# AA279C Homework 2

Due Wednesday, May 2, 2018

## 1 Euler's Equation

1. Implement Euler's equation using the inertia matrix for your spacecraft.
2. Verify our stability analysis from class by simulating your spacecraft's motion about each principle axis. Start with an initial condition of $\|\omega\| = 10$ RPM about the major axis and then use the same angular momentum about each of the other axes. Add perturbations to the initial conditions to test the stability of each axis and to simulate nutation.
3. Produce a plot of the momentum sphere showing each equilibrium point and several example trajectories.

## 2 Safe Mode

Most modern spacecraft have a "safe mode" built into their operating software that is triggered in the event of a system malfunction. Attitude is an important part of this, as solar panels must be illuminated and communication antennas must be pointed to Earth to keep the spacecraft alive. Often, a spacecraft is put into a passively stable spin. Design a stable spin configuration for your satellite that keeps the solar panels pointed in an inertially fixed direction (i.e. towards the sun).

1. Specify the desired angular velocity vector in body coordinates corresponding to a spin of 10 RPM about the solar panel normal vector. In general, this will not be a principle axis.
2. Using superspin and dynamic balance, calculate the rotor momentum necessary to stabilize this angular velocity vector with an inertia ratio of at least 1.2.
3. Add rotors to your Euler equation code to implement the gyrostat equation in MATLAB.
4. Simulate the stable spin configuration you calculated. Perturb the initial conditions slightly to demonstrate stability.

## 3 Spacecraft Dynamics

Add gyrostat dynamics to your orbit simulation from HW 1. The state vector should now include the attitude quaternion, angular velocity, and rotor momentum in addition to position and velocity. Simulate the full spacecraft dynamics using the same orbit as last time and the perturbed initial conditions from question 2.4. For now, assume the sun vector is parallel to the $x$-axis in ECI coordinates. Plot the components of the attitude quaternion as well as the pointing error of the solar panel normal vector in degrees over several nutation periods.