Gazebo Sim (Harmonic) Plugins and Sensors for ROS2

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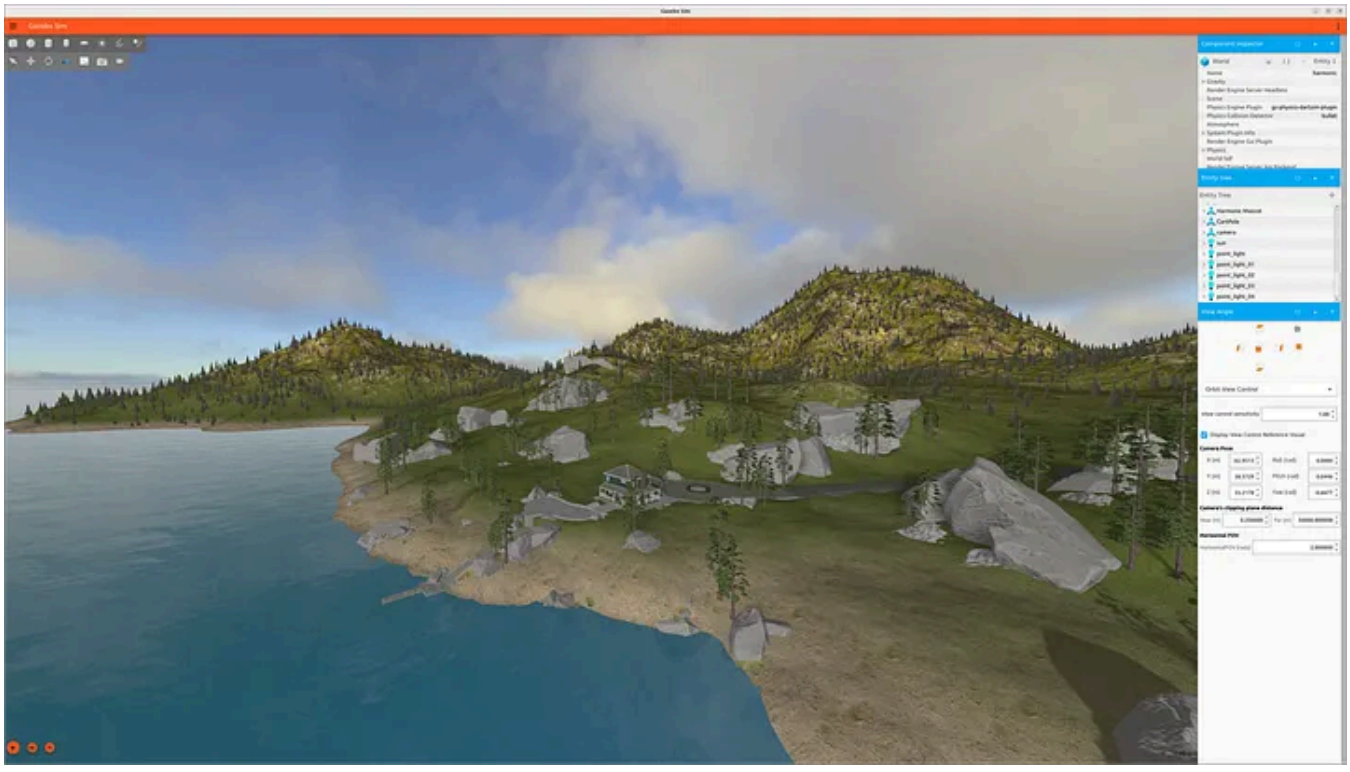
You can access code examples from this GitHub repository. The repository includes a variety of sensor applications for simulation. I'm thinking about adding content on how to use GazeboSim sensor data with **ROS2** and **RViz2**. If you're interested in integrating with ROS2, let me know with a like or comment. Stay tuned, and happy reading!



Gazebo Sim Harmonic

Sensors

GPU Lidar

```
<sensor name="gpu_lidar" type="gpu_lidar">
        <lidar>
          <scan>
            <horizontal>
              <samples>1800</samples>
              <resolution>1</resolution>
              <min_angle>-3.1459</min_angle>
              <max_angle>3.1459</max_angle>
            </horizontal>
            <vertical>
              <samples>16</samples>
              <resolution>1</resolution>
              <min_angle>-0.261799</min_angle>
              <max_angle>0.261799</max_angle>
            </vertical>
          </scan>
          <range>
            <min>0.05</min>
            <max>100</max>
            <resolution>0.01</resolution>
          </range>
          <noise>
            <type>gaussian</type>
            <mean>0</mean>
            <stddev>0.01</stddev>
          </noise>
        </lidar>
        <gz_frame_id>saye/sensor_link</gz_frame_id>
        <topic>laser_scan</topic>
        <visualize>true</visualize>
        <update_rate>10</update_rate>
      </sensor>
```

IMU

```
      <!-- IMU  -->
      <sensor name="imu_sensor" type="imu">
        <always_on>1</always_on>
        <update_rate>50</update_rate>
        <imu>
          <enable_orientation>0</enable_orientation>
          <angular_velocity>
            <x>
              <noise type="gaussian">
```

```
          <mean>0</mean>
          <stddev>0.009</stddev>
          <bias_mean>0.00075</bias_mean>
          <bias_stddev>0.005</bias_stddev>
          <dynamic_bias_stddev>0.00002</dynamic_bias_stddev>
          <dynamic_bias_correlation_time>400.0</dynamic_bias_correlation_
          <precision>0.00025</precision>
        </noise>
      </x>
      <y>
        <noise type="gaussian">
          <mean>0</mean>
          <stddev>0.009</stddev>
          <bias_mean>0.00075</bias_mean>
          <bias_stddev>0.005</bias_stddev>
          <dynamic_bias_stddev>0.00002</dynamic_bias_stddev>
          <dynamic_bias_correlation_time>400.0</dynamic_bias_correlation_
          <precision>0.00025</precision>
        </noise>
      </y>
      <z>
        <noise type="gaussian">
          <mean>0</mean>
          <stddev>0.009</stddev>
          <bias_mean>0.00075</bias_mean>
          <bias_stddev>0.005</bias_stddev>
          <dynamic_bias_stddev>0.00002</dynamic_bias_stddev>
          <dynamic_bias_correlation_time>400.0</dynamic_bias_correlation_
          <precision>0.00025</precision>
        </noise>
      </z>
    </angular_velocity>
    <linear_acceleration>
      <x>
        <noise type="gaussian">
          <mean>0</mean>
          <stddev>0.021</stddev>
          <bias_mean>0.05</bias_mean>
          <bias_stddev>0.0075</bias_stddev>
          <dynamic_bias_stddev>0.000375</dynamic_bias_stddev>
          <dynamic_bias_correlation_time>175.0</dynamic_bias_correlation_
          <precision>0.005</precision>
        </noise>
      </x>
      <y>
        <noise type="gaussian">
          <mean>0</mean>
          <stddev>0.021</stddev>
          <bias_mean>0.05</bias_mean>
          <bias_stddev>0.0075</bias_stddev>
          <dynamic_bias_stddev>0.000375</dynamic_bias_stddev>
          <dynamic_bias_correlation_time>175.0</dynamic_bias_correlation_
          <precision>0.005</precision>
```

```
            </noise>
          </y>
          <z>
            <noise type="gaussian">
              <mean>0</mean>
              <stddev>0.021</stddev>
              <bias_mean>0.05</bias_mean>
              <bias_stddev>0.0075</bias_stddev>
              <dynamic_bias_stddev>0.000375</dynamic_bias_stddev>
              <dynamic_bias_correlation_time>175.0</dynamic_bias_correlation_
              <precision>0.005</precision>
            </noise>
          </z>
        </linear_acceleration>
      </imu>
    </sensor>
```

Intel Real Sense D435 RGBD Camera

```
    <!-- Based on Intel realsense D435 (intrinsics and distortion not modelec
    <sensor name="rs_front" type="rgbd_camera">
      <pose>0.122 0 0.257 0 0.46 0</pose>
      <always_on>1</always_on>
      <update_rate>30</update_rate>
      <camera name="rs_front">
        <horizontal_fov>1.50098</horizontal_fov>
        <lens>
          <intrinsics>
            <!-- fx = fy = width / ( 2 * tan (hfov / 2 ) ) -->
            <fx>343.159</fx>
            <fy>343.159</fy>
            <!-- cx = ( width - 1 ) / 2 -->
            <cx>319.5</cx>
            <!-- cy = ( height - 1 ) / 2 -->
            <cy>179.5</cy>
            <s>0</s>
          </intrinsics>
        </lens>
        <distortion>
          <k1>0.0</k1>
          <k2>0.0</k2>
          <k3>0.0</k3>
          <p1>0.0</p1>
          <p2>0.0</p2>
          <center>0.5 0.5</center>
        </distortion>
        <image>
          <width>640</width>
```

```
        <height>360</height>
        <format>R8G8B8</format>
      </image>
      <clip>
        <near>0.01</near>
        <far>300</far>
      </clip>
      <depth_camera>
        <clip>
          <near>0.1</near>
          <far>10</far>
        </clip>
      </depth_camera>
      <noise>
        <type>gaussian</type>
        <mean>0</mean>
        <stddev>0.007</stddev>
      </noise>
    </camera>
  </sensor>
```

> *Front Camera*

```
  <sensor name="camera_front" type="camera">
    <pose>0.111 0.03 0.235 0 0 0</pose>
    <always_on>1</always_on>
    <update_rate>25</update_rate>
    <camera name="camera_front">
      <horizontal_fov>1.658</horizontal_fov>
      <lens>
        <intrinsics>
          <!-- fx = fy = width / ( 2 * tan (hfov / 2 ) ) -->
          <fx>329.9</fx>
          <fy>329.9</fy>
          <!-- cx = ( width - 1 ) / 2 -->
          <cx>359.5</cx>
          <!-- cy = ( height - 1 ) / 2 -->
          <cy>539.5</cy>
          <s>0</s>
        </intrinsics>
      </lens>
      <distortion>
        <k1>0.0</k1>
        <k2>0.0</k2>
        <k3>0.0</k3>
        <p1>0.0</p1>
        <p2>0.0</p2>
        <center>0.5 0.5</center>
```

```
      </distortion>
      <image>
        <width>720</width>
        <height>1080</height>
        <format>R8G8B8</format>
      </image>
      <clip>
        <near>0.01</near>
        <far>300</far>
      </clip>
      <noise>
        <type>gaussian</type>
        <mean>0</mean>
        <stddev>0.007</stddev>
      </noise>
    </camera>
  </sensor>
```

Rear Camera

```
  <sensor name="camera_rear" type="camera">
    <pose>0.069 -0.03 0.235 0 0 3.141592653589793</pose>
    <always_on>1</always_on>
    <update_rate>25</update_rate>
    <camera name="camera_rear">
      <horizontal_fov>1.658</horizontal_fov>
      <lens>
        <intrinsics>
          <!-- fx = fy = width / ( 2 * tan (hfov / 2 ) ) -->
          <fx>329.9</fx>
          <fy>329.9</fy>
          <!-- cx = ( width - 1 ) / 2 -->
          <cx>359.5</cx>
          <!-- cy = ( height - 1 ) / 2 -->
          <cy>539.5</cy>
          <s>0</s>
        </intrinsics>
      </lens>
      <distortion>
        <k1>0.0</k1>
        <k2>0.0</k2>
        <k3>0.0</k3>
        <p1>0.0</p1>
        <p2>0.0</p2>
        <center>0.5 0.5</center>
      </distortion>
      <image>
        <width>720</width>
```

```
        <height>1080</height>
        <format>R8G8B8</format>
      </image>
      <clip>
        <near>0.01</near>
        <far>300</far>
      </clip>
      <noise>
        <type>gaussian</type>
        <mean>0</mean>
        <stddev>0.007</stddev>
      </noise>
    </camera>
  </sensor>
```

Camera Left


```
  <sensor name="camera_left" type="camera">
    <pose>0.085 0.09 0.27 0 0 1.5707963267948966</pose>
    <always_on>1</always_on>
    <update_rate>25</update_rate>
    <camera name="camera_left">
      <horizontal_fov>1.658</horizontal_fov>
      <lens>
        <intrinsics>
          <!-- fx = fy = width / ( 2 * tan (hfov / 2 ) ) -->
          <fx>329.9</fx>
          <fy>329.9</fy>
          <!-- cx = ( width - 1 ) / 2 -->
          <cx>359.5</cx>
          <!-- cy = ( height - 1 ) / 2 -->
          <cy>539.5</cy>
          <s>0</s>
        </intrinsics>
      </lens>
```

```
      <distortion>
        <k1>0.0</k1>
        <k2>0.0</k2>
        <k3>0.0</k3>
        <p1>0.0</p1>
        <p2>0.0</p2>
        <center>0.5 0.5</center>
      </distortion>
      <image>
        <width>720</width>
        <height>1080</height>
        <format>R8G8B8</format>
      </image>
      <clip>
        <near>0.01</near>
        <far>300</far>
      </clip>
      <noise>
        <type>gaussian</type>
        <mean>0</mean>
        <stddev>0.007</stddev>
      </noise>
    </camera>
  </sensor>
```

Camera Right

```
  <sensor name="camera_right" type="camera">
    <pose>0.085 -0.09 0.27 0 0 -1.5707963267948966</pose>
    <always_on>1</always_on>
    <update_rate>25</update_rate>
    <camera name="camera_right">
      <horizontal_fov>1.658</horizontal_fov>
      <lens>
        <intrinsics>
          <!-- fx = fy = width / ( 2 * tan (hfov / 2 ) ) -->
          <fx>329.9</fx>
          <fy>329.9</fy>
          <!-- cx = ( width - 1 ) / 2 -->
          <cx>359.5</cx>
          <!-- cy = ( height - 1 ) / 2 -->
          <cy>539.5</cy>
          <s>0</s>
        </intrinsics>
      </lens>
      <distortion>
        <k1>0.0</k1>
        <k2>0.0</k2>
```

```
            <k3>0.0</k3>
            <p1>0.0</p1>
            <p2>0.0</p2>
            <center>0.5 0.5</center>
          </distortion>
          <image>
            <width>720</width>
            <height>1080</height>
            <format>R8G8B8</format>
          </image>
          <clip>
            <near>0.01</near>
            <far>300</far>
          </clip>
          <noise>
            <type>gaussian</type>
            <mean>0</mean>
            <stddev>0.007</stddev>
          </noise>
        </camera>
      </sensor>
```

Magnetometer

```
      <sensor name="magnetometer" type="magnetometer">
        <always_on>1</always_on>
        <update_rate>50</update_rate>
        <magnetometer>
          <x>
            <noise type="gaussian">
              <mean>0.000000080</mean>
              <bias_mean>0.000000400</bias_mean>
            </noise>
          </x>
          <y>
            <noise type="gaussian">
              <mean>0.000000080</mean>
              <bias_mean>0.000000400</bias_mean>
            </noise>
          </y>
          <z>
            <noise type="gaussian">
              <mean>0.000000080</mean>
              <bias_mean>0.000000400</bias_mean>
            </noise>
          </z>
```

```
    </magnetometer>
  </sensor>
```

Thermal Camera

```
<sensor name="thermal_camera" type="thermal">
  <pose>0.44 -0.17 0.574 0 0 0</pose>
  <camera name="thermal_camera">
    <horizontal_fov>0.628</horizontal_fov>
    <lens>
      <intrinsics>
        <!-- fx = fy = width / ( 2 * tan (hfov / 2 ) ) -->
        <fx>317.173</fx>
        <fy>317.173</fy>
        <!-- cx = ( width - 1 ) / 2 -->
        <cx>102.5</cx>
        <!-- cy = ( height - 1 ) / 2 -->
        <cy>77.5</cy>
        <s>0</s>
      </intrinsics>
    </lens>
    <image>
      <width>206</width>
      <height>156</height>
      <format>L8</format>
    </image>
    <clip>
      <near>0.1</near>
      <far>100</far>
    </clip>
  </camera>
  <always_on>1</always_on>
  <update_rate>9</update_rate>
  <plugin
    filename="gz-sim-thermal-sensor-system"
    name="gz::sim::systems::ThermalSensor">
    <min_temp>253.15</min_temp>
    <max_temp>673.15</max_temp>
    <resolution>1.6</resolution>
  </plugin>
</sensor>
```

NavSat Sensor

```
        <sensor name="navsat_sensor" type="navsat">
          <always_on>1</always_on>
          <update_rate>30</update_rate>
        </sensor>
```

Air Pressure

```
    <sensor name="air_pressure" type="air_pressure">
          <always_on>1</always_on>
          <update_rate>20</update_rate>
          <air_pressure>
            <reference_altitude>0</reference_altitude>
            <noise type="gaussian">
              <mean>0.00000008</mean>
            </noise>
          </air_pressure>
        </sensor>
```

. . .

Contact Sensor

```
          <sensor name='sensor_contact' type='contact'>
            <contact>
              <collision>collision_sphere</collision>
              <topic>/contact_example</topic>
            </contact>
            <always_on>1</always_on>
            <update_rate>100</update_rate>
          </sensor>
```

Plugins

```
<plugin
  filename="gz-sim-physics-system"
  name="gz::sim::systems::Physics">
```

```
</plugin>
<plugin
  filename="gz-sim-air-pressure-system"
  name="gz::sim::systems::AirPressure">
</plugin>
<plugin
  filename="gz-sim-altimeter-system"
  name="gz::sim::systems::Altimeter">
</plugin>
<plugin
  filename="gz-sim-imu-system"
  name="gz::sim::systems::Imu">
</plugin>
<plugin
  filename="gz-sim-magnetometer-system"
  name="gz::sim::systems::Magnetometer">
</plugin>
<plugin
  filename="gz-sim-forcetorque-system"
  name="gz::sim::systems::ForceTorque">
  <gz::system_priority>10</gz::system_priority>
</plugin>
<plugin
  filename="gz-sim-user-commands-system"
  name="gz::sim::systems::UserCommands">
</plugin>
<plugin
  filename="gz-sim-scene-broadcaster-system"
  name="gz::sim::systems::SceneBroadcaster">
</plugin>

<plugin
  filename="gz-sim-joint-controller-system"
  name="gz::sim::systems::JointController">
  <joint_name>j1</joint_name>
  <initial_velocity>1.0</initial_velocity>
</plugin>

<plugin
  filename="gz-sim-pose-publisher-system"
  name="gz::sim::systems::PosePublisher">
  <publish_link_pose>true</publish_link_pose>
  <use_pose_vector_msg>true</use_pose_vector_msg>
  <static_publisher>true</static_publisher>
  <static_update_frequency>1</static_update_frequency>
</plugin>

<plugin
  filename="gz-sim-odometry-publisher-system"
  name="gz::sim::systems::OdometryPublisher">
  <odom_frame>vehicle/odom</odom_frame>
  <robot_base_frame>vehicle</robot_base_frame>
</plugin>
```

```
<plugin
  filename="gz-sim-diff-drive-system"
  name="gz::sim::systems::DiffDrive">
  <left_joint>front_left_wheel_joint</left_joint>
  <left_joint>rear_left_wheel_joint</left_joint>
  <right_joint>front_right_wheel_joint</right_joint>
  <right_joint>rear_right_wheel_joint</right_joint>
  <wheel_separation>1.25</wheel_separation>
  <wheel_radius>0.3</wheel_radius>
  <topic>cmd_vel</topic>
</plugin>

<plugin filename="gz-sim-triggered-publisher-system"
  name="gz::sim::systems::TriggeredPublisher">
  <input type="gz.msgs.Empty" topic="/reset_robot"/>
  <output type="gz.msgs.Twist" topic="/cmd_vel">
      linear: {x: 0}
  </output>
  <service
    name="/world/triggered_publisher/set_pose"
    reqType="gz.msgs.Pose"
    repType="gz.msgs.Boolean"
    timeout="3000"
    reqMsg="name: 'blue_vehicle', id: 8, position: {x: -3, z: 1}">
  </service>
</plugin>

<world>
  ...
  <plugin filename="gz-sim-altimeter-system"
    name="gz::sim::systems::Altimeter">
  </plugin>
  ...
</world>

<plugin
  filename="gz-sim-diff-drive-system"
  name="gz::sim::systems::DiffDrive">
  <left_joint>left_wheel_joint</left_joint>
  <right_joint>right_wheel_joint</right_joint>
  <wheel_separation>1.25</wheel_separation>
  <wheel_radius>0.3</wheel_radius>
  <odom_publish_frequency>1</odom_publish_frequency>
  <max_linear_acceleration>1</max_linear_acceleration>
  <min_linear_acceleration>-1</min_linear_acceleration>
  <max_angular_acceleration>2</max_angular_acceleration>
  <min_angular_acceleration>-2</min_angular_acceleration>
  <max_linear_velocity>0.5</max_linear_velocity>
  <min_linear_velocity>-0.5</min_linear_velocity>
  <max_angular_velocity>1</max_angular_velocity>
  <min_angular_velocity>-1</min_angular_velocity>
</plugin>
```

```
<plugin
  filename="gz-sim-ackermann-steering-system"
  name="gz::sim::systems::AckermannSteering">
  <left_joint>front_left_wheel_joint</left_joint>
  <left_joint>rear_left_wheel_joint</left_joint>
  <right_joint>front_right_wheel_joint</right_joint>
  <right_joint>rear_right_wheel_joint</right_joint>
  <left_steering_joint>front_left_wheel_steering_joint</left_steering_joint>
  <right_steering_joint>front_right_wheel_steering_joint</right_steering_joint>
  <kingpin_width>1.0</kingpin_width>
  <steering_limit>0.5</steering_limit>
  <wheel_base>1.0</wheel_base>
  <wheel_separation>1.25</wheel_separation>
  <wheel_radius>0.3</wheel_radius>
  <min_velocity>-1</min_velocity>
  <max_velocity>1</max_velocity>
  <min_acceleration>-3</min_acceleration>
  <max_acceleration>3</max_acceleration>
</plugin>

<plugin
  filename="gz-sim-mecanum-drive-system"
  name="gz::sim::systems::MecanumDrive">
  <front_left_joint>front_left_wheel_joint</front_left_joint>
  <front_right_joint>front_right_wheel_joint</front_right_joint>
  <back_left_joint>rear_left_wheel_joint</back_left_joint>
  <back_right_joint>rear_right_wheel_joint</back_right_joint>
  <wheel_separation>1.25</wheel_separation>
  <wheelbase>1.511</wheelbase>
  <wheel_radius>0.3</wheel_radius>
  <min_acceleration>-5</min_acceleration>
  <max_acceleration>5</max_acceleration>
</plugin>

<plugin filename="ImageDisplay" name="Visible 2D">
  <topic>your_image_topic</topic>
  <gz-gui>
    <title>Visible 2D</title>
    <property key="state" type="string">docked</property>
    <property type="double" key="height">400</property>
    <property type="double" key="width">600</property>
  </gz-gui>
</plugin>

<gui fullscreen="0">

  <!-- 3D scene -->
  <plugin filename="MinimalScene" name="3D View">
    <gz-gui>
      <title>3D View</title>
      <property type="bool" key="showTitleBar">false</property>
      <property type="string" key="state">docked</property>
```

```
    </gz-gui>

    <engine>ogre2</engine>
    <scene>scene</scene>
    <ambient_light>1.0 1.0 1.0</ambient_light>
    <background_color>0.8 0.8 0.8</background_color>
    <camera_pose>-6 0 6 0 0.5 0</camera_pose>
  </plugin>

  <!-- Plugins that add functionality to the scene -->
  <plugin filename="EntityContextMenuPlugin" name="Entity context menu">
    <gz-gui>
      <property key="state" type="string">floating</property>
      <property key="width" type="double">5</property>
      <property key="height" type="double">5</property>
      <property key="showTitleBar" type="bool">false</property>
    </gz-gui>
  </plugin>
  <plugin filename="GzSceneManager" name="Scene Manager">
    <gz-gui>
      <property key="resizable" type="bool">false</property>
      <property key="width" type="double">5</property>
      <property key="height" type="double">5</property>
      <property key="state" type="string">floating</property>
      <property key="showTitleBar" type="bool">false</property>
    </gz-gui>
  </plugin>
  <plugin filename="InteractiveViewControl" name="Interactive view control">
    <gz-gui>
      <property key="resizable" type="bool">false</property>
      <property key="width" type="double">5</property>
      <property key="height" type="double">5</property>
      <property key="state" type="string">floating</property>
      <property key="showTitleBar" type="bool">false</property>
    </gz-gui>
  </plugin>
  <plugin filename="CameraTracking" name="Camera Tracking">
    <gz-gui>
      <property key="resizable" type="bool">false</property>
      <property key="width" type="double">5</property>
      <property key="height" type="double">5</property>
      <property key="state" type="string">floating</property>
      <property key="showTitleBar" type="bool">false</property>
    </gz-gui>
  </plugin>

  <!-- World control -->
  <plugin filename="WorldControl" name="World control">
    <gz-gui>
      <title>World control</title>
      <property type="bool" key="showTitleBar">false</property>
      <property type="bool" key="resizable">false</property>
      <property type="double" key="height">72</property>
```

```
      <property type="double" key="z">1</property>

      <property type="string" key="state">floating</property>
      <anchors target="3D View">
        <line own="left" target="left"/>
        <line own="bottom" target="bottom"/>
      </anchors>
    </gz-gui>

    <play_pause>true</play_pause>
    <step>true</step>
    <start_paused>true</start_paused>
    <use_event>true</use_event>

  </plugin>

  <!-- World statistics -->
  <plugin filename="WorldStats" name="World stats">
    <gz-gui>
      <title>World stats</title>
      <property type="bool" key="showTitleBar">false</property>
      <property type="bool" key="resizable">false</property>
      <property type="double" key="height">110</property>
      <property type="double" key="width">290</property>
      <property type="double" key="z">1</property>

      <property type="string" key="state">floating</property>
      <anchors target="3D View">
        <line own="right" target="right"/>
        <line own="bottom" target="bottom"/>
      </anchors>
    </gz-gui>

    <sim_time>true</sim_time>
    <real_time>true</real_time>
    <real_time_factor>true</real_time_factor>
    <iterations>true</iterations>
  </plugin>

  <plugin filename="ImageDisplay" name="Full 2D">
    <topic>topic_name</topic>
    <gz-gui>
      <title>Full 2D</title>
      <property key="state" type="string">docked</property>
      <property type="double" key="height">400</property>
      <property type="double" key="width">600</property>
    </gz-gui>
  </plugin>

  <plugin filename="ImageDisplay" name="Visible 2D">
    <topic>topic_name</topic>
    <gz-gui>
      <title>Visible 2D</title>
```

```
      <property key="state" type="string">docked</property>
      <property type="double" key="height">400</property>
      <property type="double" key="width">600</property>
    </gz-gui>
  </plugin>
```



```
      <property key="state" type="string">docked</property>
      <property type="double" key="height">400</property>
      <property type="double" key="width">600</property>
    </gz-gui>
  </plugin>

</gui>

<plugin filename="gz-sim-contact-system" name="gz::sim::systems::Contact"/>
```


Gazebosim Plugin | Gazebosim Sensor | Harmonic | Ros2 | Gazebo

Written by Ali Tekeş

Sakarya University - Computer Engineering Student (3/4) - TUBITAK Intern Researcher

Responses (1)

Christyj
Feb 1

great content. can you explain how to choose the plugin and integrate it to a robot such that it can be visualized with rviz2 and the latest gz sim. Thanks

 1 reply Reply

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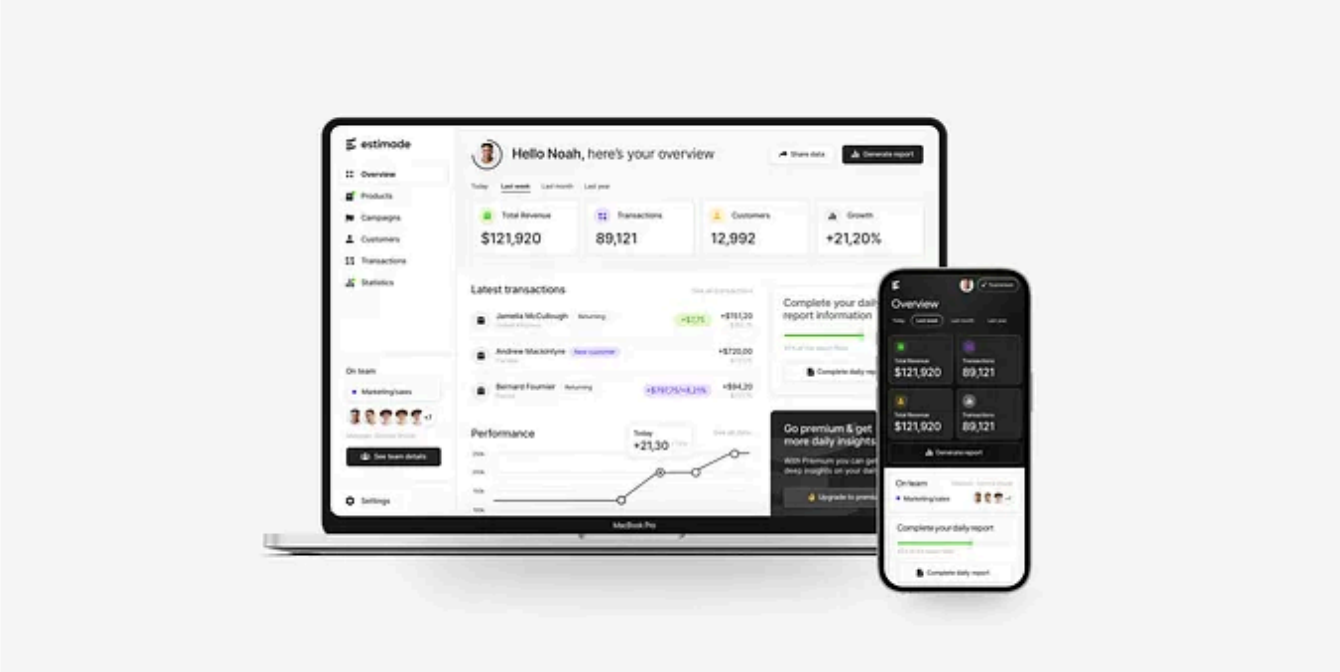

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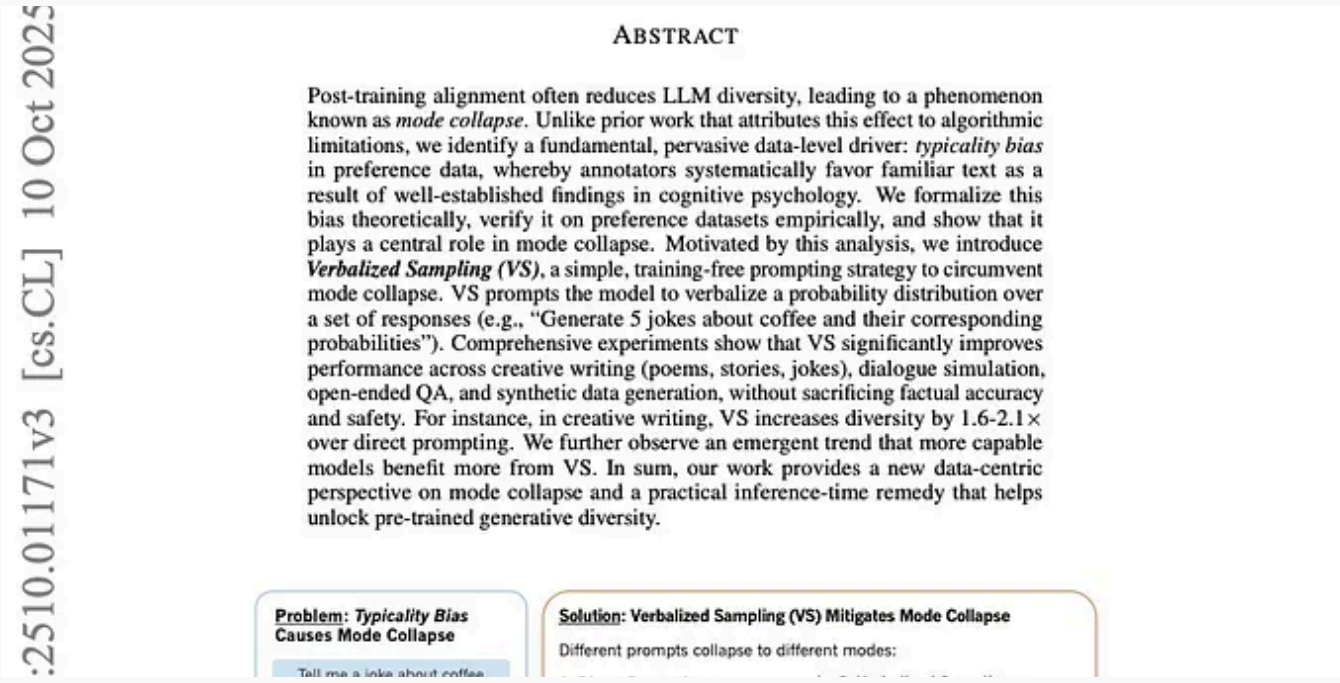

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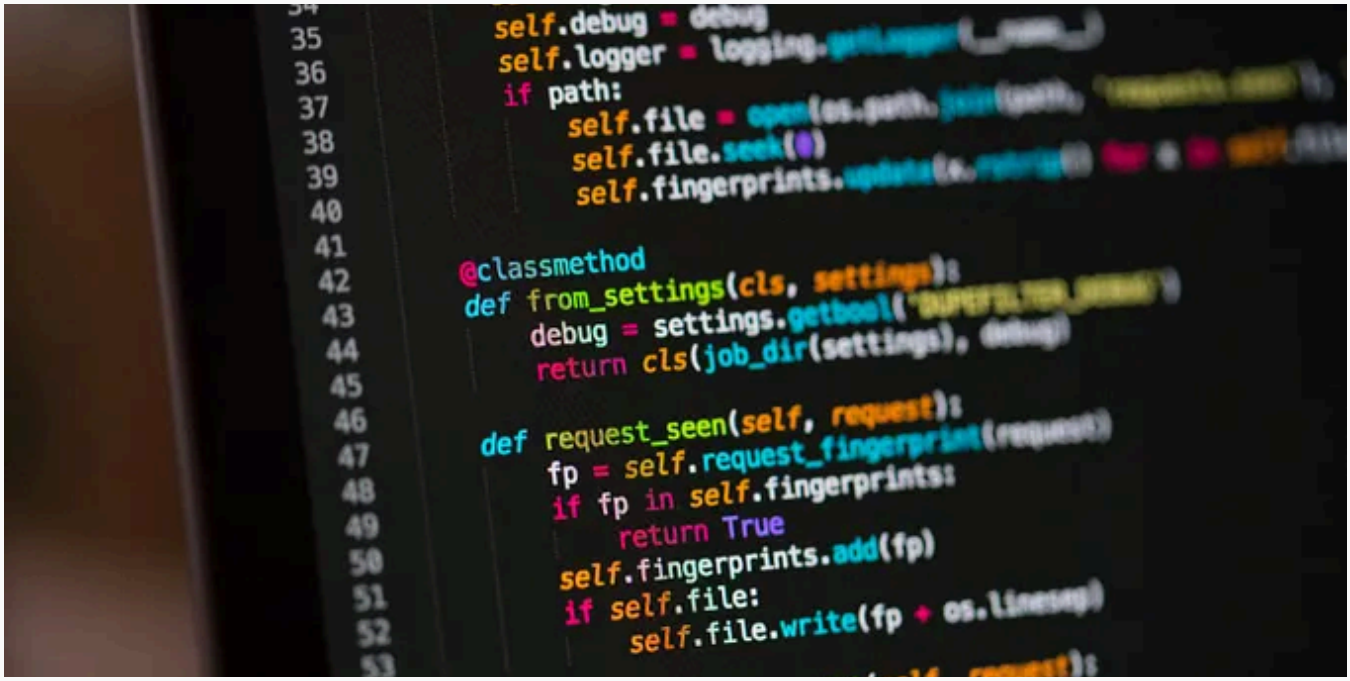

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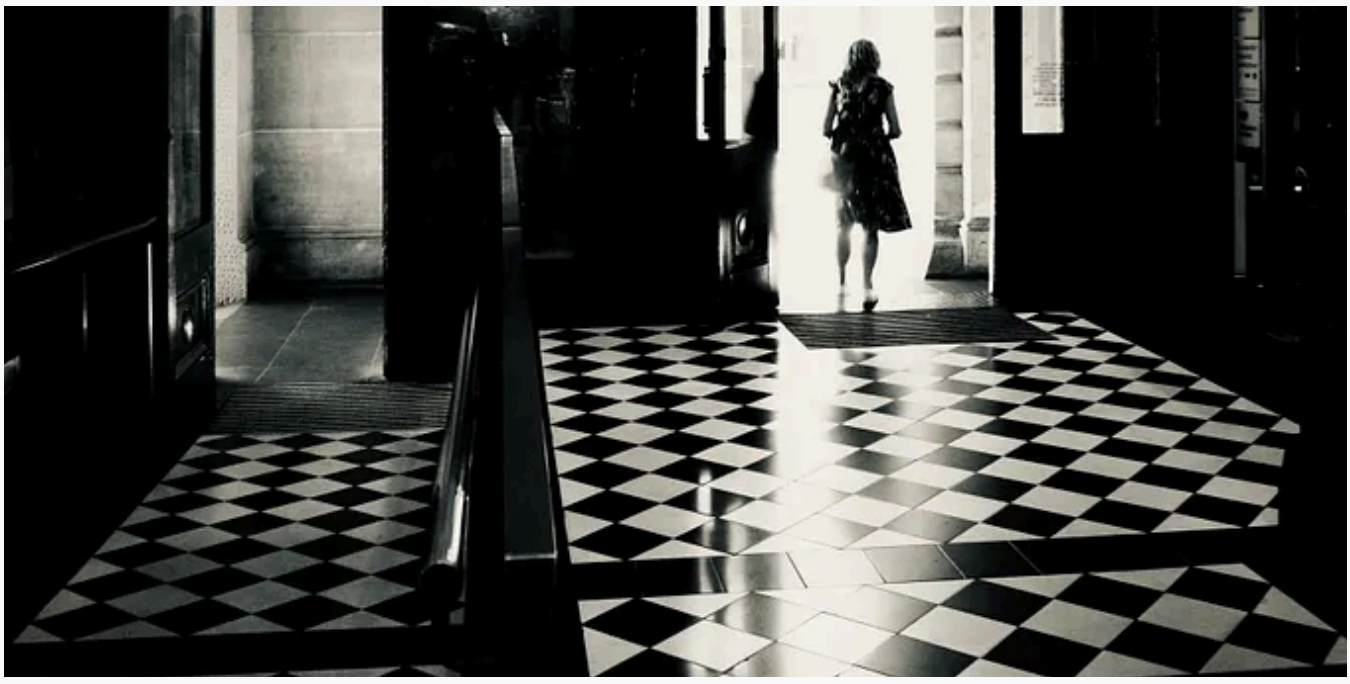

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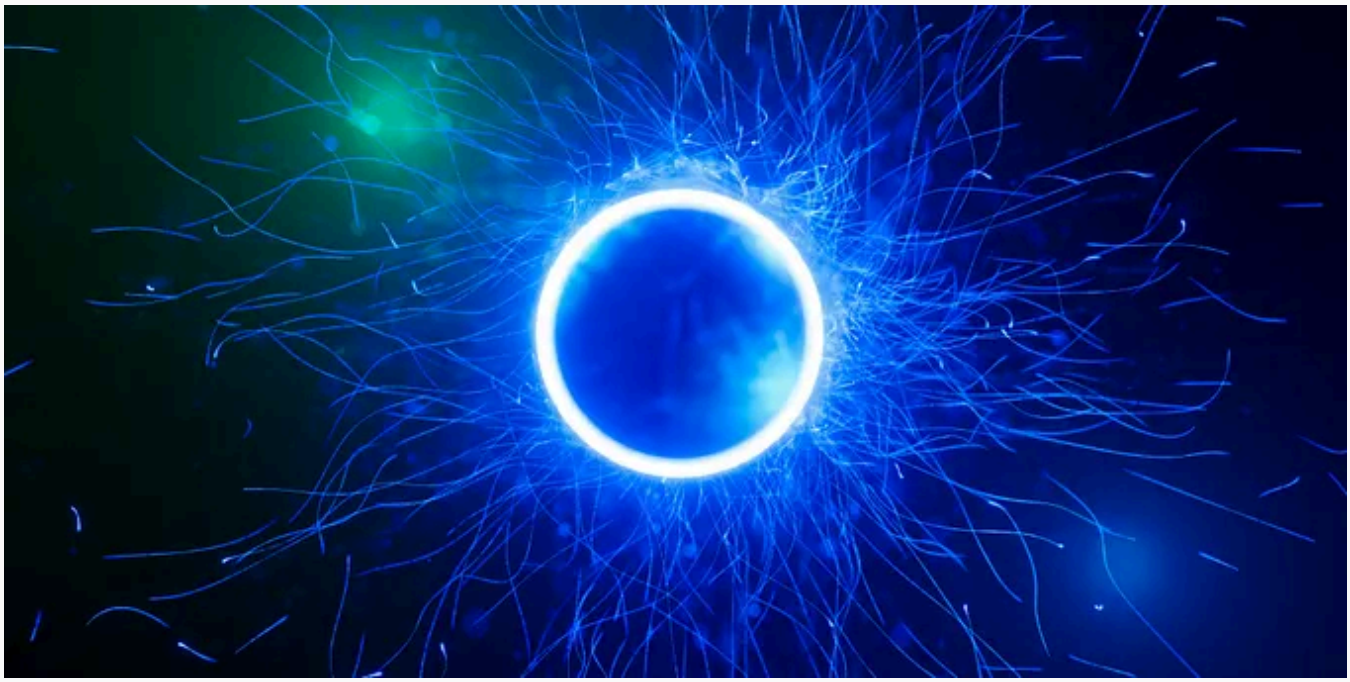

Will Lockett

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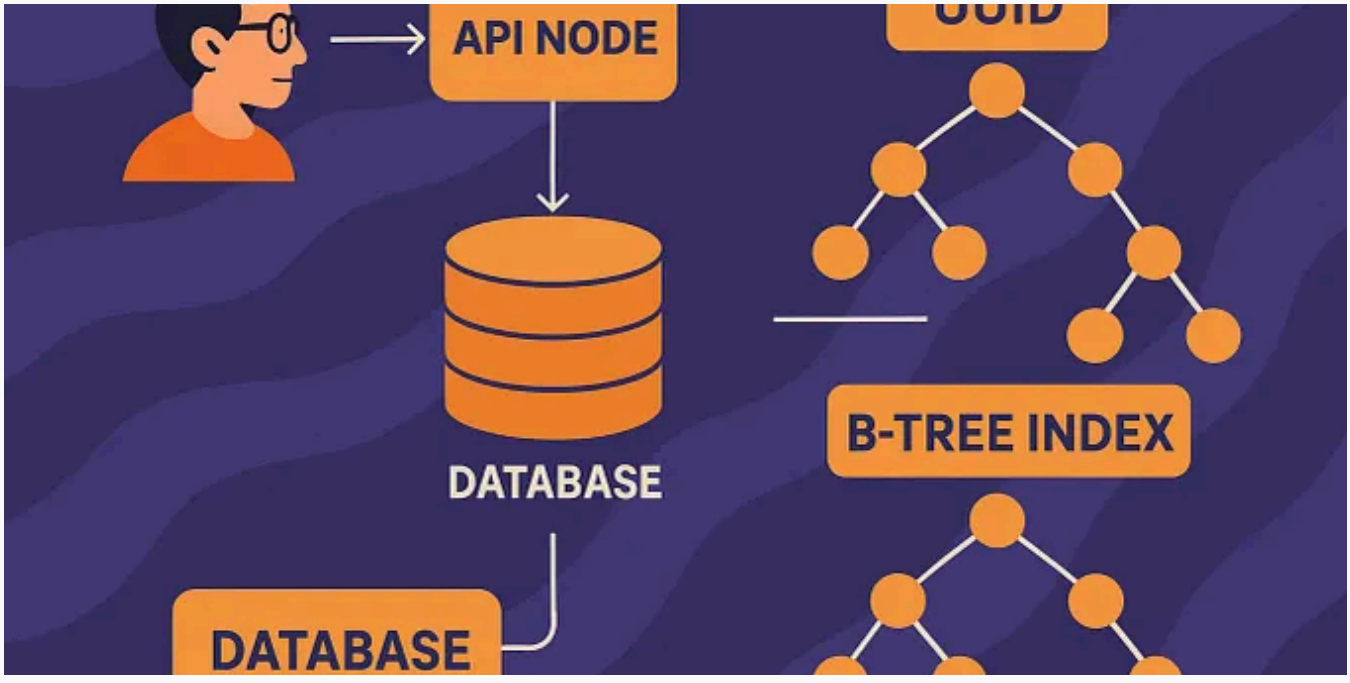

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