IMU Sensor Project

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Problem Statement

- Each site has different floor type based on the material used to build it
- Some sites are smooth, some are bumpy or have cracks and crevices on floor
- Driving over the bumps and cracks often causes the chuck to hardstop
- Bad floor also adversely affects the navigation capabilities of chuck
- Thus, a bad floor leads to an increase in number of hardstops

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Goals:

- Develop a tool using data from IMU/Vibration sensor that would help analyze the floor conditions at a site and determine whether bad flooring is a cause of hardstops
- Write a python script that would output the sensor data in graphical form which would help visualize and analyze flooring conditions
- Take a new site with good floors as the ground truth (or the floor at 117), and compare it with a site with bad floors and determine how bad flooring conditions affect performance of chucks

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IMU v/s Vibration sensor

Advantages of using IMU over Vibration sensor:

- IMU is already installed on the MB, unlike vibration sensor, and thus we don’t have to buy additional sensors, saving costs
- If using vibration sensor, the right location to place it is tough to determine. It is also difficult to keep it fixed in place over a long period of time. IMU is fixed firmly at the same place on MB
- Vibration sensor gives the linear acc (in x,y and z) of chk as output which is had to visualize. IMU gives the orientation data which can be converted to give pitch, roll and yaw of chk. The change in pitch as chk passes over a bump/crack is easier to visualize
- Moreover, IMU also gives the linear acceleration data as output, if needed
- So, it was decided to go ahead with IMU

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Milestones achieved:

- Wrote the python script that would help analyze the floor conditions
- It outputs two plots which are useful in determining the floor conditions
- The plots also depict the time for which the data was recorded
- Using foxglove tool, these plots can be obtained along with the map coordinates where chuck was driving. This helps diagnose bad floors better
- Foxglove combines the script with rviz

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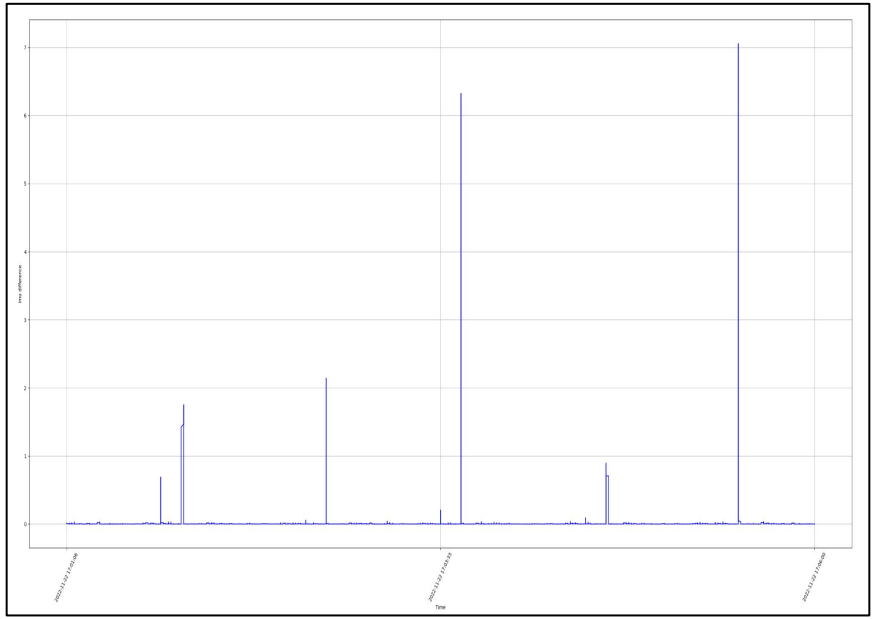
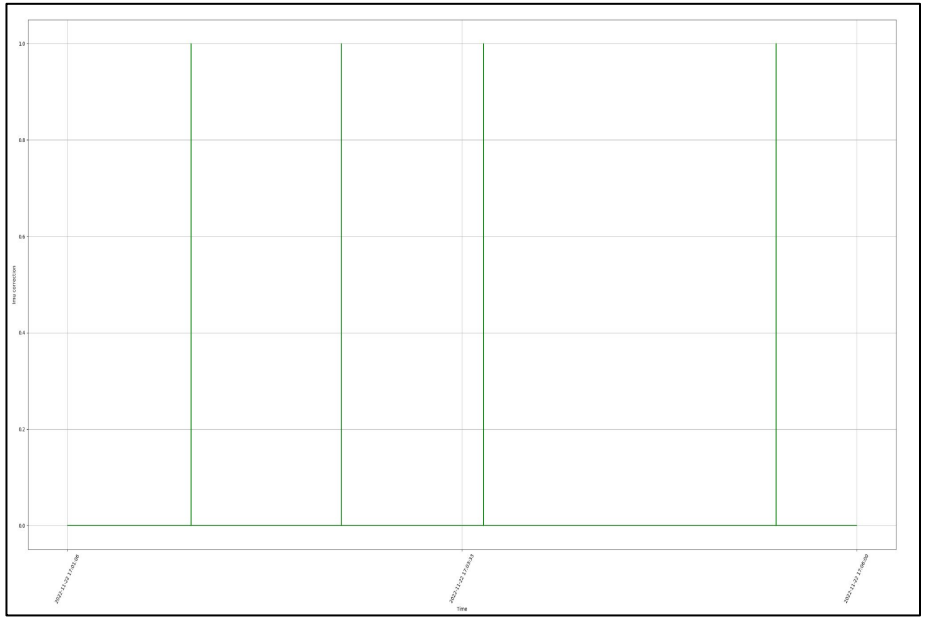
Sample plots



Plot 1



Plot 2

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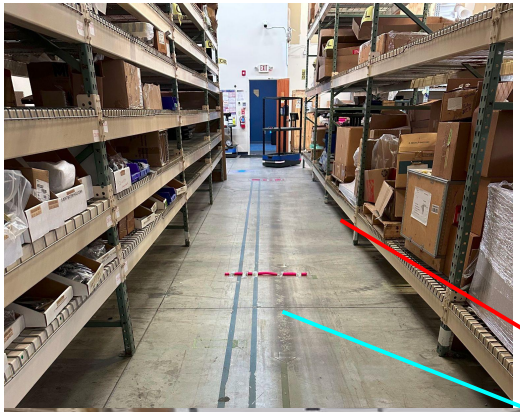
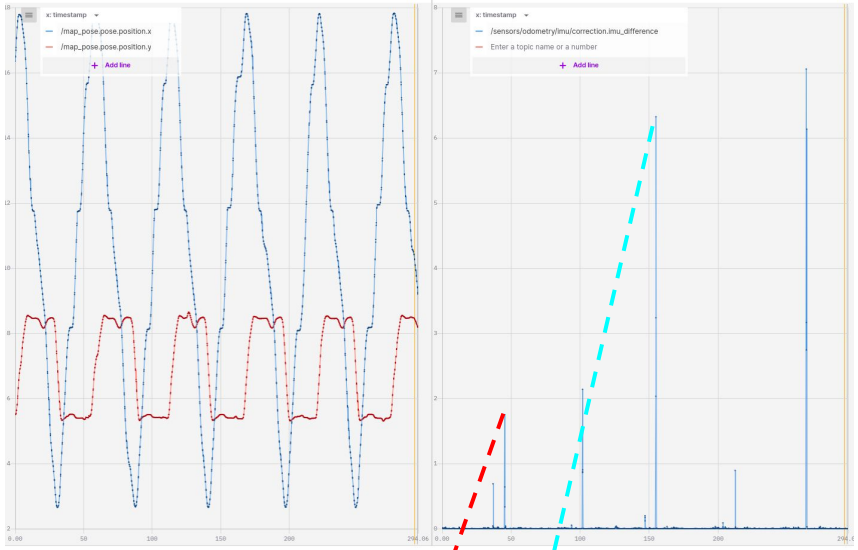
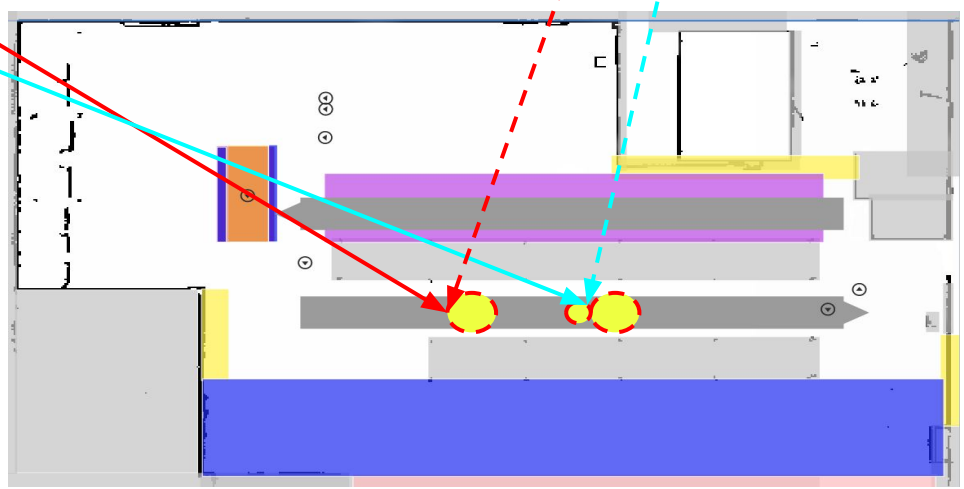
2022-12-07 IMU correlation to physical obstacles







Reading the graphs

- Once the bagfile is entered in script and run, it outputs two plots
- 1. A plot which gives either 0 or 1 (True/False) value as output. 1 is when a chuck passes over a crack/bump and gives error. (e.g overspeed error). 0 is when the chuck is running fine

  2. A plot which outputs even smaller cracks/bumps on floor that don't affect chuck's performance (more sensitive than first one)
- The x-axis has the time stamps for which the data was recorded

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Challenge #1:

- The script does output the plots where the chuck encounters bumps/cracks but doesn't tell the location of chuck in the map
- Location is important to verify whether the data from plot is correct

Solution:

- Combine rviz with the python script

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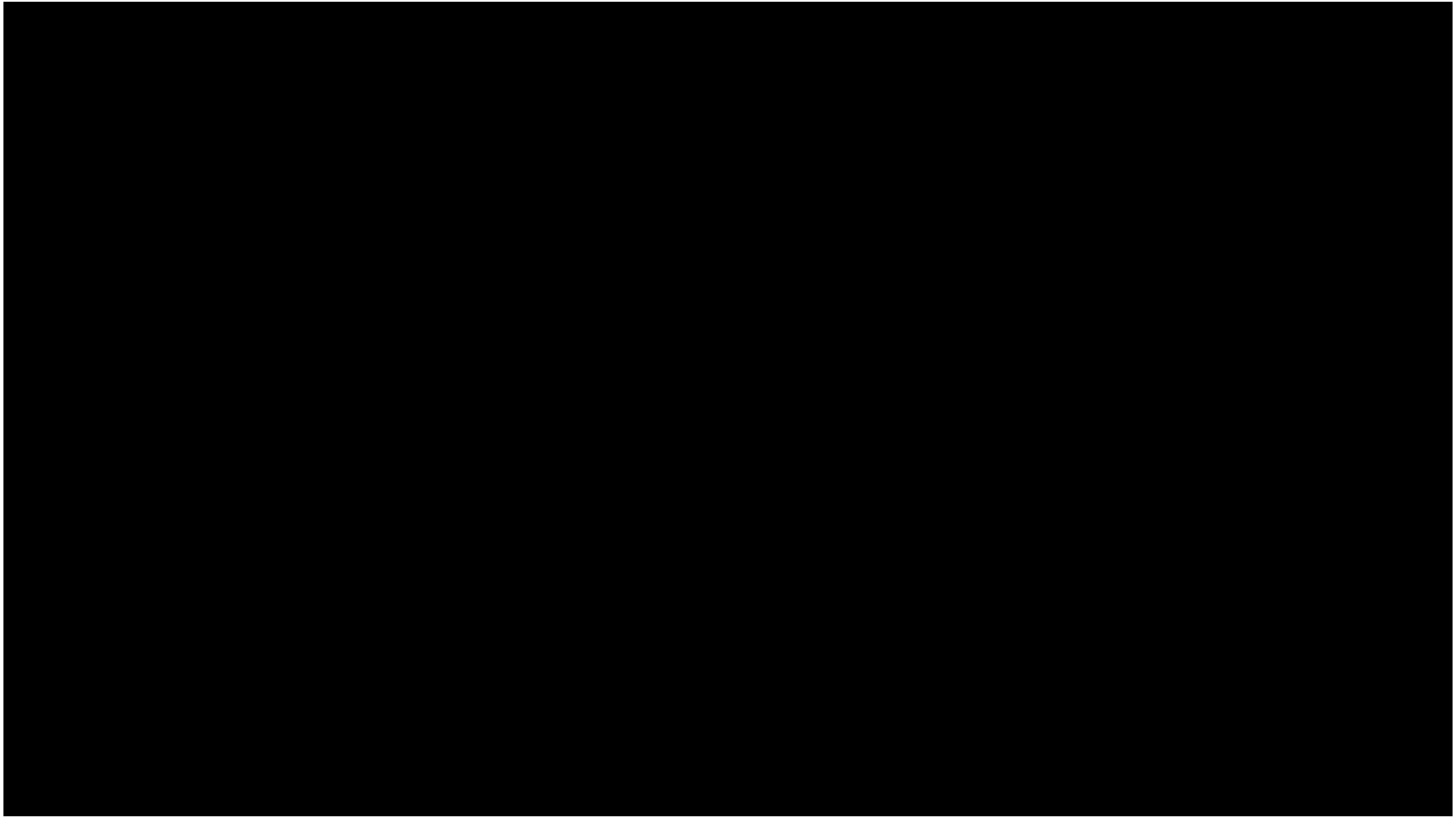

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Challenge #2:

- Running rviz along with script doesn't give time stamps.
- It's tough to relate the position of robot in rviz with the timestamps on plot

Solution:

- Use Foxglove tool

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Thank you

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