

## Chapter 3. Design Project

- 3.1. Read appendix D on building s-functions in Simulink, and also the Matlab documentation on s-functions. Refer to the 's-functions\_Appendix\_D' folder.
- 3.2. Implement the MAV equations of motion given in equations (3.14) through (3.17) using the Simulink s-function. (Optionally, you could use quaternion instead of Euler angles.) Assume that the inputs to the block are the forces and moments applied to the MAV in the body frame. Block parameters should include the mass, the moments and products of inertia, and the initial conditions for each state. Use the parameters of the Aerosonde UAV model given as aerosonde.m.
- 3.3. Connect the equations of motion to the animation block developed in the previous chapter. Verify that the equations of motion are correct by individually setting the forces and moments along each axis to a nonzero value and convincing yourself that the motion is appropriate.
- 3.4. Since  $J_{XZ}$  is non-zero, there is gyroscopic coupling between roll and yaw. To test your simulation, set  $J_{XZ}$  to zero and place nonzero moments on  $l$  and  $n$  and verify that there is no coupling between the roll and yaw axes. Verify that when  $J_{XZ}$  is not zero, there is coupling between the roll and yaw axes.

### Tip

- \* Put all files of previous assignments in the folder of the ongoing assignment.
- \* When you set the name of parameters, check the existing parameter names.
- \* Especially, mass and  $m$  (one of moments [ $l$ ,  $m$ ,  $n$ ]) are often confused.
- \* To avoid singularity, 'Quaternion' is suggested in principle. For this assignment, the use of 'Quaternion' is not mandatory but optional.