RIS Lab I Project Report

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1. Launch uuv_gazebo/rexrov_default.launch and inspect the nodes, topics, services it launches and the message/service types they use to communicate.

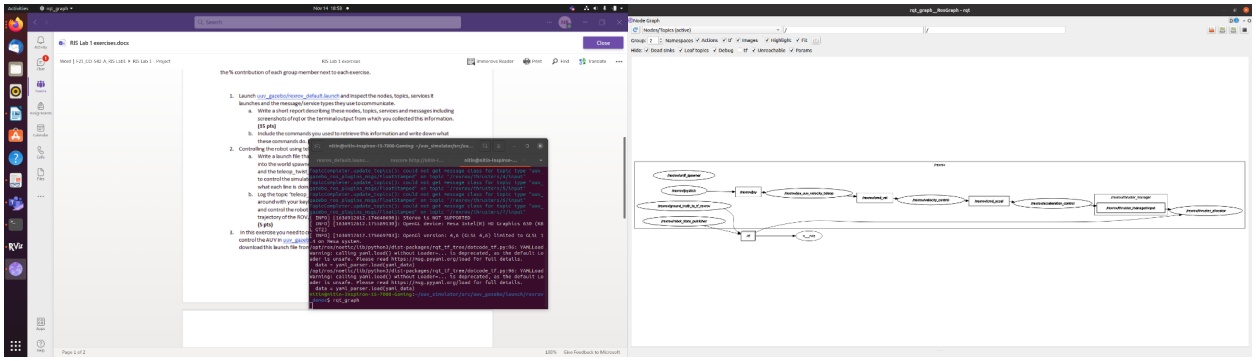
a. Write a short report describing these nodes, topics, services and messages including screenshots of rqt or the terminal output from which you collected this information. (15 pts) — contribution(33.33% each)

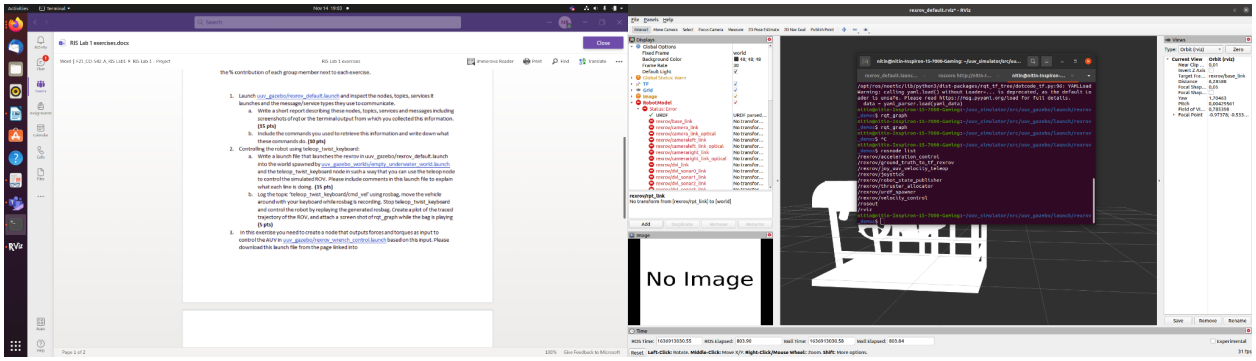
Solution: After we launch the rexrov_default.launch file, we can view the rviz. We can view the nodes and topics of the file that has launched from the rqt and rqt_graph(view graph) or can view all the nodes, topics, messages and services from the terminal.

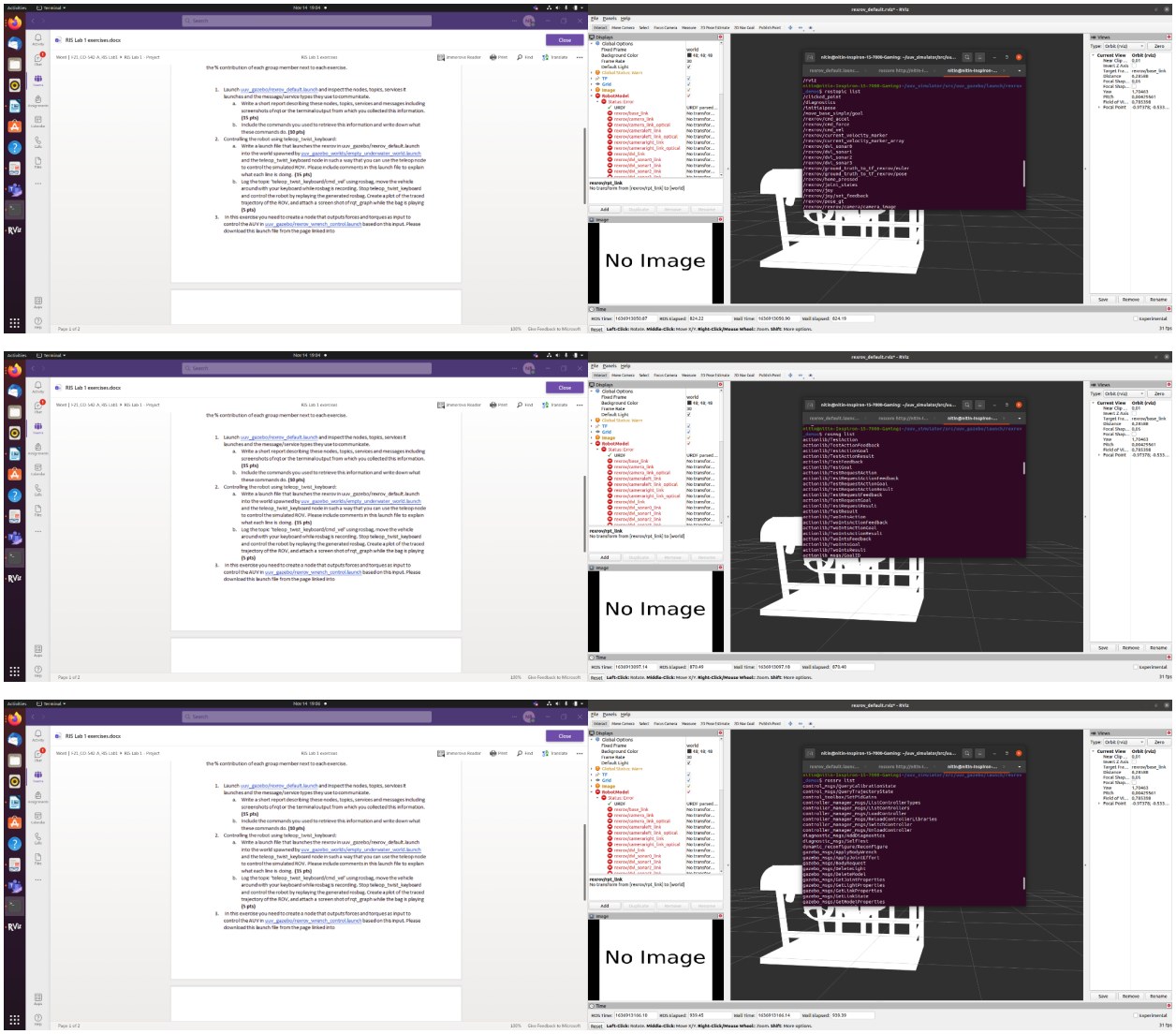
If we view the rqt_graph to see the nodes and topics that are generated, we can see we have eight nodes which are in a spherical container. These nodes are for different purposes and functionalities. For eg. /rexrov/urdf_spawner is to spawn the robot as soon as we launch it and /rexrov/joystick is for the control of the robot. Nodes here in the graph can be seen connected but are passing through the rectangular boxes. These boxes contain the ‘topics’. Nodes are communicating with the exchange of topics which basically is information. For eg. the node ‘rexrov/joy_uuv_velocity_teleop’ is subscribing to the topic called ‘/rexrov/joy’ and data(messages) transmitted by the node ‘/rexrov/joystick’ is received by the subscribing topic.

Here the messages come in as well. There are many ros messages generated while this file is launching. We can view it in the example screenshot below as well. These messages for example visualization/msgs/Imagemaker, turtlesim/color, tf/tfMessage etc. are published by the nodes. These messages have descriptions about the node we have. We have services, generally defined by ‘srv’ files(screenshots as example attached). Some services like

gazebo_msgs/DeleteLight and control_msgs/QueryTrajectoryState are used here to request and reply provided by nodes.







b. Include the commands you used to retrieve this information and write down what these commands do. (10 pts) — contribution(33.33% each)

Solution: Following are the command lines in order after we have git cloned the uuv_simulator package in our workspace:

1. catkin_make

   Here, we built the packages using the ‘catkin_make’ command.

2. source devel/setup.bash

After we build the packages, we need to make sure the ros path is active in the terminal we are working on and for that we source using the ‘source devel/setup.bash’ command.

3. roscore

We open a new terminal and run the ‘roscore’ command. We make sure run this before we running any commands as it enables communication

4. roslaunch rexrov_default.launch

Finally, we get into the directory where the rexrov_default.launch file is located and launch the file to view it in rviz using the ‘roslaunch rexrov_default.launch’ command line.

5. rqt

We obtain the rqt screen where we can view all the nodes, topics, services and messages and msg/srv types. We just type ‘rqt’.

6. rqt_graph

We can view the detailed graph of launched file with ‘rqt_graph’ com mand. We got to see nodes, tf and topics and how they were connected.

7. rosnode list

We can view all the nodes in the launch file while its running from the command using this command line.

8. rostopic list

View topic directly from the command line

9. rosmsg list

View the messages involved in the launch

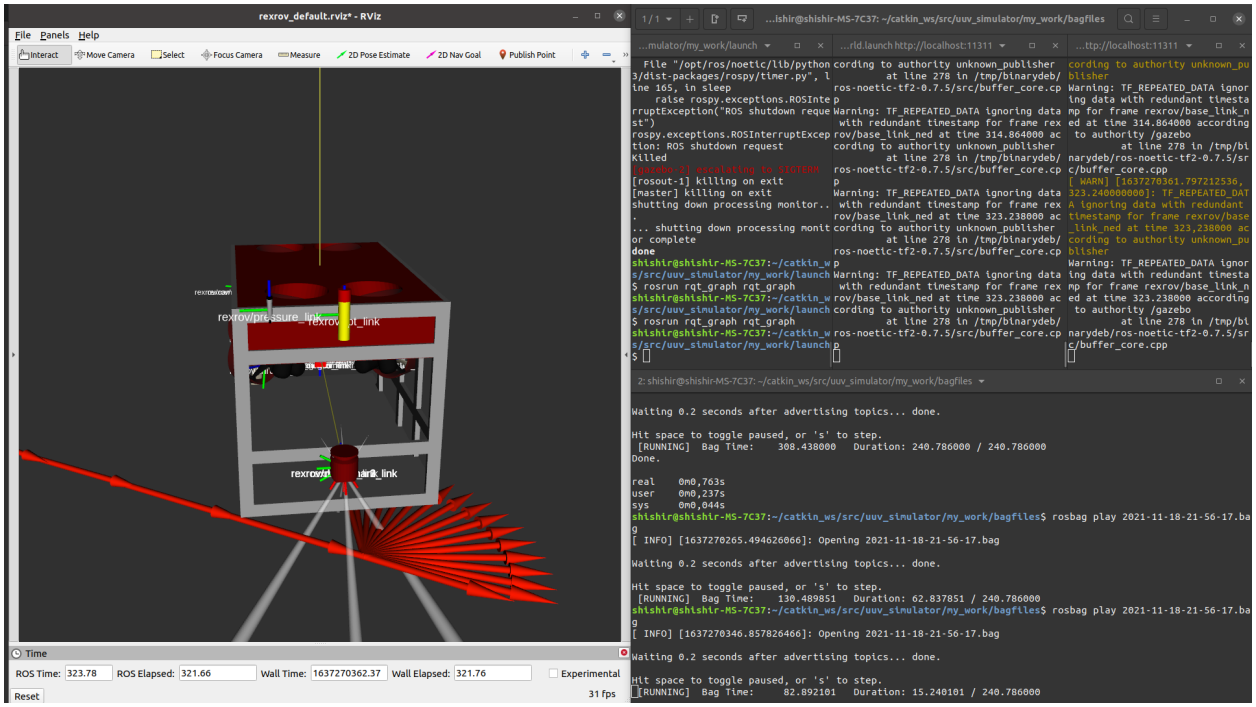
10. rossrv list

View the services running while the file launches

2. Controlling the robot using teleop_twist_keyboard:

a. Write a launch file that launches the rexrov in uuv_gazebo/rexrov_default.launch into the world spawned by uuv_gazebo_worlds/empty_underwater_world.launch and the teleop_twist_keyboard node in such a way that you can use the teleop node to control the simulated ROV. Please include comments in this launch file to explain what each line is doing. (15 pts) — contribution(33.33% each)

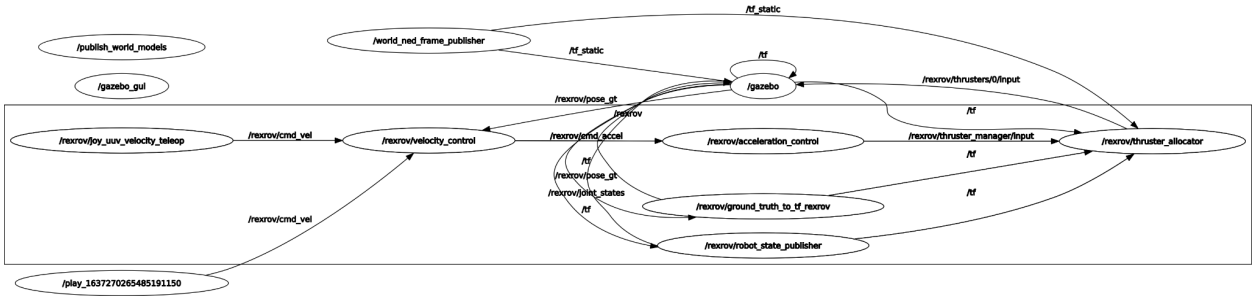
Solution: The code is in the github repo which link is attached here. Also screenshot of rviz attached below:



b. Log the topic ‘teleop_twist_keyboard/cmd_vel’ using rosbag, move the vehicle around with your keyboard while rosbag is recording. Stop

teleop_twist_keyboard and control the robot by replaying the generated rosbag. Create a plot of the traced trajectory of the ROV, and attach a screen shot of rqt_graph while the bag is playing (5 pts) — contribution(33.33% each)

Solution: Here is the screenshot of the rqt_graph while the bag is playing (Also attached in the github).



3. In this exercise you need to create a node that outputs forces and torques as input to control the AUV in uuv_gazebo/rexrov_wrench_control.launch based on this input. Please download this launch file from the page linked into

catkin_ws/src/uuv_simulator/uuv_gazebo/launch/rexrov_demos and launch it into the world spawned by uuv_gazebo_worlds/empty_underwater_world.launch

a. Write a node similar to teleop_twist_keyboard that publishes forces and torques to control the AUV. Your node must publish to the topic /rexrov/thruster_manager/input (15pts) — contribution(33.33% each)

Solution: The node teleop_forces_torques.py to publish forces and torques to control the AUV is in the github repo. There is a short description file as Readme.md as well.

b. Write a launch file similar to the one in exercise 2 that launches the AUV and your node. (5 pts) — contribution(33.33% each)

Solution: The link to access the launch file is attached here.

4. Creating and controlling your own robot.

a. Create a urdf file that describes a simple ROV of your own design using the default geometric shapes (or design your own robot in Blender) (10 pts) — contribution(33.33% each)

Solution: We have created an urdf file of our ROV model along with its launch file and have attached the file link here. The urdf model code is described in order below.

The name of our robot is ‘ROV’. We have 3 links(body) and 2 joints to connect them. The description of every link and joints are under their respective tags.

The position, geometry and inertial attributes of links are in the respective tags. The visual part under <visual> tag has the shapes or geometry of the links and joints. Mass and inertia for the link is under the <inertia> tag. For the geometry part, the shape of link1 which is our base link is spherical in shape while the other side links are boxes of given sizes. Links are given a color which is black under the <material> tag. Links have been given masses and inertia under the <inertia> tag.

For joints, we have shown to which link is each of two joints connected to. The parent link to both joints is joint1, meaning that the other two links(link2 and link3) are child links for the joints. The <origin> and <axis> tag defines the location of either it be the links or joints.

b. Decide on the placement of thrusters for this ROV and give your reasoning. (5 pts) — contribution(33.33% each)

Solution: So we will have eight thrusters in our ROV model to provide good controllability to our ROV. The four thrusters are placed in the base that helps in lateral movement. They are placed at an angle of 45 degrees to make the movement more effective and there is also no disturbance between the thrusters in between which can impact the movement of ROV as well.

The other four thrusters are placed on top of ROV. This helps in the vertical movement of the ROV and the number of thrusters installed makes the movement powerful.

c. Write your own node that takes in forces and torques as input and publishes thrust commands for your ROV. The conversion from forces/torques to thrust commands has to be called as a service. (10 pts) — contribution(33.33% each)

Solution: The link to github repo where you can access the node to publish thrust command is attached below:

d. write a launch file that (10 pts) — contribution(33.33% each)

i. load this robot into uuv_gazebo_worlds/empty_underwater_world.launch in gazebo

ii. starts the node you created in exercise 3 to publish force/torque data

iii. starts the node you created in part c that publishes thrust commands to your vehicle