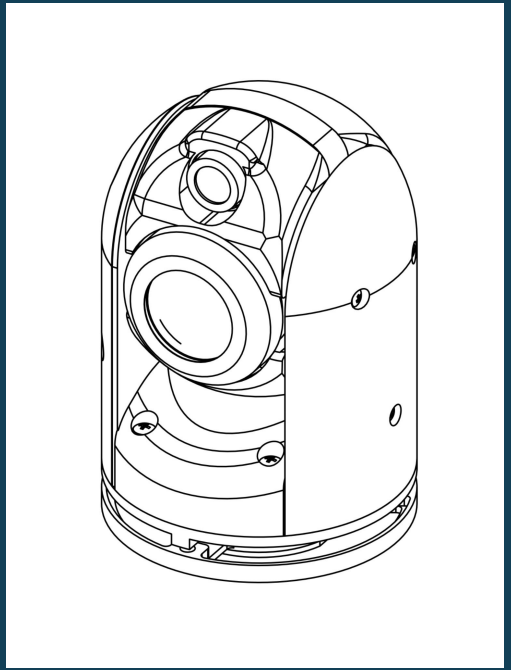
Gimbal Pointing

A Gazebo Adventure

Jae Lee, Abe Martin



Introduction

Abe Martin
Jae Lee

1

Problem Overview

What are we trying to do?

Objective

Create a two-axis gimballed camera that can be controlled and attached to any other Gazebo model.

Starting Questions

- How to create a model in Gazebo?
- How to attach a camera sensor to the model?
- How to publish the camera view?
- How to give commands to the gimbal?
- How to make the gimbal obey commands?

Learning Experiences

Tutorials We Tried:

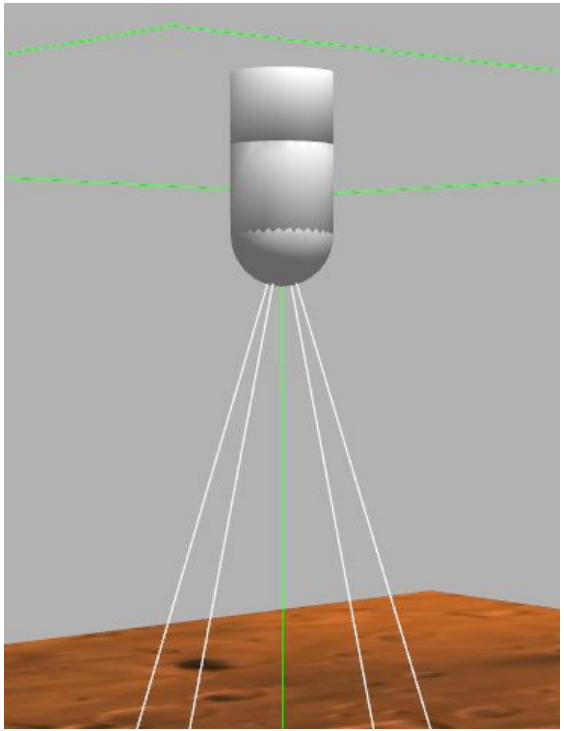
- http://gazebosim.org/tutorials?cat=guided_i&tut=guided_i1
- http://gazebosim.org/tutorials?tut=build_model&cat=build_robot
- http://gazebosim.org/tutorials?tut=build_robot&cat=build_robot
- http://gazebosim.org/tutorials?tut=add_laser&cat=build_robot
- http://gazebosim.org/tutorials?tut=plugins_hello_world&cat=write_plugin
- http://gazebosim.org/tutorials?tut=plugins_model&cat=write_plugin
- http://gazebosim.org/tutorials?tut=ros_overview&cat=connect_ros
- http://gazebosim.org/tutorials?tut=ros_wrapper_versions&cat=connect_ros
- http://gazebosim.org/tutorials?tut=ros_urdf&cat=connect_ros
- http://gazebosim.org/tutorials?tut=ros_gzplugins&cat=connect_ros
- http://gazebosim.org/tutorials?tut=ros_control&cat=connect_ros
- http://gazebosim.org/tutorials?tut=ros_comm&cat=connect_ros
- http://gazebosim.org/tutorials?tut=ros_plugins&cat=connect_ros
- http://gazebosim.org/tutorials?cat=guided_i&tut=guided_i5
- http://gazebosim.org/tutorials?cat=guided_i&tut=guided_i6
- https://magiccvs.byu.edu/wiki/Gazebo_Tutorials:Overview

2

Gimbal Model

Geometry in Gazebo

A gimbal is worth a thousand words



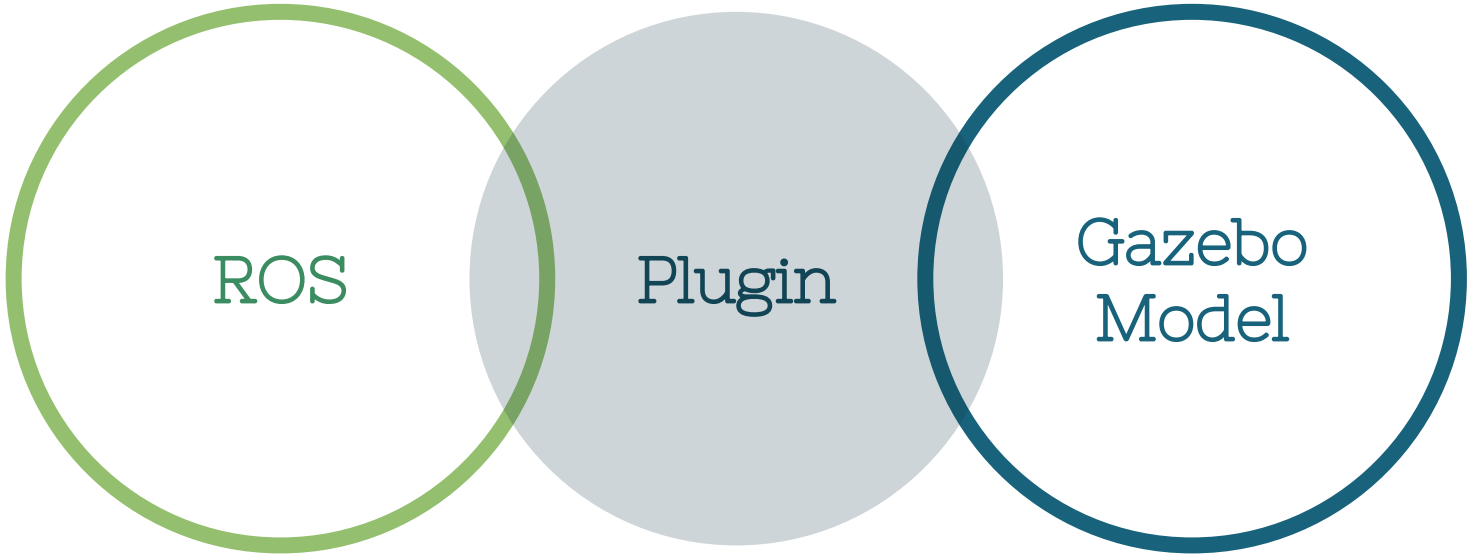
```
<world name="default">

  <include>
    <uri>model://ground_plane</uri>
  </include>

  <include>
    <uri>model://sun</uri>
  </include>
  <include>
      <uri>model://mars</uri>
  </include>

  <model name="pan_tilt_camera">
    <pose>0 0 10 0 0 0</pose>
    <link name="base">
      <!-- Offset the base by half the length of the cylinder -->
      <pose>0 0 0.029335 0 0 0</pose>
      <inertial>
        <mass>1.2</mass>
        <inertia>
          <ixx>0.001087473</ixx>
          <iyy>0.001087473</iyy>
          <izz>0.001092437</izz>
          <ixy>0</ixy>
          <ixz>0</ixz>
          <iyz>0</iyz>
        </inertia>
      </inertial>
      <collision name="base_collision">
        <geometry>
      <cylinder>
        <!-- Radius and length provided by Velodyne -->
        <radius>.04267</radius>
        <length>.05867</length>
      </cylinder>
        </geometry>
      </collision>
      <!-- The visual is mostly a copy of the collision -->
      <visual name="base_visual">
        <geometry>
      <cylinder>
        <radius>.04267</radius>
        <length>.05867</length>
      </cylinder>
        </geometry>
      </visual>
    </link>

    <!-- Give the base link a unique name -->
    <link name="top">
      <!-- Vertically offset the top cylinder by the length of the bottom
```

3

Gimbal Control

Use the force...

Gazebo Plugin



Key Plugin Commands

PD Controller

Setpoint -> Desired Angle

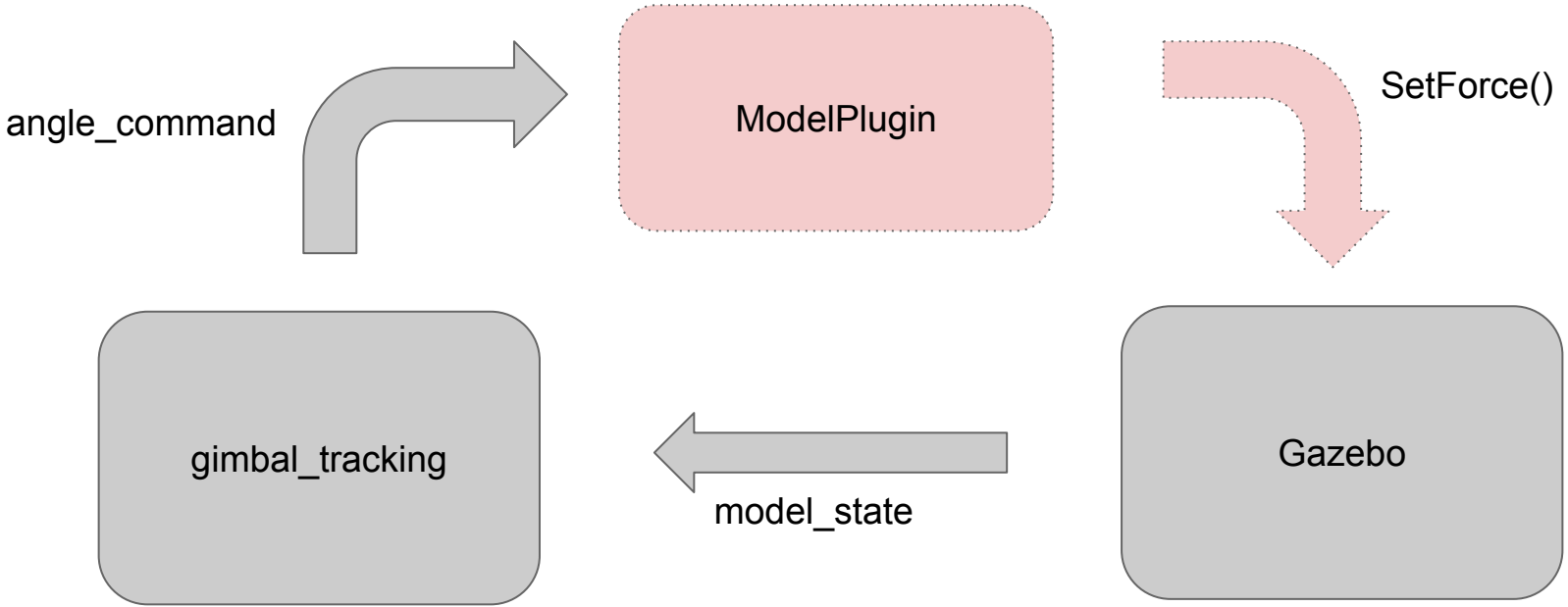
Error = Desired Angle - Current Angle

Error Derivative = (Error - Previous Error)/Time Step

Force = Kp*Error + Kd*Error Derivative

Set Force

ROS Publisher / Subscriber



Joystick Control

Get joystick command with:

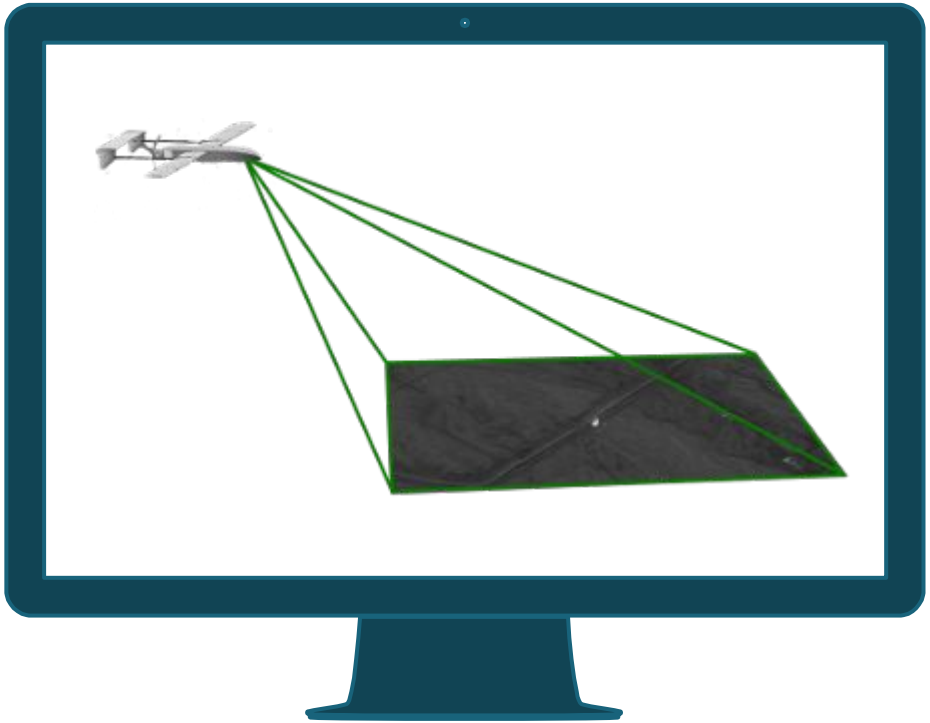
<node pkg="joy" type="joy_node" name="joy" />

Translate to azimuth and elevation:

<node pkg="teleop_twist_joy" type="teleop_node" name="teleop" />

Gimbal Tracking Control

Camera is pointed automatically based on target location.



Gimbal Tracking Equations

Flat Earth Model

$$ell\_i = p\_obj - p\_MAV$$

$$ell\_b = 1/norm(ell\_i)*R\_i\_b*ell\_i$$

$$az\_c = -asin(ell\_b.z)$$

$$el\_c = atan2(ell\_b.y/ell\_b.x)$$

4

Demo

The Fun Part

Lessons Learned

- URDF vs SDF File
  - Pick one and stay with it.
- Gazebo vs Gazebo for ROS
  - Easier to start with ROS if Gazebo will be used for ROS
- Know where Gazebo and ROS keep their files
  - /opt/ros/indigo/share/
  - ~/.gazebo/models
  - /usr/share/gazebo-2.2
- Keep environment variables straight
- Don’t trust any single Gazebo tutorial

THANKS!

Any questions?