
Add Remove Rena	ame		
Time			8 X
Wall Time: 1358085908.73 Wa	ll Elapsed: 21.	30 ROS Time: 1358085908.73 ROS Elapsed	: 21.30 Reset

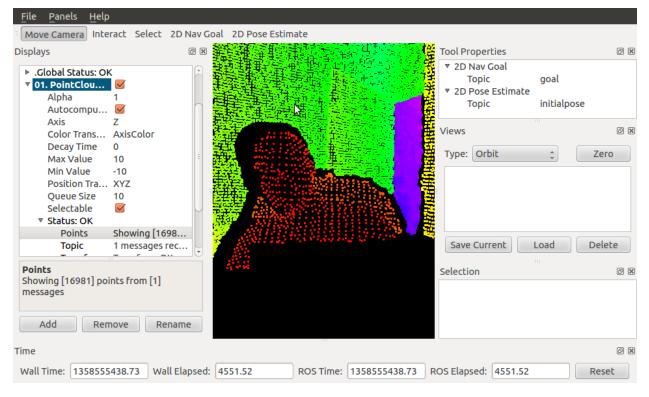
The rviz screen with the two-lasers contour. The green contour is the new data.



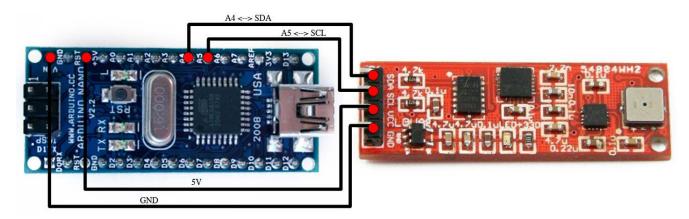
Using the depth sensor



Add a new PointCloud2 data visualization for 3D

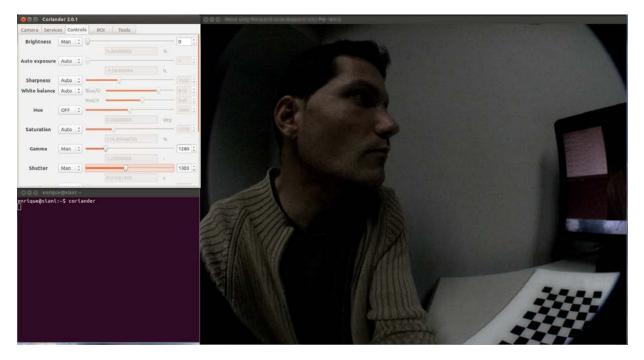


Resolution is less than the original data



Low-cost IMU - 10 degrees of freedom

Chapter 6, Computer Vision



Configuration in Coriander



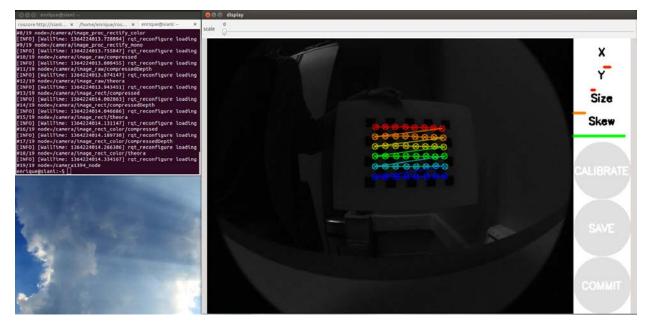
Configuration in Coriander with better exposure



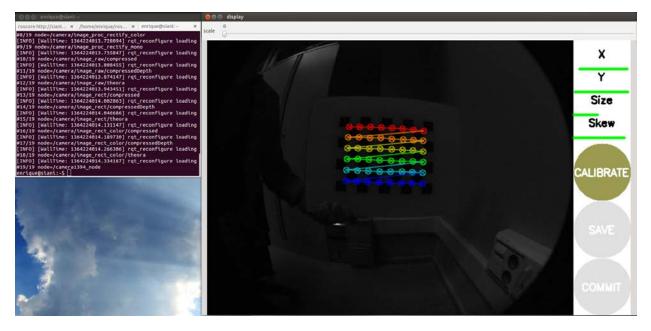
RAW image of the USB camera, which is in color



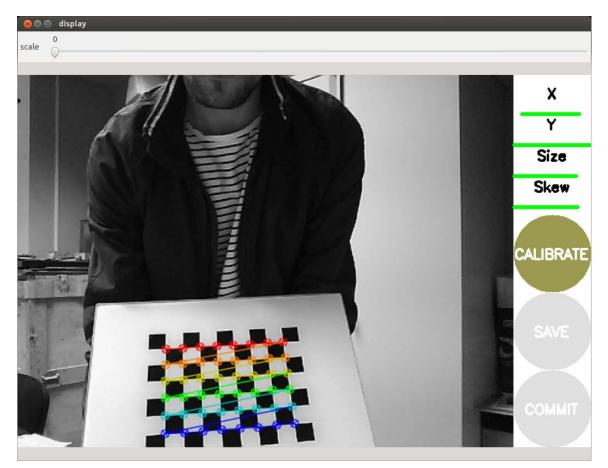
Visualization of the camera images with image_view



Calibrating the camera



Calibrating the camera



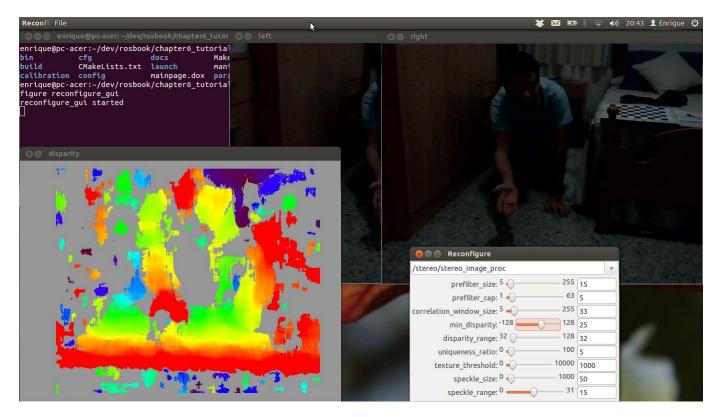
The calibration process in the GUI, identical to the one with FireWire cameras



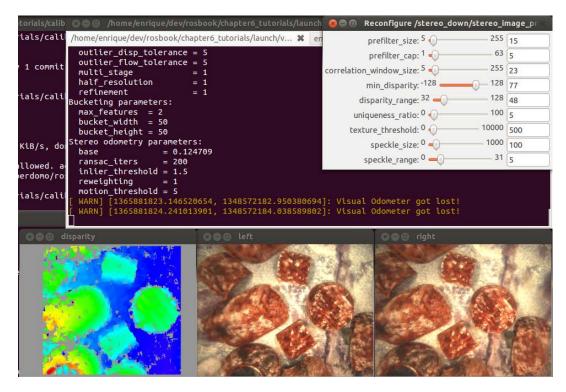
The end of the calibration process



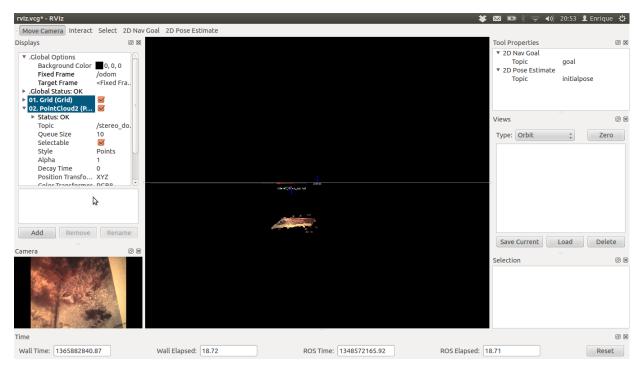
Stereo Calibration



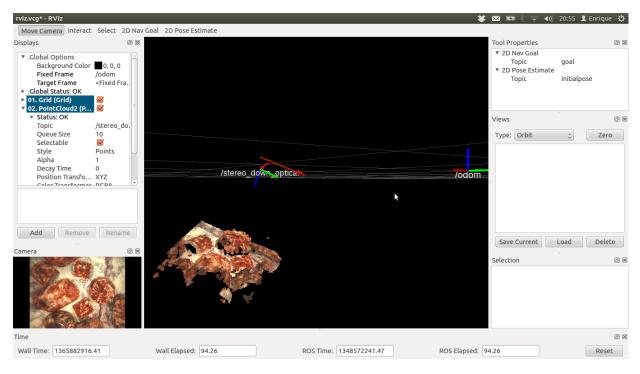
Using disparity parameters, which can be set with reconfigure_gui



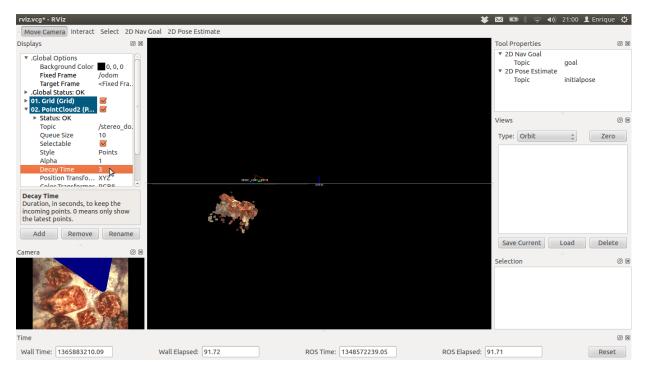
The left, right, and disparity images, and the reconfigure_gui interface used to configure the disparity algorithm



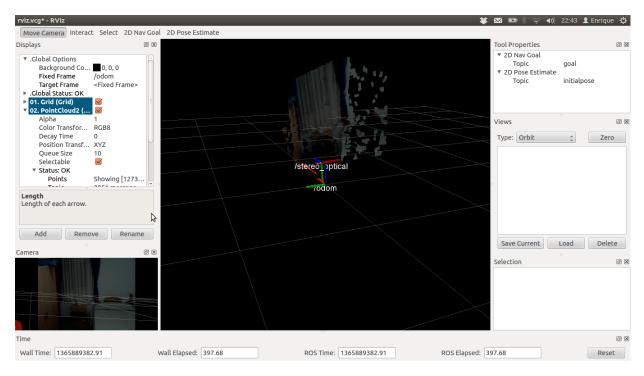




A closer view

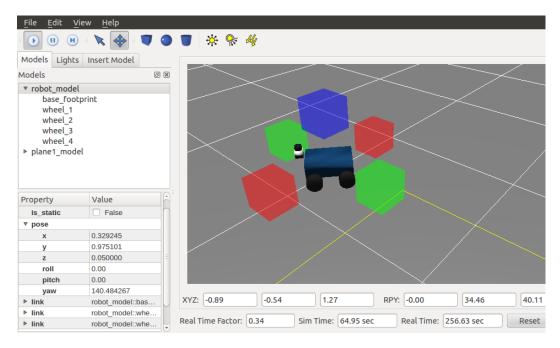


3D reconstruction using the visual odometry

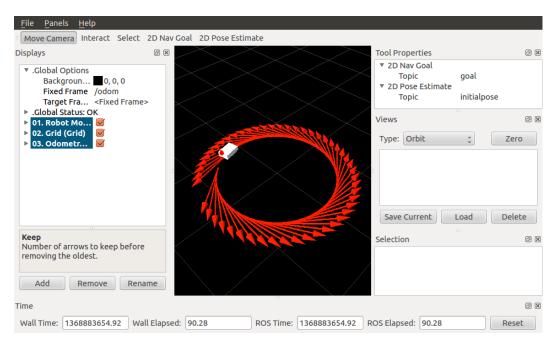


A visual odometry system running for our low-cost stereo camera

Chapter 7, Navigation Stack – Robot Setups



The Gazebo simulator showing robot properties and data

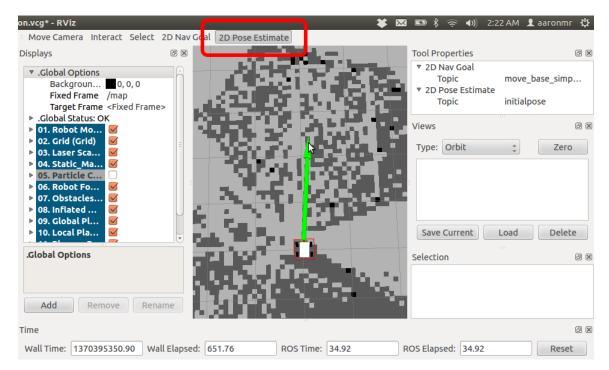


The robot moving over red arrows (grid) as you published a new tf frame transform

File Panels Help Move Camera Interact Select 2D Nav Goal 2D Pose Estimate Displays Tool Properties 6 X 6 X ▼ 2D Nav Goal Global Options move_base_simp... Topic Backgroun... 0, 0, 0 ▼ 2D Pose Estimate Fixed Frame /map Target Frame <Fixed Frame> initialpose Торіс .Global Status: OK Views 6 X 01. Robot Mo.. 02. Grid (Grid) \checkmark Type: Orbit Zего * 03. Laser Sca... 04. Static Ma... \checkmark 05. Particle C... \checkmark 06. Robot Fo... $\overline{\checkmark}$ 07. Obstacles.. \checkmark 08. Inflated ... 09. Global Pl... \checkmark \checkmark $\overline{\checkmark}$ 10. Local Pla... Save Current Load Delete 11. Planner P.. \checkmark Current G Selection 0 X Add Remove Rename Time 6 × Wall Time: 1370389639.58 Wall Elapsed: 264.03 ROS Time: 26.72 ROS Elapsed: 26.72 Reset

Chapter 8, Navigation Stack – Beyond Setups

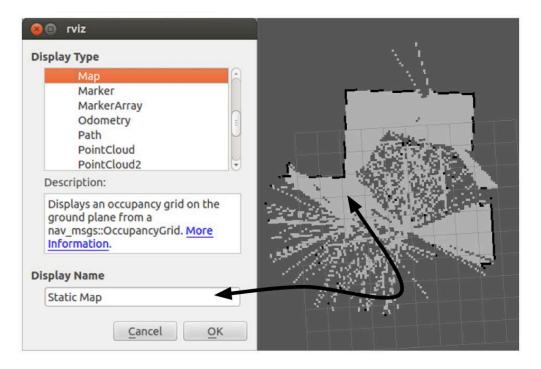
\$ roslaunch chapter8_tutorials move_base.launch



Use of initialpose



Use of /move_base_simple/goal



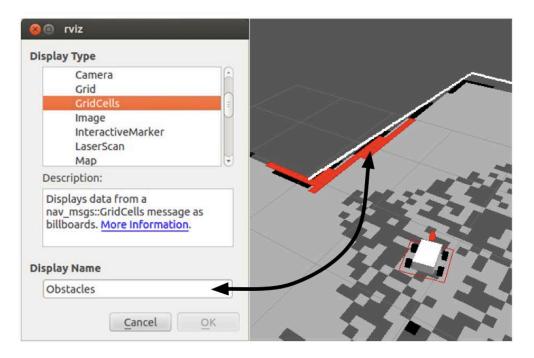
A static map

😣 🗉 rviz	- ielen
Display Type	
Polygon Pose	Alexandre and a second s
PoseArray	
Range RobotModel TF ▼ rviz_plugin_tutorials	
Description:	Electron a law and
Displays the poses from a geometry_msgs::PoseArray message as a cloud of arrows on the ground plane. <u>More Information</u>	
Display Name	
Particle Cloud	
<u>Cancel</u> <u>OK</u>	H

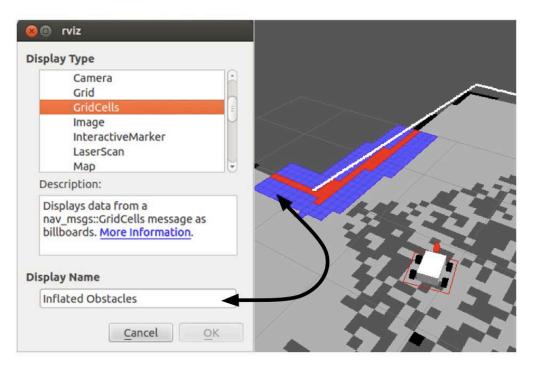
A particle cloud

😣 🗊 rviz	
Display Type	
Odometry Path PointCloud PointCloud2	
Polygon Pose PoseArray	
Description:	
Displays data from a geometry_msgs::Polygon message as lines. More Information.	
Display Name	
Robot Footprint	
<u>C</u> ancel <u>O</u> K	

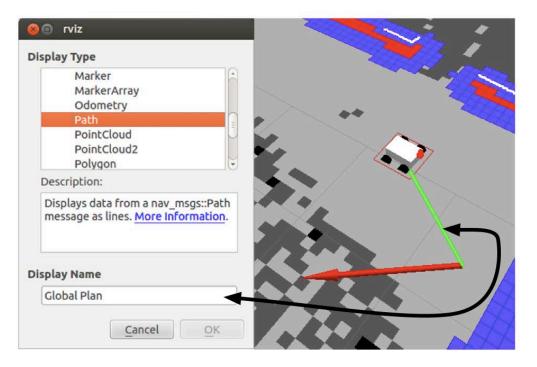
Robot footprint



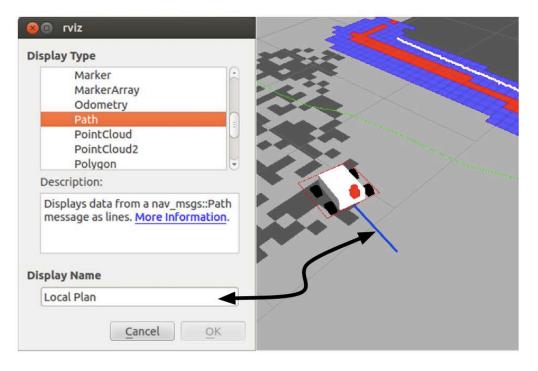
Obstacles



Inflated obstacles



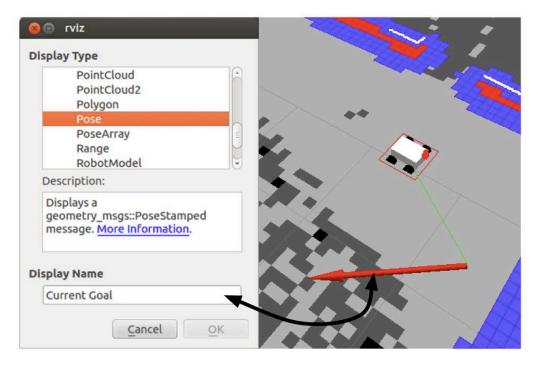
Global Plan



Local Plan

😣 🗈 rviz	
Display Type	
Marker MarkerArray Odometry Path PointCloud PointCloud2 Polygon	
Description:	A CONTRACT OF THE OWNER OWNER OF THE OWNER OF THE OWNER OF THE OWNER OWNE OWNER OWNE
Displays data from a nav_msgs::Path message as lines. More Information.	
Display Name	\rightarrow
Planner Plan	
<u>C</u> ancel <u>O</u> K	

Planner Plan



Current Goal

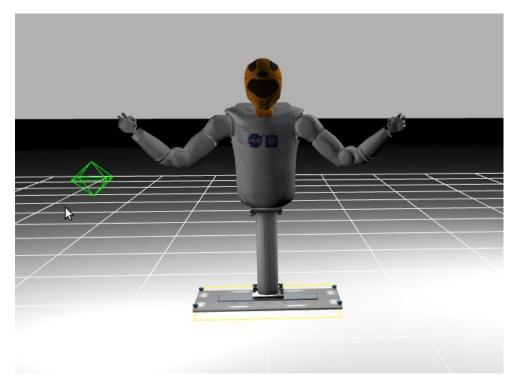
Move Camera Interact Select	2D Nav Goal 2D Pos		Tool Properties	0 1
 ▶ 05. Particle C ▶ 06. Robot Fo ▶ 07. Obstacles ▶ 08. Inflated 			 ✓ 2D Nav Goal Topic ✓ 2D Pose Estimate Topic 	move_base_simp
 ▶ 09. Global Pl ▶ 10. Local Pla 	1 × 3		Views	0 8
▶ 11. Planner P 🗹 ▼ 12. Current G 🗹	= ǎ 🏄	23 D. 194	Type: Orbit	‡ Zero
Topic /goal Shape Arrow ▼ Shape Properties Color 255, 25, 0 Alpha 1 Shaft L 1			Save Current	Load Delete
Topic geometry msgs::PoseStamped to			Selection	Ø
to subscribe to.	ame		Global Plan	
ime				8
			.59 ROS Elapsed: 379.59	

Avoiding obstacles

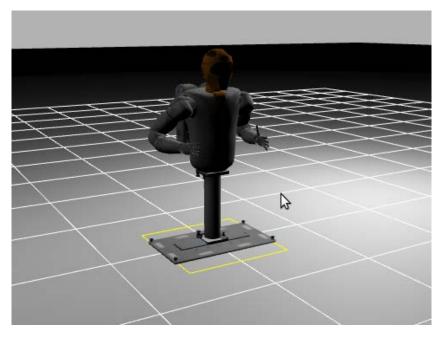


Sending Goals

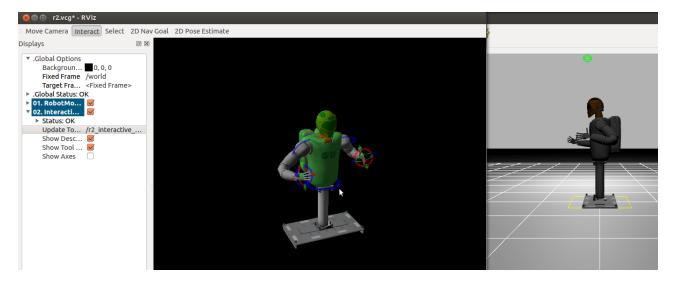
Chapter 9, Combining Everything – Learn by Doing



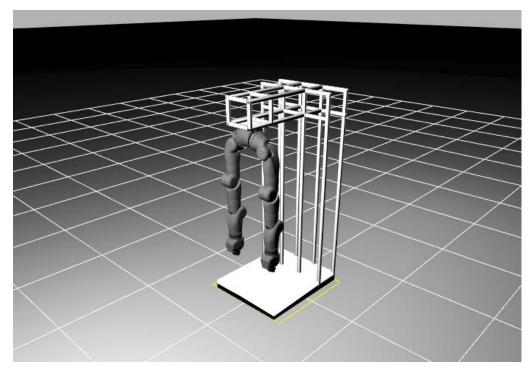
The R2 in the Gazebo empty world



Controlling the R2 arms



Controlling the robot easily with interactive markers



The R2 IVA climbing legs of a real Robonaut model



The R2 on the pedestal inside of the ISS world loaded in Gazebo



The R2 with the Task Board