ENPM662 - Introduction to Robot Modelling

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Project 1: CAD Modeling and Simulation using Gazebo

Goals :

• Build a specific robot model on SolidWorks and export it as URDF.

• Add a LiDAR Sensor on to your robot and show your visualization (LiDAR points) in RViz.

• Perform Teleop and move around in the map in Gazebo.

• Code up a simple publisher and subscriber for your robot so that it moves ahead in a straight line or circular loop for 10~15 seconds.

Steps followed :

• .Created a toy car model with castor wheels to steer the front wheels separately.

• Assembled the chassis and castor wheels in the Solid works and defined the axes of rotation for each wheel and created a coordinate system with the origin at the bottom center of the toy car.

• Exported the toy car model as a URDF file and specified the parent and child links by using the URDF export tool.

• Built a catkin_ws and all the packages in the src folder of the workspace.

• Created a dummy link and added transmission in the URDF and integrated the LIDAR sensor using Xacro.

• Defined the list of controllers and type of controllers (Velocity for rear wheels and Effort for front wheels) all within the .yaml file in the config file.

• Integrated all the tasks using the launch file, performed the Teleop and operated the model in the new world environment in the gazebo.

• Performed RViz simulation and visualization while moving the toy car model using Teleop.

• Coded a simple publisher-subscriber and made the toy-car move in the empty gazebo world in a circle and then in a straight line.

Problems faced :

• Alignment of the origin of the Solidworks URDF model and gazebo environment was not done correctly. We changed the origin in Solidworks to the bottom center to fix the problem.

• Steering axis was not defined properly for the front wheels, and we were unable to steer the toy car. Later, we defined the steering axis to the castor revolute joints properly and we were able to steer the front wheels independently.

• We specified the joint type between the shaft and wheel incorrectly while exporting the URDF file, due to this we could not rotate the wheels using the shafts, so we had to make changes to the joint type from fixed to continuous to solve the issue.

• The wheels were rotating in the opposite direction while using Teleop. We changed the axis of rotation of each wheel in the URDF file to make it move appropriately with the key bindings of Teleop.

Contributions :

• Designed the chassis of the toy car model in Solid works.

• Defined the axes of rotation and coordinate system for each wheel and toy-car.

• Coordinated and built a catkin_ws with the URDF package in the src folder of the workspace.

• Created a dummy world and dummy joint to visualize the toy-car model in gazebo.

• Coordinated and completed all the tasks for the launch and xacro file to integrate the lidar sensor to the model and launch the model in competition arena world in gazebo.

• Worked together to find the solution to the problems discussed above and changed the origin of the model, steering axis alignment, and joint type definitions.

• Coordinated and performed the Teleop with simulation and visualization in gazebo and RViz.

• Coded a simple publisher-subscriber to move the model in a straight line.

Video links :

1. Teleop along with RViz simulation:
https://drive.google.com/file/d/1jPhknL6o5AQxgUZweEbDEyEOKgioJvIW/view?usp=sharing

2. Publisher and Subscriber:

https://drive.google.com/file/d/1Wnrpiy5AzGDfJ8WjYb9B5XhBPYpRw0cK/view?usp=sharing