Posting Date: Monday Sept. 9th.
Due Date: Monday Sept. 16th.

1. Complete the MATLAB template file `ffunctaircraft01_temp.m` by completing the parts of the code where ???? appears. The result will be the MATLAB function `ffunctaircraft01.m`. This function must compute the state rate dynamics model for the 6-element state vector of a 3-dimensional point-mass aircraft translational model.

2. Use your `ffunctaircraft01.m` function from part 1, the MATLAB scripts `script_simaircraft01.m` and `script_simaircraft02.m`, and the MATLAB data files `maneuver01_data.mat` and `maneuver02_data.mat` to run simulations of the same two aircraft flight cases that have been presented in lecture. Hand in hardcopies of the figures that plot altitude ($-Z$), airspeed (V), flight path angle (γ), and heading angle (ψ) for the two cases. Also, hand in the final state vector to 15 significant digits for the second case, the one run by `script_simaircraft02.m`. You can print the final state vector in the MATLAB command prompt window by executing the following two MATLAB commands:

   ```
   >> format long
   >> xhist(end,:)'
   ```

   As a way of checking your work, these operations produce the following result for the `script_simaircraft01.m` case:

   ```
   ans =  1.0e+04 *
     0.158647266678672
    -2.346841979941329
     0.061558912737262
     0.013988616814884
    -0.000011110309497
    -0.000158233102668
   ```

   (Note: Your answer may agree only to the first 10 significant digits if you are using a different release of MATLAB than was used to generated this result.)

3. Re-write the dynamic equations for the aircraft in terms of X, Y, Z, $\dot{X}$, $\dot{Y}$, $\dot{Z}$, $\ddot{X}$, $\ddot{Y}$, and $\ddot{Z}$. That is, derive formulas for $\ddot{X}$, $\ddot{Y}$, and $\ddot{Z}$ in terms of X, Y, Z, $\dot{X}$, $\dot{Y}$, and $\dot{Z}$, the aircraft parameters, and the control inputs T, α, and ϕ. Your three coordinate acceleration formulas may end up including terms that involve $\cos\gamma$, $\sin\gamma$, $\cos\psi$, $\sin\psi$, L, and D. If so, then derive formulas for these 6 quantities that explicitly include any dependence on X, Y, Z, $\dot{X}$, $\dot{Y}$, or $\dot{Z}$.

   Hints: You can substitute the $\dot{V}$, $\dot{\gamma}$, and $\dot{\psi}$ dynamics model equations from lecture into the $\ddot{X}$, $\ddot{Y}$, and $\ddot{Z}$ equations from lecture in order to derive the needed coordinate acceleration formulas. Be sure to collect terms in order to simplify your expressions as much as possible. What happens to the gravity terms? Does this make sense? You can use the kinematic expressions for $\dot{X}$, $\dot{Y}$, and $\dot{Z}$ in terms of V, γ, and ψ from lecture in order to solve for the latter 3 quantities in terms of the former 3. These results can be used to derive the needed formulas for $\cos\gamma$, $\sin\gamma$, $\cos\psi$, $\sin\psi$, L, and D.