Tutorial: Creating a Velodyne sensor

The Future of Robocup Rescue Simulation Workshop
March 1, 2016

Open Source Robotics Foundation

Humanoids

Atlas

- http://gazebosim.org/tutorials?cat=drcsim
- Issue: No open-source controller

Nao (via Robocup soccer simulation league)

- https://github.com/robocup-logistics/gazebo-rcll
- Issue: Again, no open-source controller

Others

- Hubo, Robonaut 2, Valkyrie

Velodyne HDL-32

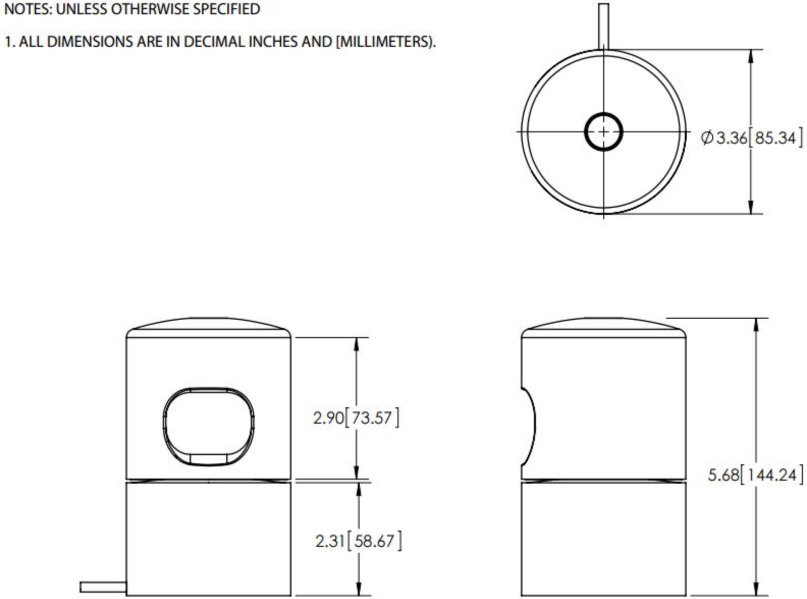
Tutorial for demonstration purposes

Collect information

- http://velodynelidar.com/hdl-32e.html
- Physical properties

  Dimension, mass, joints
- Sensor properties

  Type of sensor (sonar, camera, lidar)
  Accuracy, range, etc.


NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIMENSIONS ARE IN DECIMAL INCHES AND [MILLIMETERS].
Ø3.36[85.34]
2.90[73.57]
2.31[58.67]
5.68[144.24]

Create the SDF model

http://gazebosim.org/tutorials?tut=guided_i1

Start simple and build the model progressively

- Use simple shapes
- Ignore joints, inertia

Use available tools

- Start simulation paused (-u command line argument)
- Visualize model properties: collision, joint, inertia
- Joint command widget to verify joint properties

Future tools

- Graphical model editor
- Plotting utility

Create the SDF model: Steps

http://gazebosim.org/tutorials?tut=guided_i1

Step 1: Create a simple model

Step 2: Add Inertia

Step 3: Add the joint

Step 4: Add the sensor

Model appearance

http://gazebosim.org/tutorials?tut=guided_i2

Importance

- Improve user experience
- Improve sensor data, such as from cameras

How?

- Use pre-generated 3D meshes, create your own, use an artist
- Same applies for textures

Advanced

- Normal maps, for improved lighting effects
- Custom GL shaders

Model appearance: Steps

http://gazebosim.org/tutorials?tut=guided_i2

Step 1: Mesh Acquisition

Step 2: Add meshes to SDF

Step 3: Textures

Sensor Noise

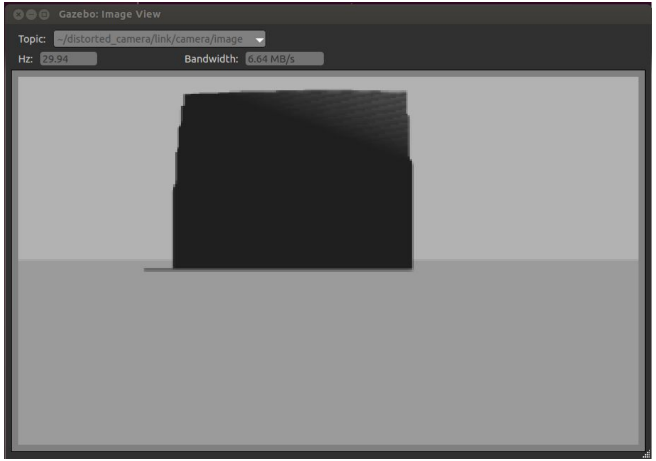
http://gazebosim.org/tutorials?tut=guided_i3

Why?

- Data from simulation can be too perfect
- Modify output to match physical properties
  - Lens effects, noise

How?

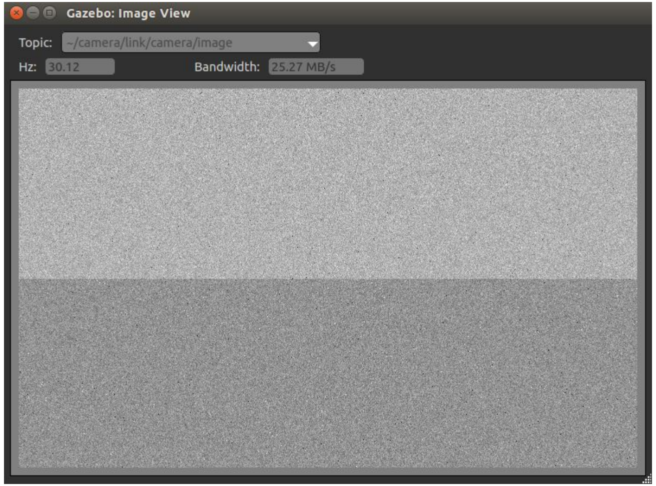
- A: Use Gazebo's internal noise models
- B: Write a plugin to modify sensor data
- C: Pass data through a ROS node



Gazebo: Image View

Topic: ~/distorted_camera/link/camera/image

Hz: 29.94 Bandwidth: 6.64 MB/s



Gazebo: Image View

Topic: ~/camera/link/camera/image

Hz: 30.12 Bandwidth: 25.27 MB/s

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Sensor Noise: Steps

http://gazebosim.org/tutorials?tut=guided_i3

Step 1: Visualize data

Step 2: Add noise

Contribute model

http://gazebosim.org/tutorials?tut=guided_i4

Why?

- Let Gazebo manage your resources
  - Auto-download
  - Share materials and meshes between models
- Don’t re-invent the wheel
  - Other users benefit from your contribution

How?

- Fork https://bitbucket.org/osrf/gazebo_models
- Add your model
- Create pull-request

Plugin

http://gazebosim.org/tutorials?tut=guided_i5

Purpose

Attach custom code to simulation

Types

Model: Control the model & its joints

Sensor: Modify data generation

World: Monitor/modify models and world properties

System: Control system startup

API: http://gazebosim.org/api

Plugin: Steps

http://gazebosim.org/tutorials?tut=guided_i5

Step1: Create workspace

Step 2&3: Write the plugin & build script

Step 4: Attach plugin to model

Step 5: Create an API

Step 6: Test

Connect to ROS

http://gazebosim.org/tutorials?tut=guided_i6

Access to the ROS ecosystem

- Rviz, MoveIt, RQT, SLAM, etc

Approaches

- Use or write a plugin for http://wiki.ros.org/gazebo_ros_pkgs
- Directly add ROS to your Gazebo plugin

[Step 1: Add ROS transport]

[Step 2: Control Velodyne]

[Step 3: Visualize in Rviz] (https://bitbucket.org/DataspeedInc/velodyne_simulator/src)