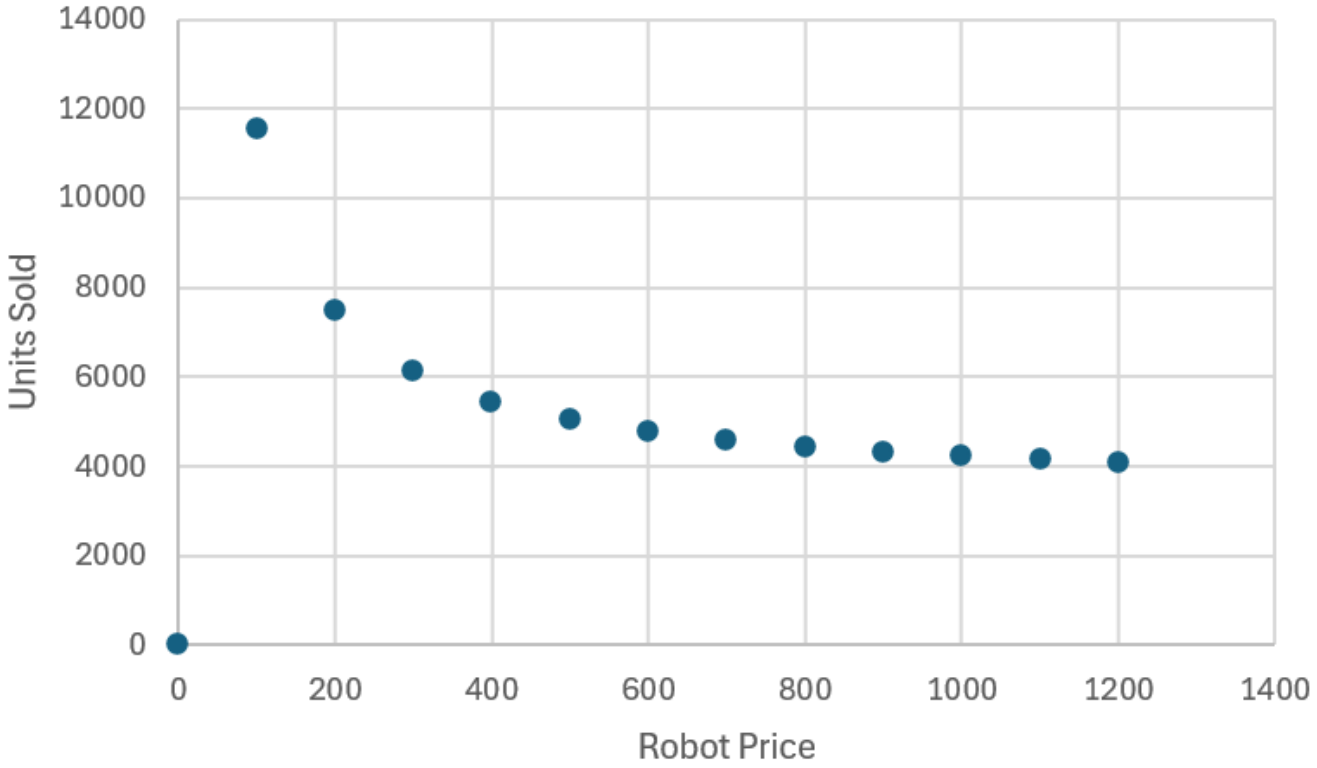

SSG
MOBILE ROBOTICS CO.

Our Solution

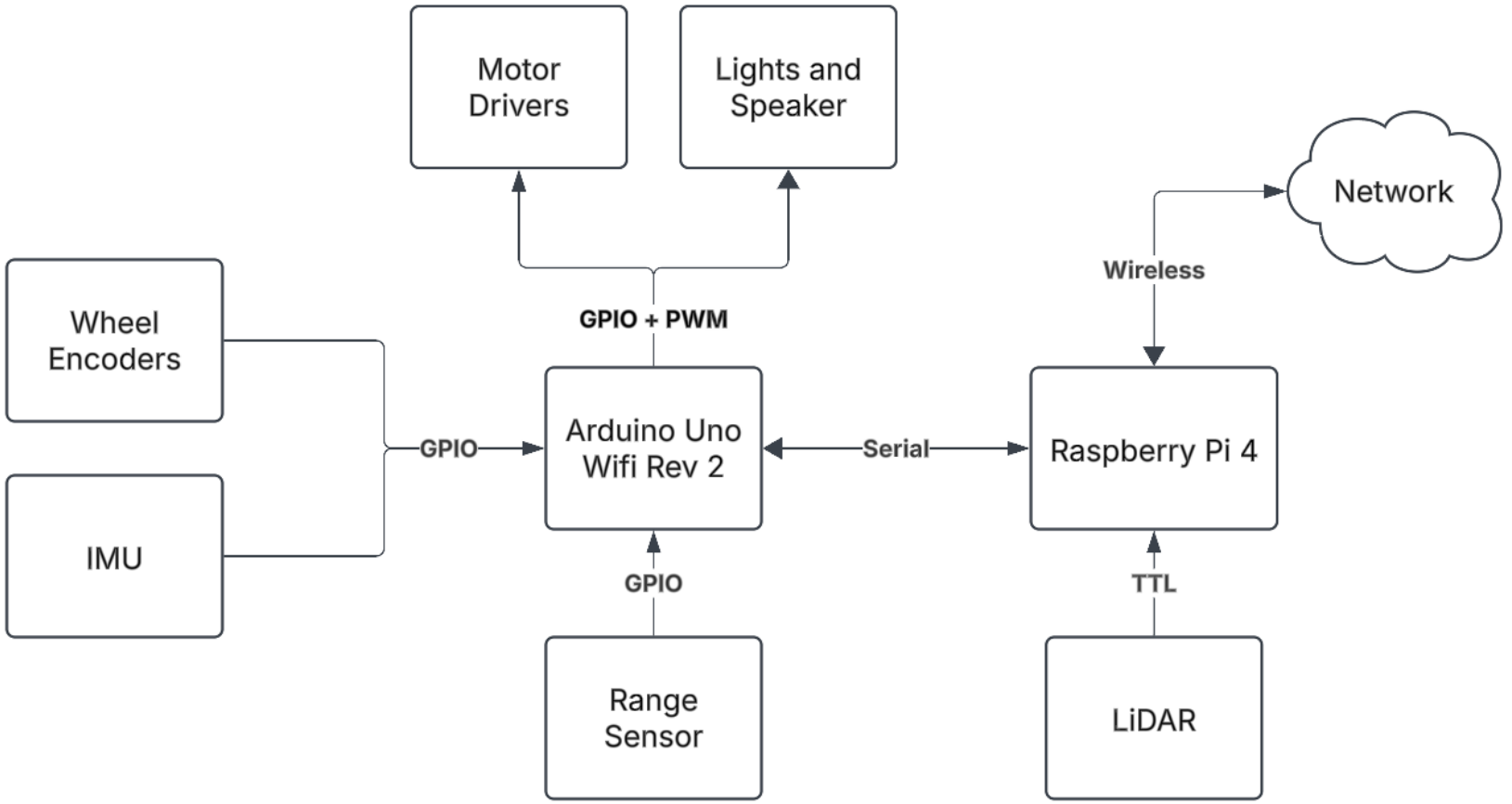
A software stack designed specifically for the implementation of mobile robotics within airport environments.

Cost Analysis

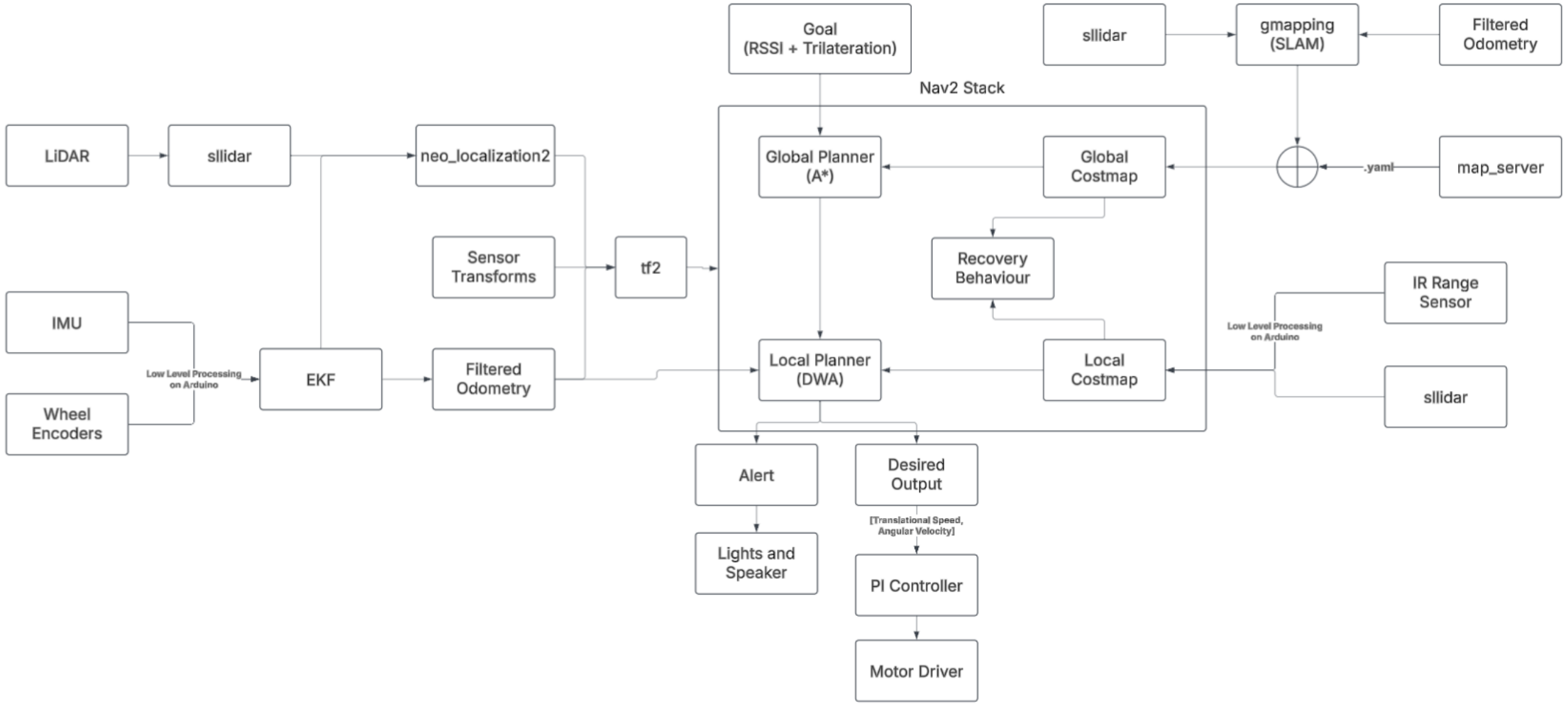
- 5 Year Lifespan
- 1,000 Units Sold
- Profit of $2,500
- Robot Price $4,225



Hardware Systems Diagram



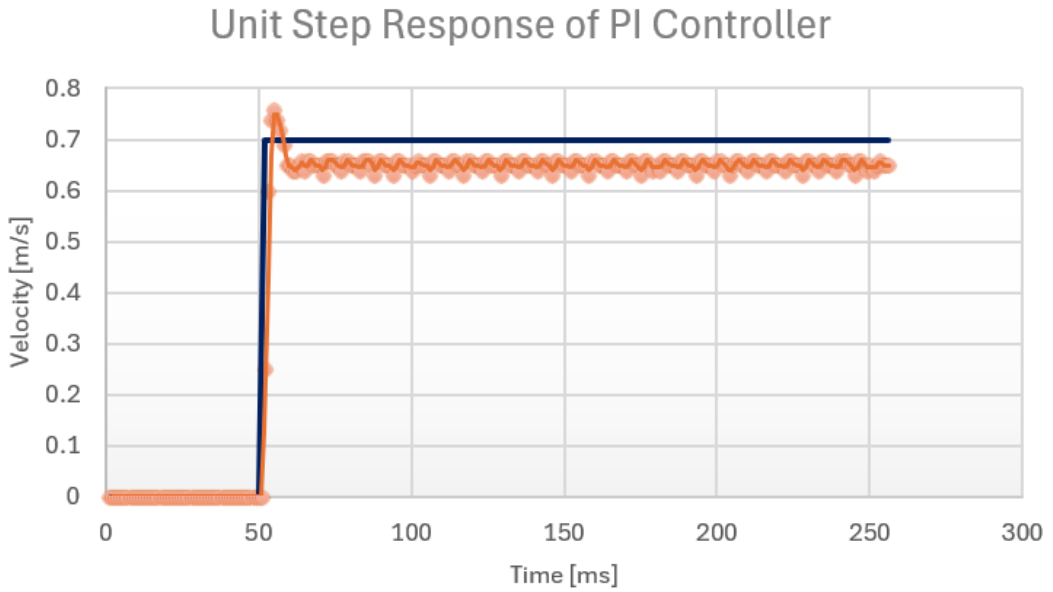
Software Systems Diagram

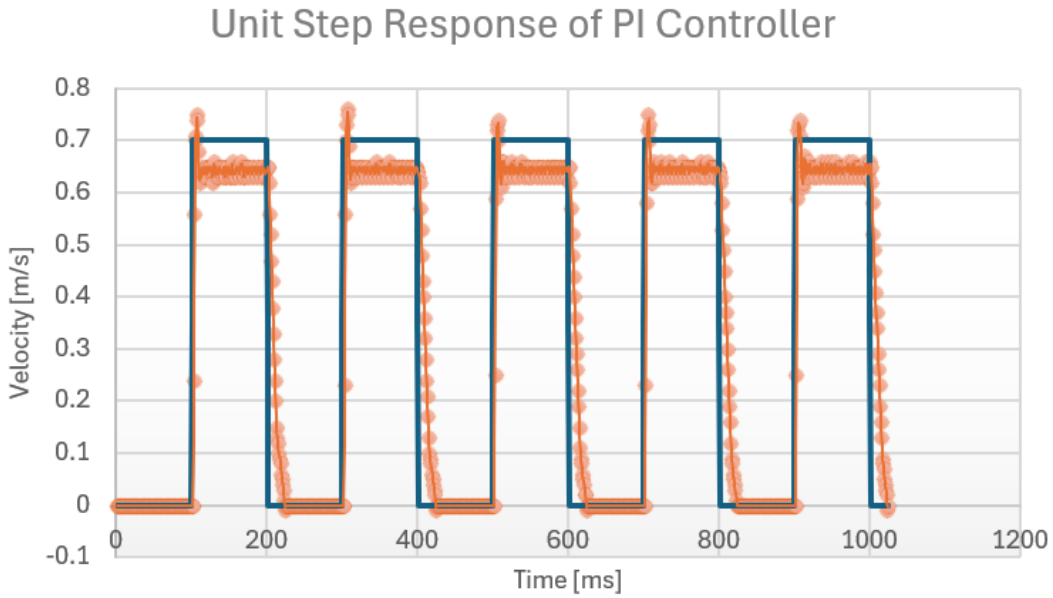


Proportional Integral Controller

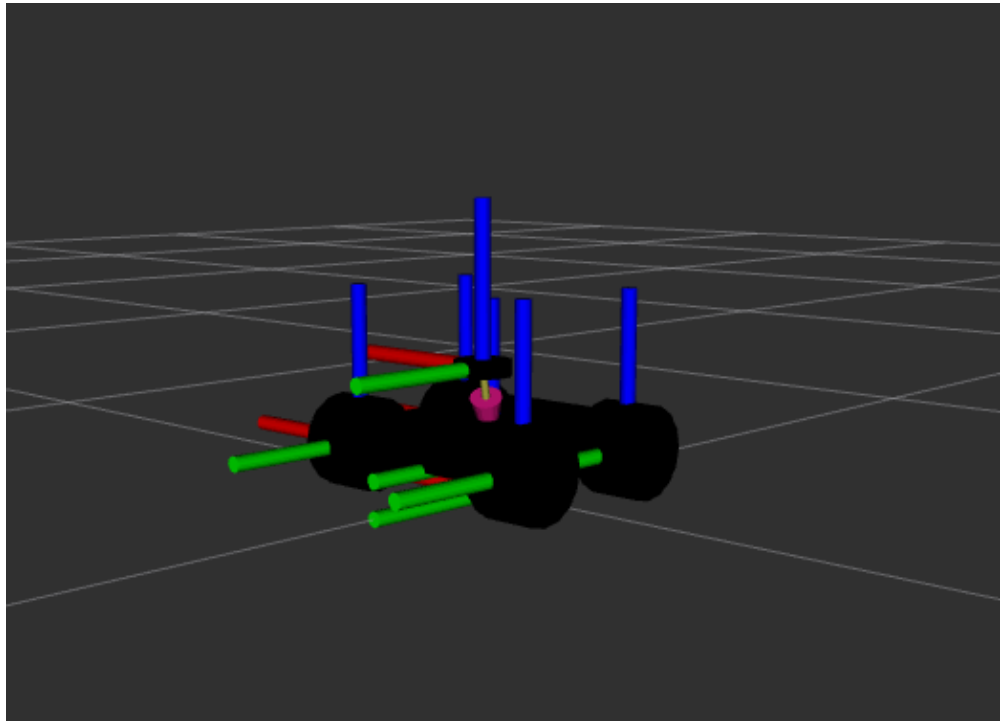
$$u[n] = K_p e[n] + K_i \sum_{n=0}^{5} e_i[n]$$

```
// Find the proportional error in wheel speed
e_nowR = v_R_desired - v_R;
e_nowL = v_L_desired - v_L;

// Integral error NEED TO UPDATE TO SUM OF ONLY RELEVANT PREV ERRORS USE QUEUE.
e_intRT -= e_intR[i];   // Subtract oldest value from integral error sum
e_intR[i] = e_nowR;     // Update the oldest calue of integral error array
e_intRT += e_intR[i];   // Add updated value to array

e_intLT -= e_intL[i];   // Same as prev
e_intL[i] = e_nowL;
e_intLT += e_intL[i];

i = (i + 1) % 5;        // Increment i and reset i when equal to 5

// Call PI controller
u_L = PI_controller(e_nowL, e_intLT, k_p, k_i);
u_R = PI_controller(e_nowR, e_intRT, k_p, k_i);
```





Unified Robot Description Format



URDF of the Lynxmotion Rover Prototype

```
<?xml version="1.0"?>
<robot xmlns:xacro="http://www.ros.org/wiki/xacro" name="bot_10">
	<material name="black">
		<color rbga="0 0 0 0"/>
	</material>
	<material name="white">
		<color rbga="1 1 1 1"/>
	</material>

	<link name ="base_footprint"/>

	<link name="base_link">
		<visual>
		<origin xyz="0 0 0.0275" rpy="0 0 0"/>
		<material name="black"/>
			<geometry>
				<box size="0.20 0.253 0.055"/>
			</geometry>
		</visual>
	</link>

	<link name="lidar_link">
		<visual>
			<geometry>
				<cylinder radius="0.035" length="0.02"/>
			</geometry>
		<origin xyz="0 0 0" rpy="0 0 0"/>
		<material name="white"/>
		</visual>
	</link>

	<link name="fr_wheel_link">
		<visual>
			<geometry>
				<cylinder radius="0.06" length="0.07"/>
			</geometry>
		<origin xyz="0 0 0" rpy="0 1.57 0"/>
		<material name="white"/>
		</visual>
	</link>

	<link name="fl_wheel_link">
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			<geometry>
				<cylinder radius="0.06" length="0.07"/>
			</geometry>
		<origin xyz="0 0 0" rpy="0 1.57 0"/>
		<material name="white"/>
		</visual>
	</link>

	<link name="br_wheel_link">
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			<geometry>
				<cylinder radius="0.06" length="0.07"/>
			</geometry>
		<origin xyz="0 0 0" rpy="0 1.57 0"/>
		<material name="white"/>
		</visual>
	</link>

	<link name="bl_wheel_link">
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			<geometry>
				<cylinder radius="0.06" length="0.07"/>
			</geometry>
		<origin xyz="0 0 0" rpy="0 1.57 0"/>
		<material name="white"/>
		</visual>
	</link>

	<joint name="base_joint" type="fixed">
		<parent link="base_footprint"/>
		<child link="base_link"/>
		<origin xyz="0 0 0.045" rpy="0 0 0"/>
	</joint>

	<joint name="base_fr_wheel_joint" type="continuous">
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		<child link="fr_wheel_link"/>
		<origin xyz="0.14 0.095 0.015" rpy="0 0 0"/>
		<axis xyz="1 0 0"/>
	</joint>

	<joint name="base_fl_wheel_joint" type="continuous">
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		<child link="fl_wheel_link"/>
		<origin xyz="-0.14 0.095 0.015" rpy="0 0 0"/>
		<axis xyz="1 0 0"/>
	</joint>

	<joint name="base_br_wheel_joint" type="continuous">
		<parent link="base_link"/>
		<child link="br_wheel_link"/>
		<origin xyz="0.14 -0.095 0.015" rpy="0 0 0"/>
		<axis xyz="1 0 0"/>
	</joint>

	<joint name="base_bl_wheel_joint" type="continuous">
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		<child link="bl_wheel_link"/>
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		<axis xyz="1 0 0"/>
	</joint>

	<joint name="base_lidar_joint" type="fixed">
		<parent link="base_link"/>
		<child link="lidar_link"/>
		<origin xyz="-.047 0.065 0.125" rpy="0 0 0"/>
	</joint>
</robot>
```
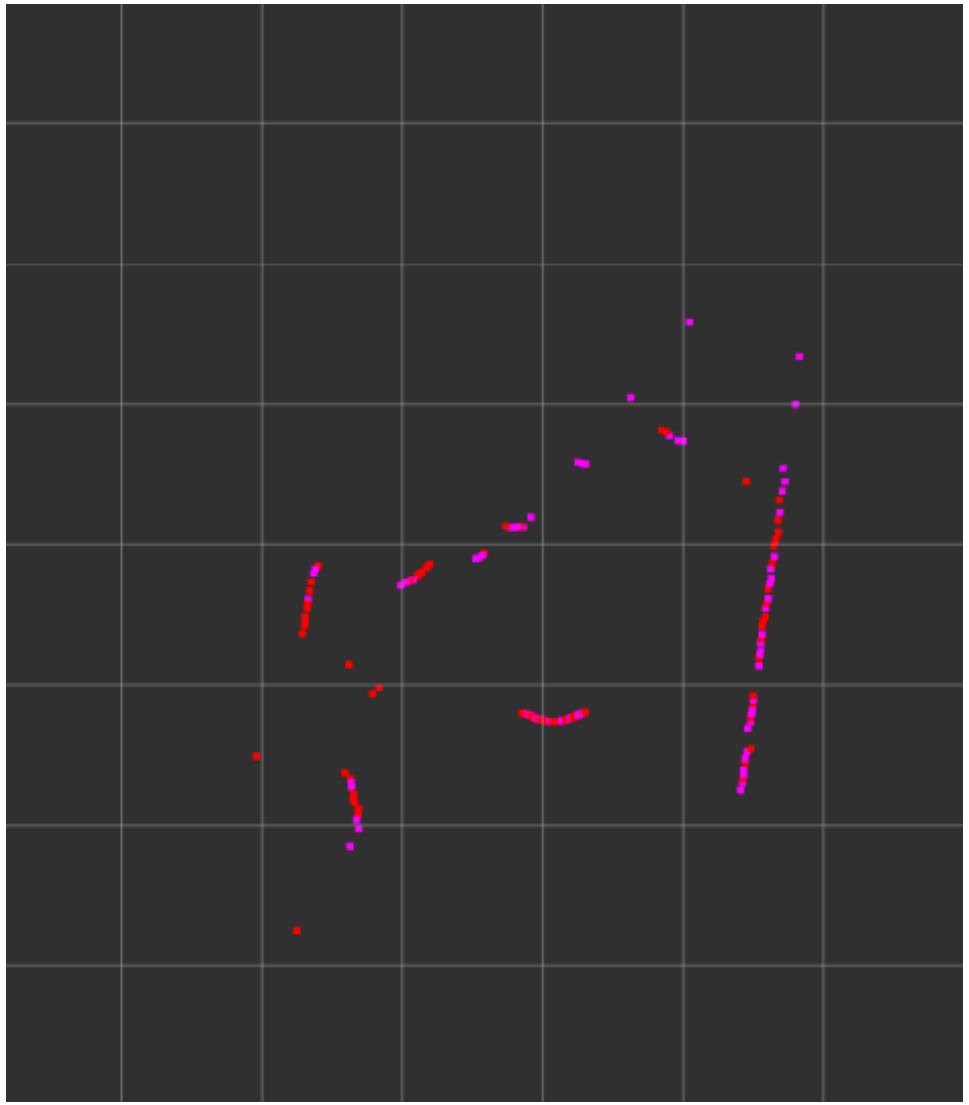
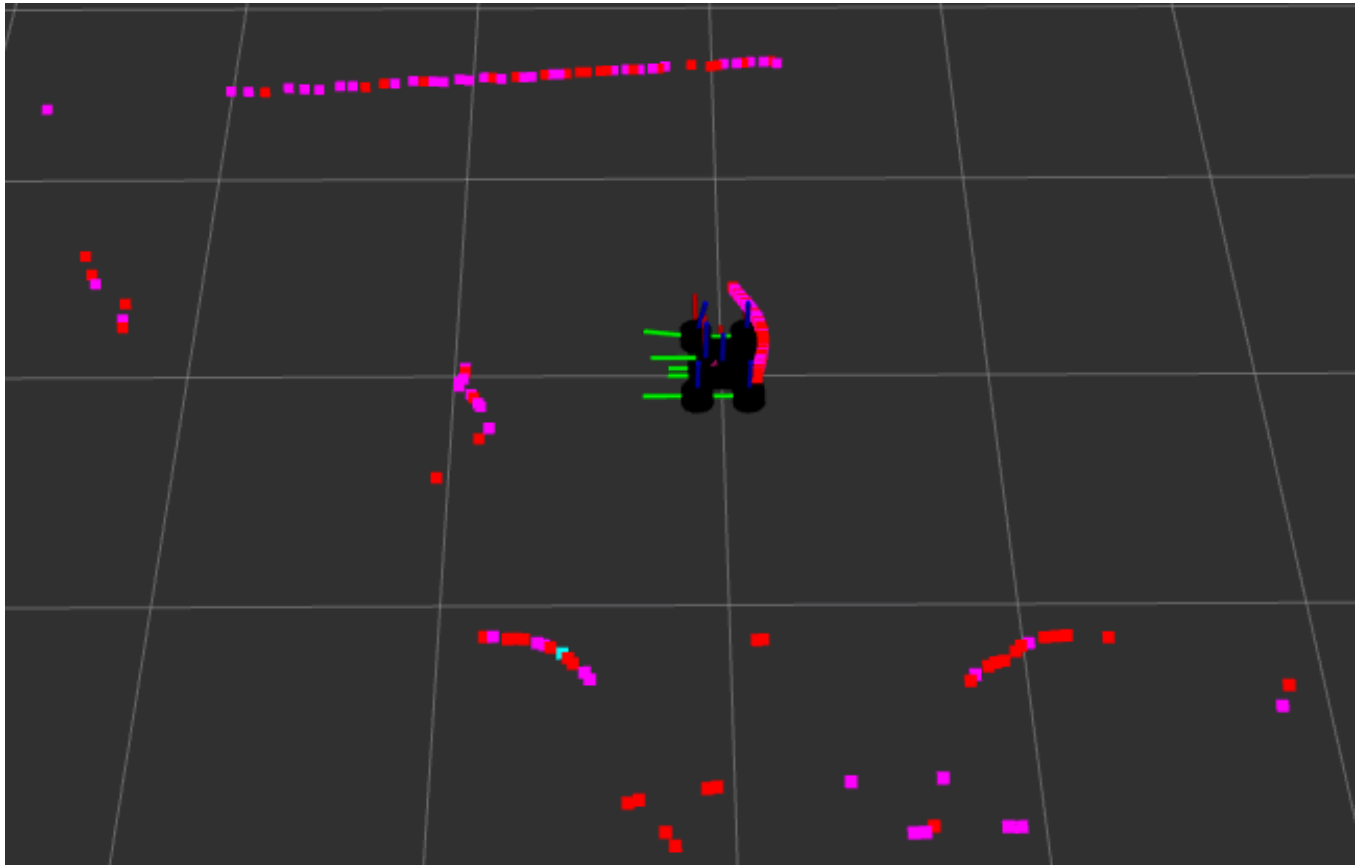

LiDAR - Range Sensing





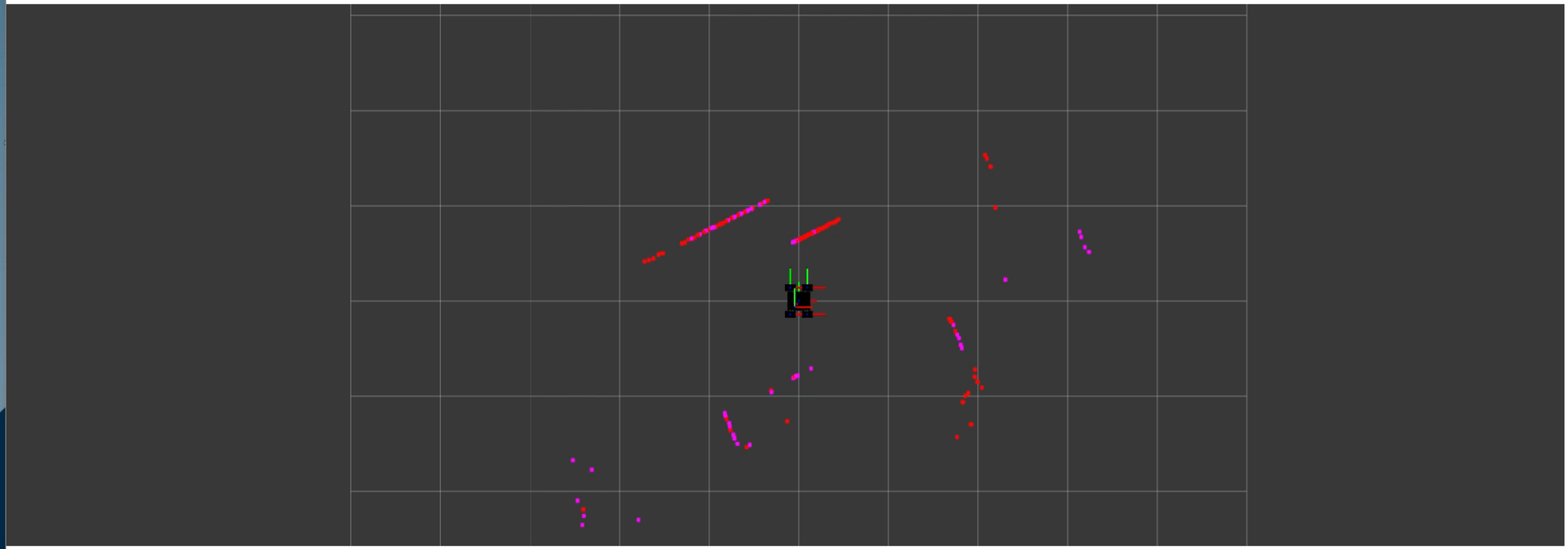
LiDAR visualization in Rviz

192.168.50.210 - Remote Desktop Connection

/home/group10/bot10.rviz* - RViz

Help

Move Camera | Select | Focus Camera | Measure | 2D Pose Estimate | 2D Goal Pose | Publish Point



1743481796.75 ROS Elapsed: 530.88 Wall Time: 1743481796.83 Wall Elapsed: 530.88 Experimer

14 f

group10@robotROBOT10-pi: ~/ros2_ws/src/keyboard_controller/keyboard_controller

File Actions Edit View Help

group10@robotROBOT10-pi...ler/keyboard_controller

```
[INFO] [1743481796.001313114] [keyboard_controller_node]: Rotational = 0.0
[INFO] [1743481796.279536789] [keyboard_controller_node]: Translational = 0.0
[INFO] [1743481796.282204375] [keyboard_controller_node]: Rotational = 4.0
```