Table of Contents

Task 1 **2**

Rqt_graph 2

Nodes 2

/rexrov/acceleration_control 3

/rexrov/ground_truth_to_tf_rexrov 4

/rexrov/robot_state_publisher 4

/rexrov/joy_uuv_velocity_teleop 5

/rviz 5

/rosout 6

/rexrov/velocity_control 6

/rexrov/urdf_spawner 7

/rexrov/joystick 7

/rexrov/thruster_allocator 7

Task 2 **8**

Part A 8

Part B 8

Task 3 **9**

Part A 9

Part B 9

Task 4

Part A **9**

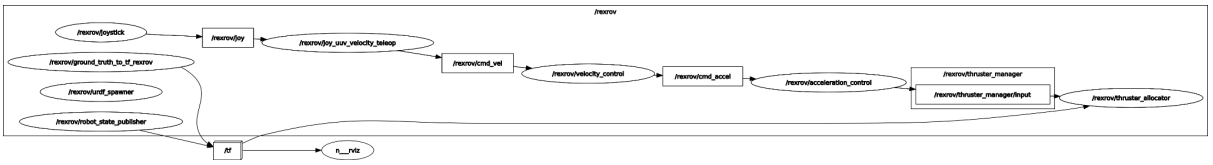
Part B

Part D (i) 9

Point Division **10**

Task 1

Rqt_graph



In order to retrieve information about the nodes, topics, services, and messages from "uuv_gazebo/rexrov_default.launch", I had to first launch the file by using the following command: `roslaunch uuv_gazebo rexrov_default.launch`.

By using the command `rosrun rqt_graph rqt_graph` we are able to have a graph visualization of /rexrov and its current active nodes and topics.

Nodes

If we would like to get specific information about every node's topic we can use `rostopic list` to list the topics and `rostopic info [topic]`, and the same can be done for services, we would only need to change topic by service. However, I mostly used `rosnode list` and `rosnode info [node]` to better understand the graph.

By using `rosnode list` I was able to get a lost of all the nodes:

1. /rexrov/acceleration_control
2. /rexrov/ground_truth_to_tf_rexrov
3. /rexrov/joy_uuv_velocity_teleop
4. /rexrov/joystick
5. /rexrov/robot_state_publisher
6. /rexrov/thruster_allocator
7. /rexrov/urdf_spawner
8. /rexrov/velocity_control
9. /rosout
10. /rviz

/rexrov/acceleration_control

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/acceleration_control
--------------------------------------------------------------------------------
Node [/rexrov/acceleration_control]
Publications:
 * /rexrov/thruster_manager/input [geometry_msgs/Wrench]
 * /rosout [rosgraph_msgs/Log]

Subscriptions:
 * /rexrov/cmd_accel [geometry_msgs/Accel]
 * /rexrov/cmd_force [unknown type]

Services:
 * /rexrov/acceleration_control/get_loggers
 * /rexrov/acceleration_control/set_logger_level


contacting node http://aguacateubuntu:38491/ ...
Pid: 29630
Connections:
 * topic: /rosout
    * to: /rosout
    * direction: outbound (38061 - 10.82.57.126:40206) [9]
    * transport: TCPROS
 * topic: /rexrov/thruster_manager/input
    * to: /rexrov/thruster_allocator
    * direction: outbound (38061 - 10.82.57.126:40216) [16]
    * transport: TCPROS
 * topic: /rexrov/cmd_accel
    * to: /rexrov/velocity_control (http://aguacateubuntu:33137/)
    * direction: inbound
    * transport: TCPROS
```

This node has two publishers of message type geometry_msgs and rosgraph_msgs. A message defines the structure of the data that is passed between nodes. The /rexrov/thruster_manager/input topic is a publisher to this node and it is a subscriber to the active node /rexrov/thruster_allocator. Along with services /rexrov/acceleration_control/get_loggers and /rexrov/acceleration_control/set_logger_level of type roscpp/GetLoggers and roscpp/SetLoggerLevel.

By using rostopic info `/rexrov/thruster_manager/input` , we are able to retrieve this information.

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rostopic info /rexrov/thr
uster_manager/input
Type: geometry_msgs/Wrench

Publishers:
 * /rexrov/acceleration_control (http://aguacateubuntu:45023/)

Subscribers:
 * /rexrov/thruster_allocator (http://aguacateubuntu:45395/)
```

/rexrov/ground_truth_to_tf_rexrov

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/ground_truth_to_tf_rexrov

--------------------------------------------------------------------------------
Node [/rexrov/ground_truth_to_tf_rexrov]
Publications:
 * /rexrov/ground_truth_to_tf_rexrov/euler [geometry_msgs/Vector3Stamped]
 * /rexrov/ground_truth_to_tf_rexrov/pose [geometry_msgs/PoseStamped]
 * /rosout [rosgraph_msgs/Log]
 * /tf [tf2_msgs/TFMessage]

Subscriptions:
 * /rexrov/pose_gt [unknown type]

Services:
 * /rexrov/ground_truth_to_tf_rexrov/get_loggers
 * /rexrov/ground_truth_to_tf_rexrov/set_logger_level
```

This node has four publishers of message type geometry_msgs, rosgraph_msgs, and tf2_msgs. The /rexrov/ground_truth_to_tf_rexrov/euler topic is only a publisher to this node. The /rexrov/ground_truth_to_tf_rexrov/pose is only a publisher to this node. This node is subscribed to only one topic and has two services of get_loggers and set_loggers_level.

/rexrov/robot_state_publisher

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/robot_state_publisher
--------------------------------------------------------------------------------
Node [/rexrov/robot_state_publisher]
Publications:
 * /rosout [rosgraph_msgs/Log]
 * /tf [tf2_msgs/TFMessage]
 * /tf_static [tf2_msgs/TFMessage]

Subscriptions:
 * /rexrov/joint_states [unknown type]

Services:
 * /rexrov/robot_state_publisher/get_loggers
 * /rexrov/robot_state_publisher/set_logger_level
```

This node has three publishers of message type rosgraph_msgs and tf2_msgs. The /tf topic has a publisher to this node and to /rexrov/robot_state_publisher. The /tf_static is only a publisher to this node. This node is subscribed to only one topic and has two services of get_loggers and set_loggers_level.

/rexrov/joy_uuv_velocity_teleop

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/joy_uuv_v
elocity_teleop
--------------------------------------------------------------------------------
Node [/rexrov/joy_uuv_velocity_teleop]
Publications:
 * /rexrov/cmd_vel [geometry_msgs/Twist]
 * /rexrov/home_pressed [std_msgs/Bool]
 * /rosout [rosgraph_msgs/Log]

Subscriptions:
 * /rexrov/joy [sensor_msgs/Joy]

Services:
 * /rexrov/joy_uuv_velocity_teleop/get_loggers
 * /rexrov/joy_uuv_velocity_teleop/set_logger_level
```

This node has three publishers of message type geometry_msgs, std_msgs, and rosgraph_msgs. The /rexrov/cmd_vel topic is only a publisher to this node. The /rexrov/home_pressed is only a publisher to this node. This node is subscribed to only one topic and has two services of get_loggers and set_loggers_level.

/rviz

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rviz
--------------------------------------------------------------------------------
Node [/rviz]
Publications:
 * /clicked_point [geometry_msgs/PointStamped]
 * /initialpose [geometry_msgs/PoseWithCovarianceStamped]
 * /move_base_simple/goal [geometry_msgs/PoseStamped]
 * /rosout [rosgraph_msgs/Log]

Subscriptions:
 * /rexrov/current_velocity_marker [unknown type]
 * /rexrov/current_velocity_marker_array [unknown type]
 * /rexrov/dvl_sonar0 [unknown type]
 * /rexrov/dvl_sonar1 [unknown type]
 * /rexrov/dvl_sonar2 [unknown type]
 * /rexrov/dvl_sonar3 [unknown type]
 * /rexrov/pose_gt [unknown type]
 * /rexrov/rexrov/camera/camera_image [unknown type]
 * /tf [tf2_msgs/TFMessage]
 * /tf_static [tf2_msgs/TFMessage]

Services:
 * /rviz/get_loggers
 * /rviz/load_config
 * /rviz/reload_shaders
 * /rviz/save_config
 * /rviz/set_logger_level
```

This node has four publishers of message type geometry_msgs and rosgraph_msgs. This node is subscribed to ten topics and has five services.

/rosout

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rosout
--------------------------------------------------------------------------------
Node [/rosout]
Publications:
 * /rosout_agg [rosgraph_msgs/Log]

Subscriptions:
 * /rosout [rosgraph_msgs/Log]

Services:
 * /rosout/get_loggers
 * /rosout/set_logger_level
```

/rosout is the name of the console log reporting mechanism in ROS. It can be thought as comprising several components: The `rosout` node for subscribing, logging, and republishing the messages

/rexrov/velocity_control

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/velocity_
control
--------------------------------------------------------------------------------
Node [/rexrov/velocity_control]
Publications:
 * /rexrov/cmd_accel [geometry_msgs/Accel]
 * /rexrov/velocity_control/parameter_descriptions [dynamic_reconfigure/ConfigDescrip
tion]
 * /rexrov/velocity_control/parameter_updates [dynamic_reconfigure/Config]
 * /rosout [rosgraph_msgs/Log]

Subscriptions:
 * /rexrov/cmd_vel [geometry_msgs/Twist]
 * /rexrov/pose_gt [unknown type]

Services:
 * /rexrov/velocity_control/get_loggers
 * /rexrov/velocity_control/set_logger_level
 * /rexrov/velocity_control/set_parameters
```

This node has four publishers of message type geometry_msgs, dynamic_reconfigure, and rosgraph_msgs. The /rexrov/cmd_accel, /rexrov/velocity_control/parameter_updates, and /rexrov/velocity_control/parameter_descriptions topics are only a publisher to this node.
This node is subscribed to two topics and has three services of get_loggers and set_loggers_level.

/rexrov/urdf_spawner

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/urdf_spaw
ner
--------------------------------------------------------------------------------
Node [/rexrov/urdf_spawner]
Publications:
 * /rosout [rosgraph_msgs/Log]

Subscriptions: None

Services:
 * /rexrov/urdf_spawner/get_loggers
 * /rexrov/urdf_spawner/set_logger_level
```

This node has one publisher of message type rosgraph_msgs. This node is subscribed to no topics and has two services of get_loggers and set_loggers_level.

/rexrov/joystick

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/joystick
--------------------------------------------------------------------------------
Node [/rexrov/joystick]
Publications:
 * /diagnostics [diagnostic_msgs/DiagnosticArray]
 * /rexrov/joy [sensor_msgs/Joy]
 * /rosout [rosgraph_msgs/Log]

Subscriptions:
 * /rexrov/joy/set_feedback [unknown type]

Services:
 * /rexrov/joystick/get_loggers
 * /rexrov/joystick/set_logger_level
```

This node has three publishers of message type diagnostic_msgs, sensor_msgs, and rosgraph_msgs. The /diagnostics and /rexrov/joy topics are only a publisher to this node. This node is subscribed to only one topic and has two services of get_loggers and set_loggers_level.

/rexrov/thruster_allocator

```
vsancnaj@aguacateubuntu:~/catkin_ws/src/uuv_simulator$ rosnode info /rexrov/thruster_
allocator
--------------------------------------------------------------------------------
Node [/rexrov/thruster_allocator]
Publications:
 * /rexrov/thrusters/0/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rexrov/thrusters/1/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rexrov/thrusters/2/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rexrov/thrusters/3/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rexrov/thrusters/4/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rexrov/thrusters/5/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rexrov/thrusters/6/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rexrov/thrusters/7/input [uuv_gazebo_ros_plugins_msgs/FloatStamped]
 * /rosout [rosgraph_msgs/Log]

Subscriptions:
 * /rexrov/thruster_manager/input [geometry_msgs/Wrench]
 * /rexrov/thruster_manager/input_stamped [unknown type]
 * /tf [tf2_msgs/TFMessage]
 * /tf_static [tf2_msgs/TFMessage]

Services:
 * /rexrov/thruster_allocator/get_loggers
 * /rexrov/thruster_allocator/set_logger_level
 * /rexrov/thruster_allocator/tf2_frames
 * /rexrov/thruster_manager/get_config
 * /rexrov/thruster_manager/get_thruster_curve
 * /rexrov/thruster_manager/get_thrusters_info
 * /rexrov/thruster_manager/set_config
```

This node has nine publishers of message type uuv_gazebo_ros_plugins_msgs It subscribes to four topics and has seven services.

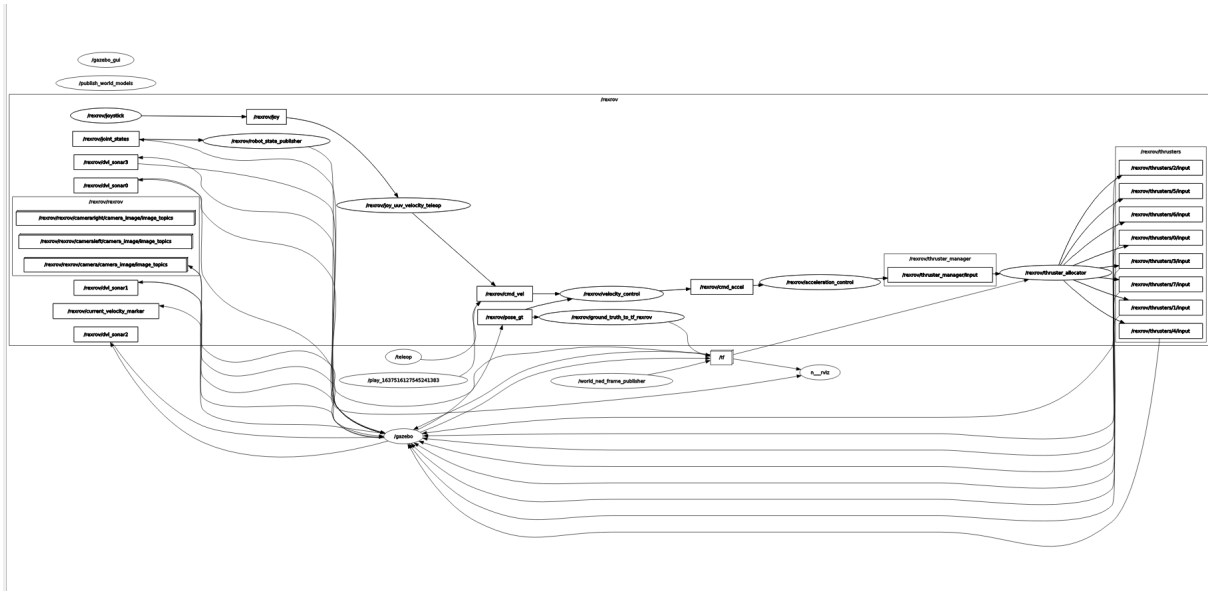
Task 2

Part A

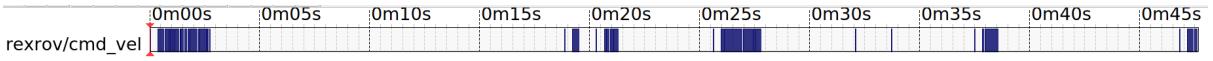
In order to see the robot launched in the gazebo world and controlled by the node teleop_twist_keyboard, you need to run the launch file under uuv_gazebo/launch/rexrov_demos/task.launch. Explanations for the functioning of the launch file are provided as comments.

Part B

Rqt_graph



Trajectory Plot



Task 3

Part A

To find the newly created node, similar to teleop_twist_keyboard, please look for the file called teleop_wrench_keyboard.py under uuv_gazebo/src/teleop_wrench_keyboard.py.
The file is similar to the previous node (teleop_twist_keyboard), but publishes a different type of messages to a different topic and contains some variables not used in the previous file.

Part B

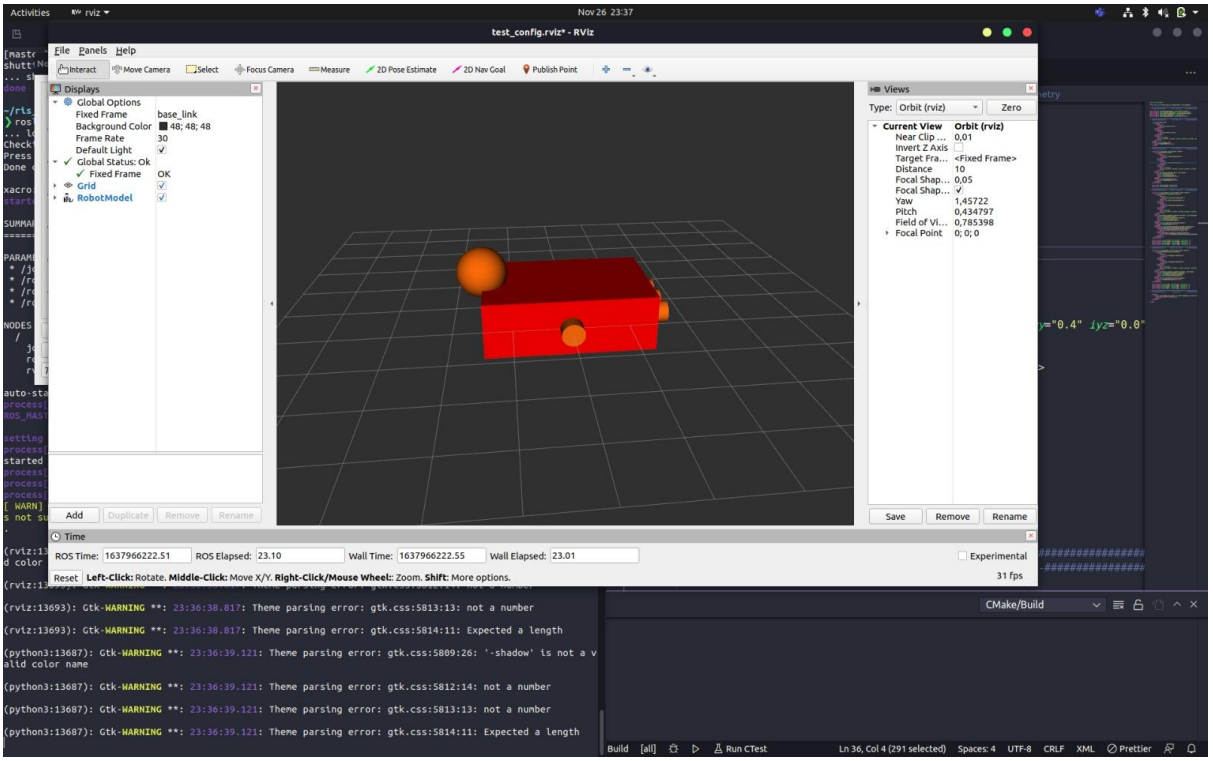
To be able to launch the robot in the gazebo world, we had to create several files. The first file is a launch file that launches the node created in the previous part of this task. The file launch_wrench_control.launch, that can be found under uuv_gazebo/launch/rexrov_demos starts the node teleop_wrench_keyboard. The second file created, also found under the same directory and called launch_rexrov_wrench, is the main launch file that combines the control node, the gazebo world and the robot in one single launch file. Detailed explanation of the functioning of the launch files can be found as comments in the launch file itself.

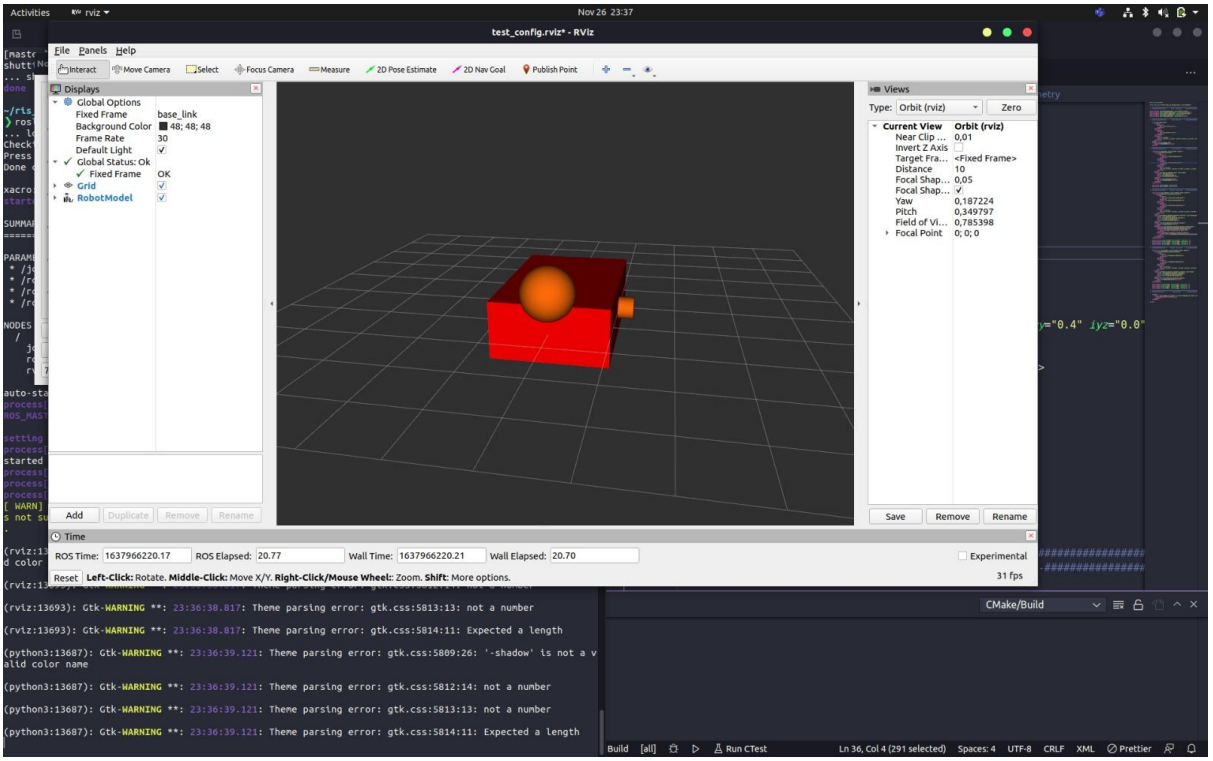
Task 4

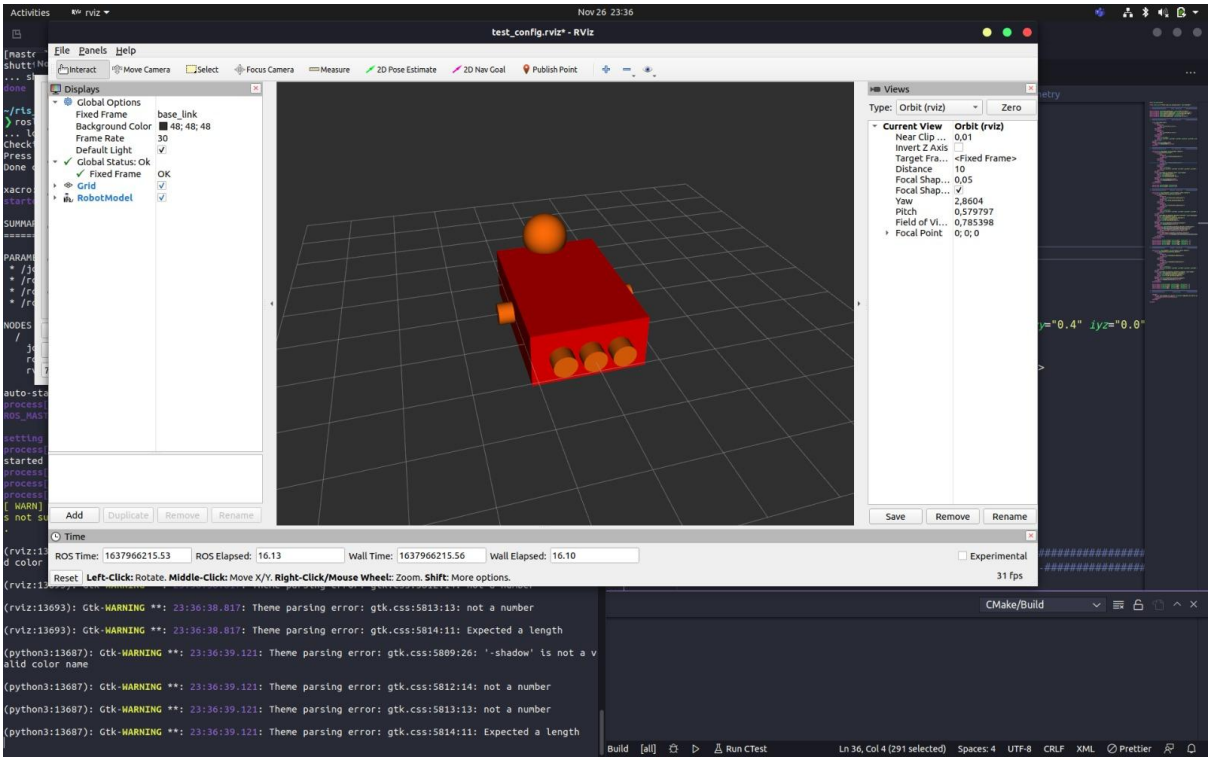
Part A

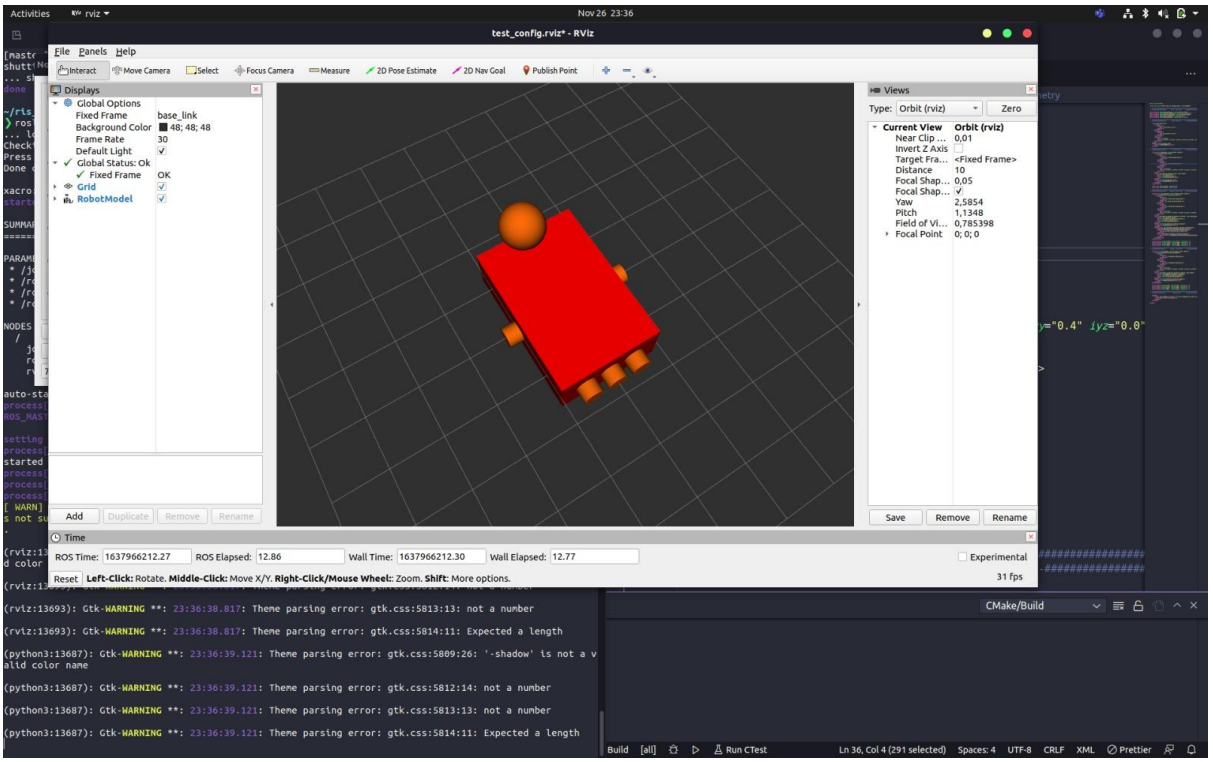
The ROV was designed using urdf and rviz and no other simulation software like blender was used.

First unzip the simulation folder and then go to workspace,
Then run roslaunch simulation test_gazebo.launcch


Activities
rviz
Nov 26 23:37
test_config.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
Displays
Global Options
Fixed Frame base_link
Background Color 48; 48; 48
Frame Rate 30
Default Light
Global Status: Ok
Fixed Frame OK
Grid
RobotModel
Add Duplicate Remove Rename
Views
Type: Orbit (rviz) Zero
Current View Orbit (rviz)
Near Clip ... 0,01
Invert Z Axis
Target Fra... <Fixed Frame>
Distance 10
Focal Shap... 0,05
Focal Shap...
Yaw 1,45722
Pitch 0,434797
Field of Vi... 0,785398
Focal Point 0; 0; 0
Save Remove Rename
Time
ROS Time: 1637966222.51 ROS Elapsed: 23.10 Wall Time: 1637966222.55 Wall Elapsed: 23.01
Experimental
Reset Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps
(rviz:13693): Gtk-WARNING **: 23:36:38.817: Theme parsing error: gtk.css:5813:13: not a number
(rviz:13693): Gtk-WARNING **: 23:36:38.817: Theme parsing error: gtk.css:5814:11: Expected a length
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5809:26: '-shadow' is not a valid color name
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5812:14: not a number
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5813:13: not a number
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5814:11: Expected a length
CMake/Build
Build [all] Run CTest Ln 36, Col 4 (291 selected) Spaces: 4 UTF-8 CRLF XML Prettier


Activities
rviz
Nov 26 23:37
test_config.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
Displays
Global Options
Fixed Frame base_link
Background Color 48; 48; 48
Frame Rate 30
Default Light
Global Status: Ok
Fixed Frame OK
Grid
RobotModel
Add Duplicate Remove Rename
Views
Type: Orbit (rviz) Zero
Current View Orbit (rviz)
Near Clip ... 0,01
Invert Z Axis
Target Fra... <Fixed Frame>
Distance 10
Focal Shap... 0,05
Focal Shap...
Yaw 0,187224
Pitch 0,349797
Field of Vi... 0,785398
Focal Point 0; 0; 0
Save Remove Rename
Time
ROS Time: 1637966220.17 ROS Elapsed: 20.77 Wall Time: 1637966220.21 Wall Elapsed: 20.70
Experimental
Reset Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps
(rviz:13693): Gtk-WARNING **: 23:36:38.817: Theme parsing error: gtk.css:5813:13: not a number
(rviz:13693): Gtk-WARNING **: 23:36:38.817: Theme parsing error: gtk.css:5814:11: Expected a length
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5809:26: '-shadow' is not a valid color name
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5812:14: not a number
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5813:13: not a number
(python3:13687): Gtk-WARNING **: 23:36:39.121: Theme parsing error: gtk.css:5814:11: Expected a length
CMake/Build
Build [all] Run CTest Ln 36, Col 4 (291 selected) Spaces: 4 UTF-8 CRLF XML Prettier





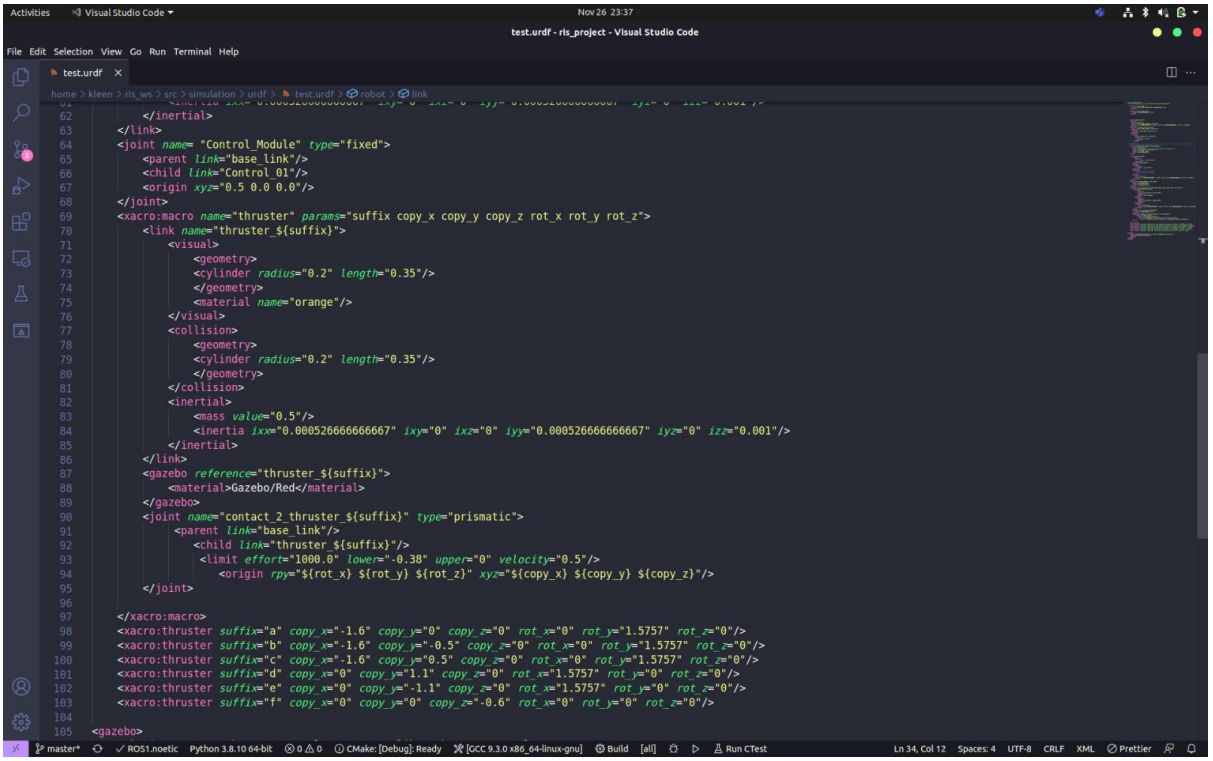
The ROV has 1 control head and 5 thrusters added.

Part B

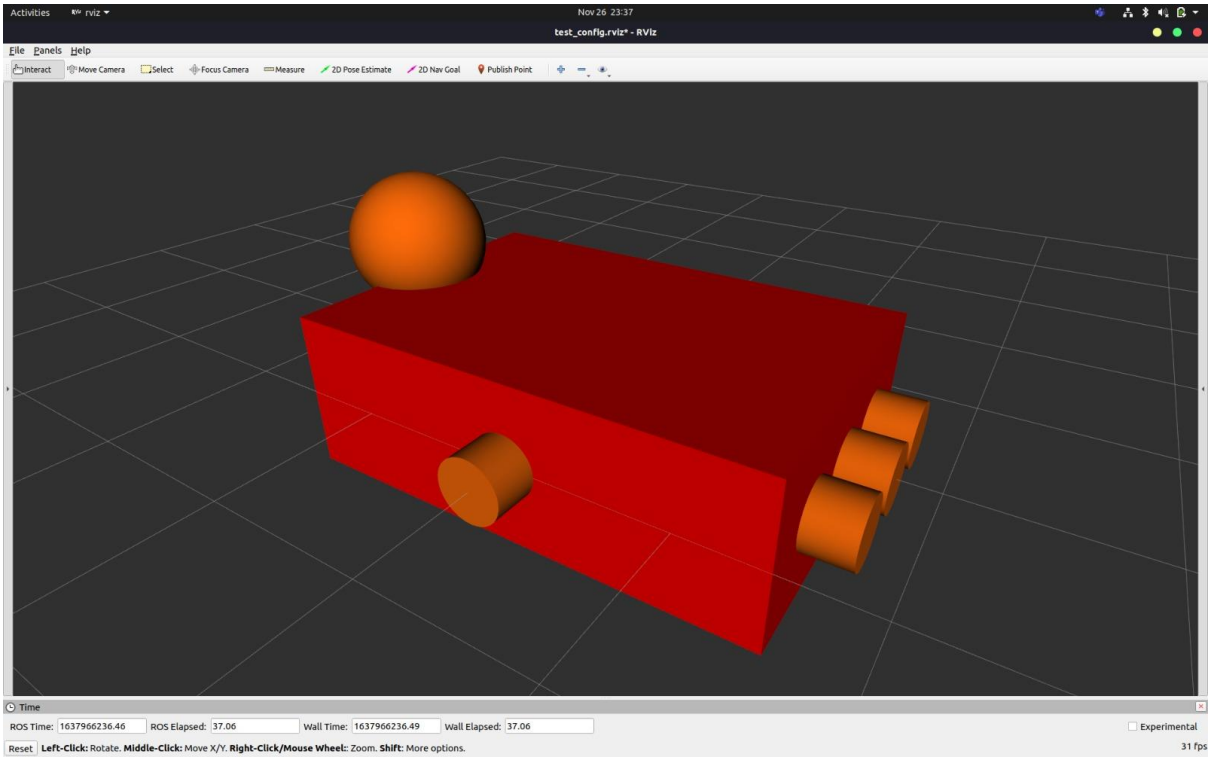
The completed URDF file has 5 thrusters.

1. One for vertical ascend and submerge function underneath the rov.
2. Two for sideways movement left and right without tilt.
3. 3 for maximum thrust from behind and reverse movement.

This was decided for optimal mobility and easy use since the ROV in question was never intended for specialized cases



Here are the xacro files for thruster rotations. They are prismatic joints allowing complex precise motions.



Part D (i)

The ROV file was launched into UUV gazebo by adding inertials, masses and gazebo colors. Use the

roslaunch simulation test_gazebo.launch

command after sourcing the folder simulation.

The ROV does not spawn perfectly in the world.

Point Division

We divided the work by questions and for some parts of those questions

1. Valentina 25 pts
2. Yassine & Valentina
    a. Yassine 10 pts & Valentina 5 pts
    b. Valentina 5 pts
3. Yassine 20 pts
4. Yasar 35 pts

Name	Percentages
Valentina	35 %
Yassine	30 %
Yasar	35 %