Real-Time Modeling of Aerodynamic Moments on Rotary Actuators at Mach Speeds

Overview:

Lockheed Martin currently employs a Hardware-in-the-Loop simulation environment to aeronautic vehicles being tested for flight, which includes the actuation of canards. However, they do not have a method for applying and measuring variable counter-torque to the canards during actuation in order to model air resistance mid-descent. The ultimate goal of the project is to help tune the vehicle’s guidance coding for improved accuracy.

Objectives:

Our team was tasked with designing and manufacturing a test fixture to hold and apply variable counter-torque to a shaft model of a vehicle’s canard connection, as well as the design of a control loop and Java program for meeting the input parameters (±12° angular deflection, 0-2 ft*lbs counter-torque, and both values being met simultaneously over 1-5 seconds).

Approach:

- Our team visited Lockheed Martin to develop a better understanding of the project
- The team of four students was divided into two subgroups, two students working on the test fixture and two students working on the control loop
- Functionality and integrability were deemed primary metric because the system is being implemented into a private simulation environment for high-tech vehicles
- CAD models were updated as additions to the test fixture concept were made (from the canard actuation simulator in the right half of fixture in picture to the variable hinge moment emulator in the left half)
- Testing was to be done using FEA on the designs, individual operation of the piston and motor, encoder coding, and control loop tuning

Outcomes:

- We purchased all necessary components and manufactured the test fixture without exceeding the budget constraints
- Only the mechanical operation of the project was completed because the motor was defective and the microcontroller was outside the scope of the team’s knowledge
- The project enabled Lockheed Martin to schedule another team of graduating seniors finish the incomplete work for next semester