Adaptive Steering Solutions Mid Semester Status Report

**Initiation**

Since the start of the 4-wheel steering project, the team has made substantial progress. This brief status report will focus on key areas of interest regarding the project.  The first is the initiation component of the project. Being that this 4-wheel steering undertaking is a direct continuation from a previous senior design group; the first major step was the initiation aspect of it all.  It was here that the team managed to conduct the necessary research for the project, and more importantly, gather all files pertaining to Quad Steering Solutions (the previous senior design group).

In the process of gathering the information, practical test data regarding steering wheel angle and turn radius was performed on the F-16 vehicle. It’s important to highlight that the F-16 is the vehicle that will integrate the 4-wheel steering system. The purpose of collecting this data was to examine the F-16 relationship with steering angle, wheel angle, and turn radius which would be relevant information for our purposes. However, conclusions from the data suggested that the vehicle's steering system had both rotational and translational free play. Upon this discovery, the team was then tasked to fix the F-16 steering system which now has been completed. The scale of these fixes resulted in much of the steering system in the car to be overhauled. The undertaking was beyond our initial projections of completion which caused this to be delayed on the Gannt chart. All that remains for the initiation section is to conduct static testing on the now-fixed steering system.

**Design/ Analysis**

For the design part we are on track to completing the set goals. A CAD model of the servo system that is to be integrated to F16 was provided to us by the previous team that worked on the project. We have already completed about 75% of building a testbed for the demonstration of the servo steering system. While we do have the CAD of the servo system ready, we are still working on the configuration of the servo system into the F16 chassis. This requires a study of the suspension kinematics and geometry which we are doing at this moment. So far, we have done a study on Ackerman which will be one of the key factors in determining the length of our tie rods. After the kinematics study is done, we will have an idea of where the steering system needs to go, and we will be working on designing the bell cranks and making necessary adjustments to the front upright or designing a new upright. After conducting a FEA on upright and bell crank design we will be conducting a full analysis of the full system integration.

**Electronics**

Since the introduction of the project, the electronics team has focused on replacing the Raspberry Pi Pico & Breadboard setup from Quad Steering Solutions with an ESP32 & PCB circuit setup. The concept behind this is that while the breadboard worked well for conceptual testbed purposes for the real integration the PCB will allow for more efficient packaging.  The ESP32 was chosen because of its faster and higher processing speeds. The Raspberry Pi Pico uses Micro-Pyhton that is interpreted versus the ESP32 that C and Micro-Python but is compiled allowing for more efficient run time. The team has nearly completed the PCB which now is fully soldered and only requires slight revisions; the task is on time and under budget.

 The electronic section has had a few setbacks regarding the integration of the potentiometer on the steering rack. The team had acquired potentiometers that were not sealed, this was a problem because the environmental effects can damage the potentiometer causing it to fail. Furthermore, the unforeseen scale of the F-16 fixes halted further progress in this area. Currently, the team now has new sealed potentiometers and is working to integrate them with the steering rack. The objective is to modify the existing structure to support the new sealed potentiometers.

Our milestone up to this point was having a preliminary design review on March 19th, where we reviewed each system's design and timeline to see if we were on track and on budget. Overall, our project is on track with our Gantt chart and we are on budget.

