# Aero 2 Lab Procedure
# Block Diagram Modelling

## Setup

1. Make sure the Aero 2 has been tested as instructed in the Quick Start Guide.
2. Launch MATLAB and browse to the working directory that includes the Simulink models for this lab.
3. Configure the Aero 2 in the 1 DOF pitch-only system:
    a. Unlock the pitch axis and lock the yaw axis.
    b. Both rotors are horizontal.
    c. Adjust weights on rotors so the Aero 2 body sits level.
4. Connect the USB cable to your PC/laptop.
5. Connect the power and turn the power switch ON. The Aero 2 base LED should be red.

## Exploration

### Part 1

1. Open the Simulink model q_aero2_thruster_model.slx (Figure 1). This model will apply a 10-24V, 0.5 Hz square wave to motor 0 and reads the propeller velocity using the tachometer as shown in Figure 1. In this lab, you will be completing a block diagram model for the Thruster Model to accomplish the desired task.

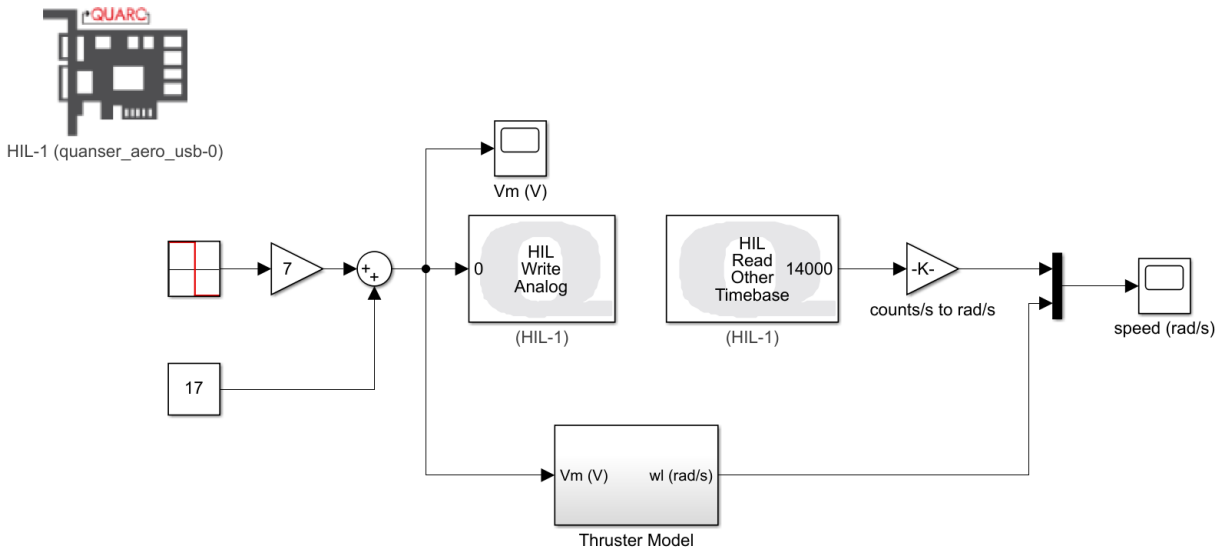


Figure 1: Simulink model that applies a set voltage and displays measured and simulated Quanser Aero 2's speed.

2. Open the subsystem called *Thruster Model*. This subsystem shown in Figure 2 contains an incomplete block diagram of a thruster system feedback loop model.


Figure 2: Incomplete Thruster Model subsystem.

3. Using the equations from the Modelling Concept Review, model the closed-loop system for one thruster, including the drag of the system, by completing the block diagram to model the motor and physical system.

   Note: The Modelling Concept Review covers equations based on a DC motor driving a simple inertial load in addition to the motor and hub. You will have to replace the load with a propeller and corresponding properller inertia term ($4.0 \times 10^{-5}\ kg\ m^2$), while maintaining the motor and hub inertia terms.

   Tips: You'll need a few *Gain* blocks for the inertia as well as the drag and back EMF, at least one more *Sum* block, and an Integrator block (to go from acceleration to velocity).

   Before running your script, it may also be helpful to look through and run the *aero2_param.m* file in Matlab. This file sets up the system parameter variables in your environment so that you can call these variables in your function blocks instead of entering the value numerically in the *Gain* blocks.

4. Build and deploy the model using the QUARC controller with your Aero 2's model. Take a screen capture of your scopes. Does your modeled system represent the physical Aero 2 well? Explain.

5. Repeat step 4 after reducing the nominal setpoint voltage from 17V to 12V, and then 5V. Does your modeled system represent the physical Aero 2 well? Explain.

6. Stop and close the model. Power OFF the Aero 2.