



Robust Flight Classifications Using Gazebo

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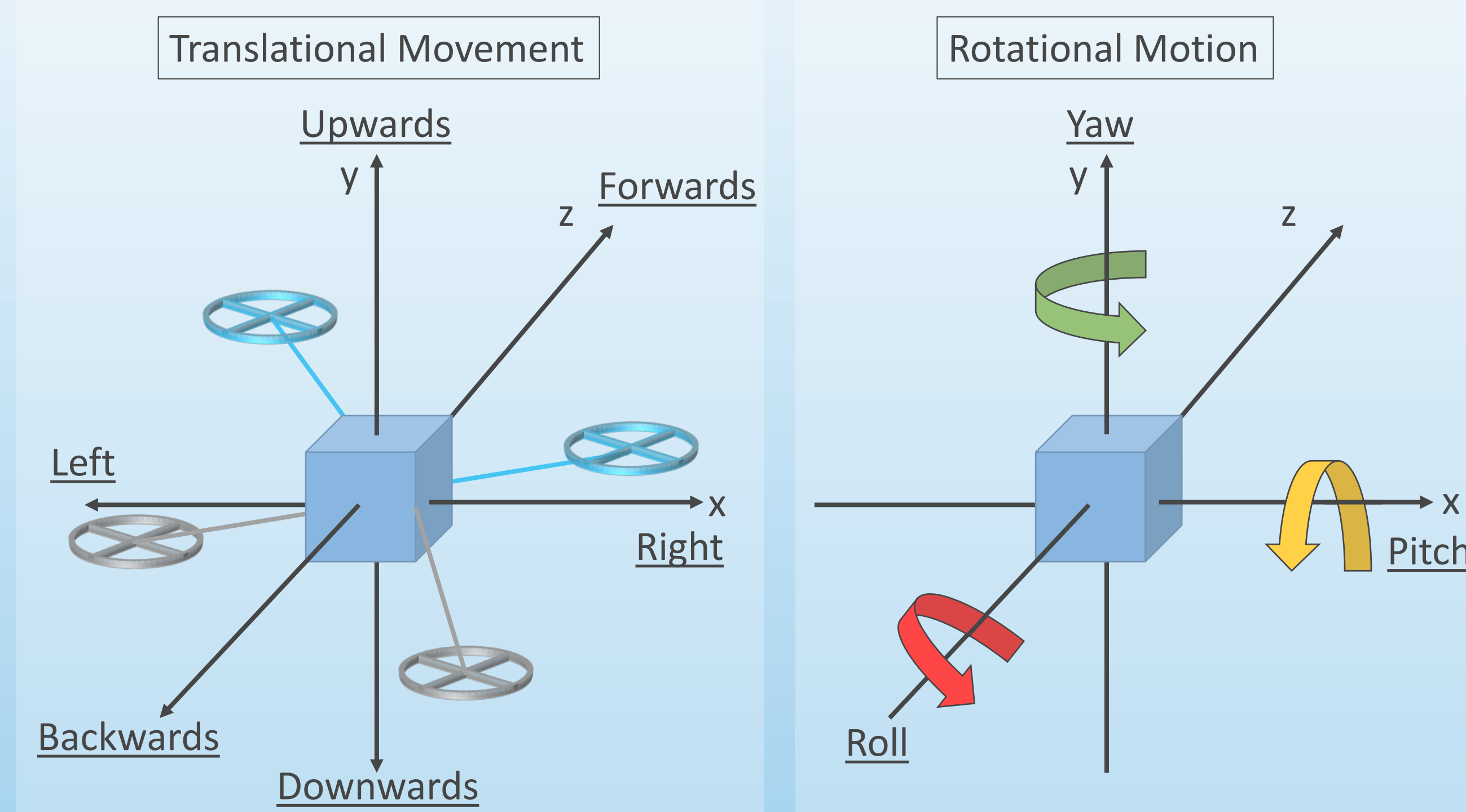


Abstract

The safety surrounding the proper execution of small Unmanned Aerial Systems (sUAS) has become a subject of concern. Consequence-aware systems, which overrides the pilot control in the event of potentially dangerous flight conditions, have been implemented as a safety precaution. However, one aspect that needs improvement is the development of a more robust sUAS that integrates a graphical user interface (GUI) and statistical analysis to determine the accuracy of flight performance. The proposed solution to improve the success of a flight is by analyzing, through a flight simulator, the difference between the estimated and actual flight patterns at varying time intervals of Unmanned Aerial Vehicle (UAV) flight logs, where a significant difference yields an unsatisfactory flight. Statistical analysis will examine the translational and rotational movement that embody the UAV, error and input/output signals generated by the sUAS warning system, commands from the user, and signal loss. By creating a GUI overlay, the user can examine the quality of the flight by providing a start and stop button to the flight simulator, a visual of the UAV, and a summary of the source(s) of error.

Background

- Autonomous vehicles are engineered to minimize the danger of operating a UAV.
- Consequence-awareness can bring a UAV to land on the ground, however, the landing command could cause additional problems if not landed properly.
- Operating ROS has many a high functionality to run UAV simulations.
- Gazebo is a platform that allows 2D/3D simulation outdoors and indoors.
- PX4 is an autopilot system that is used to experiment on UAVs and sUAS.
- Quadrotor data log will show translation and rotational movement, GPS, input and output signals.

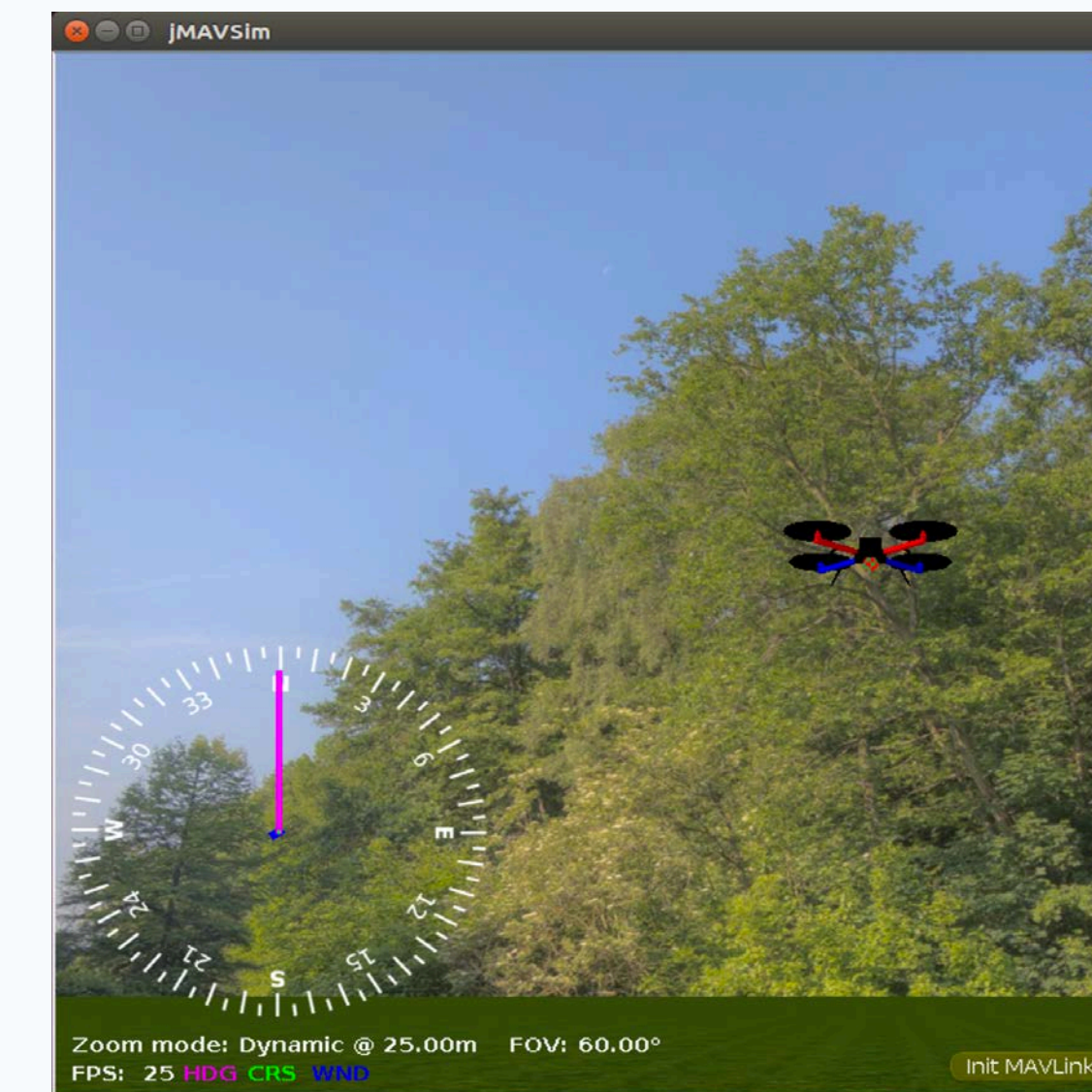


Objective

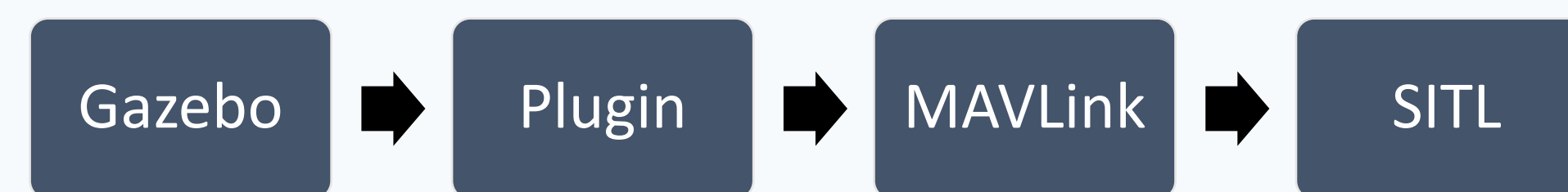
- To classify the skill of a pilot manning a UAV by analyzing the data recorded by the sUAS.
- Use a 3-D simulator, Gazebo, linked to PX4 log data
- Create a GUI Overlay on Gazebo to analyze flight logs

Methods

- Different simulators were used to determine the functionality on Ubuntu 16.04 to determine the connections between the simulation and the software.
- javMAVSim** runs quadrotor simulations on a Java based system that connects to the SITL through MAVLink. The program enters commands on the terminal through Ubuntu 16.04 to interact with the environment.

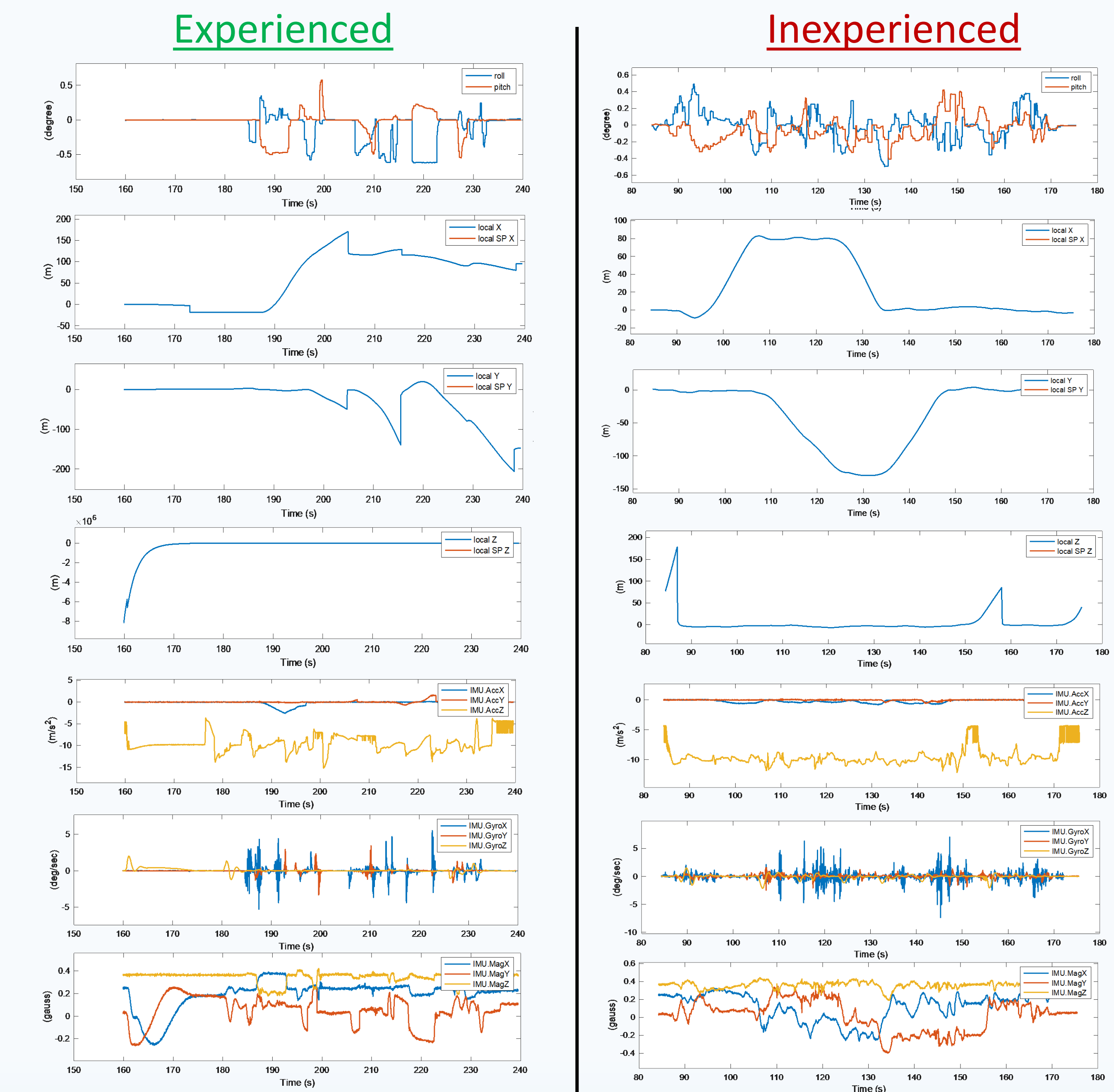
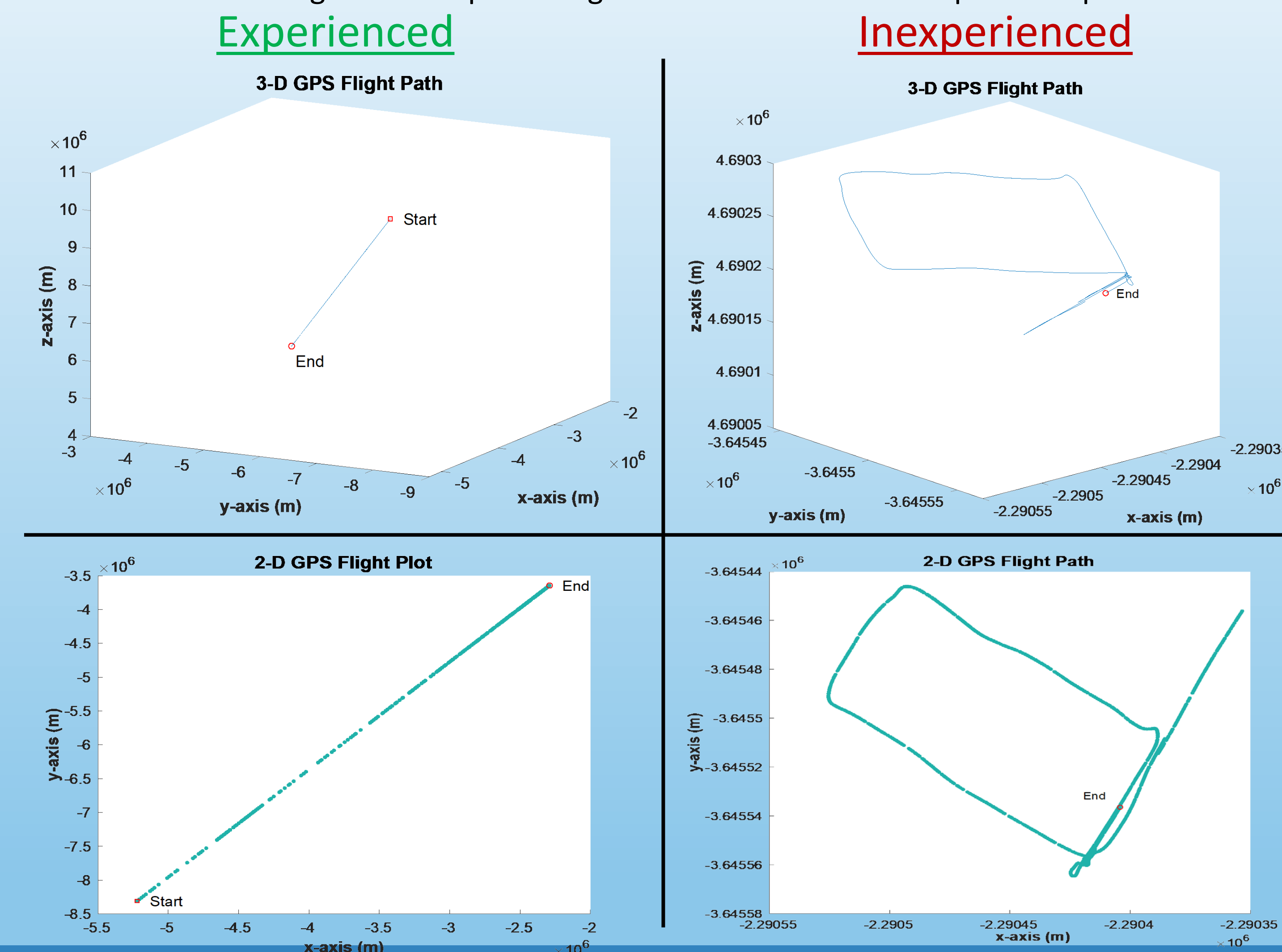


- Robot Operating System (ROS)** is a powerful robot simulator that has multiple applications and allows the user to run several simulators through Ubuntu 16.04 LTS. Using ROS-Kinetic is currently the most stable version available to simulate robots since it has the most depositories available. This is the latest version of ROS that will run with Gazebo.
- Gazebo with ROS** runs simulations since it provides a wide variety of real-time simulations not limited to robots, but also applicable to other objects in the physical world. There are many plug-ins to work with, such as PX4 simulations. The installation of Gazebo with ROS is currently functional on Ubuntu 16.04 LTS with ROS-Kinetic.



Results

Unfortunately building a robust system to analyze flight logs with Gazebo was not possible to complete since building the packages necessary to run PX4 flights as intended due to the instability of some packages available on GitHub. However, combining a python code with a statistical analysis add-on in MATLAB code, the flight log file was converted into data that could be used to merge with deep learning on how to determine if a pilot is experienced.



Conclusion

After trying different methods to connect Gazebo by installing different versions of Ubuntu and ROS, numerous hardware malfunctions occurred that made it difficult to establish a connection between Gazebo and SITL to form a more robust independent connection.

Future Studies

MATLAB has an ROS package that allows a user to connect to Gazebo via VirtualBox, which would be the next step in creating a GUI Overlay, however virtual memory has its drawback. The other option is to install PX4-Firmware v1.7.3 since it is more stable with ROS than the latest release.

References

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Acknowledgements

- This project is supported by the US Department of Education through the Minority Science and Engineering Improvement Program (MSEIP, Award No. P120A150014).