Advanced Automation 833

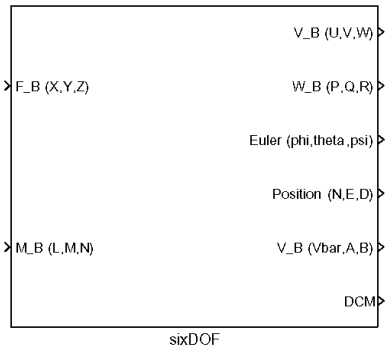
April 2019

Introductory course to aircraft dynamics

Homework 1

Question 1

Make use of MATLAB's Simulink to create a generic six degree of freedom simulation block. The block should accept the force and moment vector coordinates in body axes and internally propagate the linear velocity in body axes, the angular velocity in body axes, the Euler 3-2-1 angles and the position coordinates in NED axes. All of the internal states should be made available as outputs to the block as well as the following states: the polar coordinates of the velocity vector and the full direction cosine matrix. An example of what the block should look like is shown below.



Test the functionality of the block by,

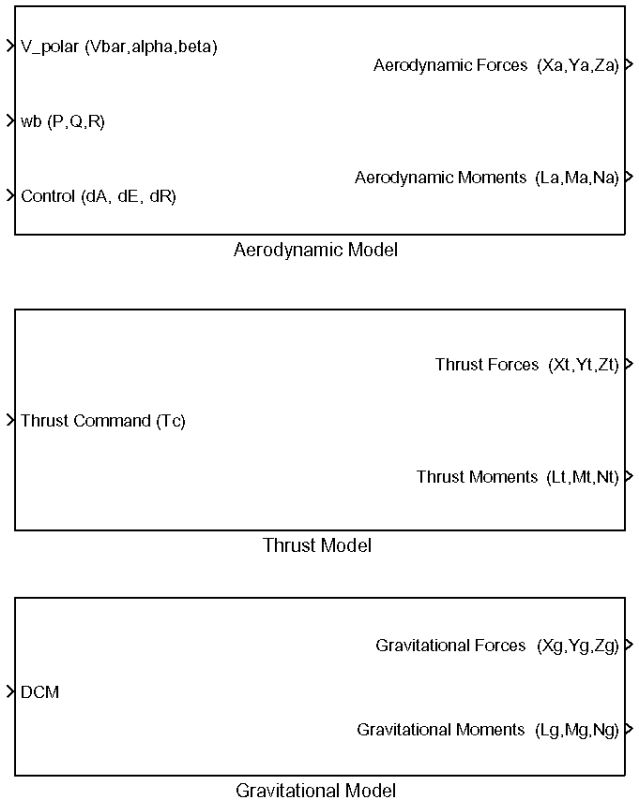
1) Applying simple force and moment inputs and verifying that intuitive results are obtained
2) Testing the block against the one available in the Simulink Aerospace Blockset

Question 2

Make use of MATLAB's Simulink to create a force and moment model for the aircraft described in Appendix A of your course notes. Assume the aircraft operates at pre-stall flight and at sea level (air density of 1.225 kg/m^3). Create three blocks in Simulink, one to model each of the major force/moment categories that act on a conventional aircraft.

The aerodynamic model block should accept as inputs the polar coordinates of the velocity vector, the body angular velocity coordinates and the aerodynamic control inputs. The thrust model block should accept the thrust command as input. The gravitational model block should accept the aircraft's attitude, or better still the DCM matrix, as an input. All blocks should provide force and moment outputs in body coordinates. These can then be summed externally to provide the total force and moment coordinates required by the six degree of freedom block you created in Homework 1.

An example of what the three blocks should look like is shown below.



Test the functionality of the block by applying simple inputs and verifying the force and moment outputs.