MECE-410: Flight Dynamics **Project #2**
Spring 2014-2015 (2145) **Due:** *March 5th, 2015*

Instructions: Use Matlab to solve all problems. Save and program your work in an m-file. Hand-in:

1. a project write-up with clearly defined answers to each problem.
2. a print out copy of your m-file program.
3. a print out copy of clearly labeled Figures and Plots

Using the data shown below for a business jet aircraft model, determine the following longitudinal stability information at subsonic speeds:

a. Wing contribution to the pitching moment: $C_{m_{o_w}} = \text{-}0.0997$, $C_{m_{\alpha_w}} = 0.167$ (1/rad)
b. Tail contribution to the pitching moment: $C_{m_{o_t}} = 0.1685$, $C_{m_{\alpha_t}} = \text{-}1.1506$ (1/rad)
c. Fuselage contribution to the pitching moment $C_{m_{o_f}} = \text{-}0.0164$, $C_{m_{\alpha_f}} = 0.4355$ (1/rad) or 0.0076 (1/deg)
d. Total pitching moment: $C_{m_o} = 0.05243$, $C_{m_\alpha} = -0.548$ (1/rad)
e. Plot the various contributions and the total pitch moment versus angle-of-attack (please use on plot and use an angle-of-attack range from 0 to 10 degrees, the x-axis on your plot will be angle-of-attack in degrees, remember: $C_{m_i} = C_{m_{o_i}} + C_{m_{o\alpha_i}} \alpha$)
f. Estimate the stick fixed neutral point: $\frac{x_{NP}}{\bar{c}} = 0.41406$

Business Jet Aircraft Data

Wing characteristics:

$S = 542.5$ (ft^2)

$b = 53.75$ (ft)

$\bar{c} = 10.93$ (ft)

$C_{m_{ac_w}} = -0.1$

$C_{L_{\alpha_w}} = 0.0583$ (1/deg)

$C_{L_{o_w}} = 0.006$ (---)

$i_w = 0$ (deg)

$\alpha_{o_w} = -1$ (deg)

Tail characteristics:

$S_t = 149$ (ft^2)

$b_t = 24.75$ (ft)

$\bar{c}_t = 6.5$ (ft)

$C_{L_{\alpha_t}} = 0.05934$ (1/deg)

$i_t = -5$ (deg)

$\eta = 0.95$

$l_t = 23.6$ (ft)

Fuselage characteristics:

$l_f = 58.6$ (ft)

$d_{max} = 7.2$ (ft)

$l_h = 14.2$ (ft)

Aircraft characteristics:

$x_{cg} = 0.25\bar{c}$ (ft)

$x_{ac} = 0.2\bar{c}$ (ft)

Remember $\frac{d\varepsilon}{d\alpha} = \frac{2C_{L_{\alpha_w}}}{\pi AR_w}$ and $\varepsilon_o = \frac{2C_{L_{o_w}}}{\pi AR_w}$ where $AR_w = \frac{b^2}{S}$, also use Figure 3.33 to find $\frac{d\varepsilon_u}{d\alpha}$ for segments 1-9 (don't worry about scaling the Figure for $C_{L_{\alpha_w}} = 0.0583$ (1/deg), i.e. use the Figure directly without scaling). Your answer for $C_{m_{\alpha_f}}$ will be in units of (1/deg)

Business Jet Aircraft Data

Fuselage section (assuming 13 sections) characteristics:

Station	ΔX , (ft)	w_f , ft	i_f , (deg)
1	2.6	2.5	-3
2	2.6	4.2	-3
3	2.2	5.5	-10
4	2.2	6.3	-10
5	3.4	6.6	0
6	3.4	7.2	0
7	3.4	7.2	0
8	3.4	7.2	0
9 (wing location)	14.6	7.2	0
10	5.2	6.6	0
11	5.2	5.4	0
12	5.2	3.8	0
13	5.2	2.1	-4