

Problem set 9 answers

1) Vary C_{m_α} from -0.683 to 0.0117

C_{m_α}	Short Period		Phugoid	
-0.683	-2.5017± i 2.562		-0.0169±i 0.2149	
-0.583	-2.5018±i 2.3045		-0.0169±i 0.2090	
-0.483	-2.5018±i 2.0141		-0.0169±i 0.2014	
-0.383	-2.5014±i 1.6739		-0.0172±i 0.1913	
-0.283	-2.5006±i 1.2435		-0.0181±i 0.1770	
-0.183	-2.4987±i 0.5356		-0.0199±i 0.1551	
-0.083	-3.4850	-1.5031	-0.0246±i 0.1150	
-0.0	-3.9189	-1.0505	-0.0679	0.0000
0.017	-3.9923	-3.9923	-0.1095	0.0350
0.017	-4.3664	-0.4053±i 0.0559		0.1397

2) Vary C_{m_q} from -9.96 to 14.0

C_{m_q}	Short Period	Phugoid
-9.96	-2.5017±i 2.5622	-0.0169±i 0.2149
-7.96	-2.2933±i 2.5911	-0.0164±i 0.2225
-5.96	-2.0849±i 2.6029	-0.0160±i 0.2309
-3.96	-1.8766±i 2.5976	-0.0154±i 0.2404
-1.96	-1.6683±2.5753	-0.0149±i 0.2512
0.0	-1.4642±i 2.5368	-0.0140±i 0.2682
2.0	-1.2559±i 2.4782	-0.0137±i 0.2775
4.0	-1.0477±i 2.4000	-0.0131±i 0.2945
10.0	-0.4209±i 2.0158	-0.0132±i 0.3747
14.0	0.0144±i 1.5584	-0.0308±i 0.4944

4. Changing C_{m_α} affects the short period mode the most however both the short period and phugoid roots migrate toward the real axis, both eventually getting there and becoming two real roots. One root migrates to the left and the other to the right along the real axis for each of the short period and phugoid modes. The right migrating root from the short period meets the left migrating root from the phugoid and these two roots then split into an oscillatory complex conjugate pair. The right migrating root from the Phugoid goes unstable.

5. Varying C_{n_β} from 0.071 to -0.02

C_{n_β}	Dutch Roll	Rolling Convergence	Spiral
0.071	-0.4879±i 2.3516	-8.4498	-0.0082
0.061	-0.4844±i 2.2095	-8.4496	-0.0152
0.051	-0.4799±i 2.0574	-8.4495	-0.0242
0.041	-0.4740±i 1.8927	-8.4493	-0.0364
0.031	-0.4654±i 1.7117	-8.4492	-0.0538
0.021	-0.4520±i 1.5081	-8.4490	-0.0806
0.011	-0.4283±i 1.2702	-8.4488	-0.1282
0.0	-0.3616±i 0.9366	-8.4487	-0.2619
-0.01	-0.1096±i 0.6102	-8.4485	-0.7661
-0.02	0.1386±i 0.4880	-8.4484	-1.2627

6. Varying C_{l_β} from -0.074 to 0.0

C_{l_β}	Dutch Roll	Rolling Convergence	Spiral
-0.074	-0.4879±i 2.3516	-8.4498	-0.0082
-0.064	-0.4991±i 2.3240	-8.4334	-0.0020
-0.054	-0.5106±i 2.2971	-8.4170	0.0044
-0.044	-0.5222±i 2.2692	-8.4004	0.0111
-0.034	-0.5341±i 2.2409	-8.3837	0.0181
-0.024	-0.5461±i 2.2122	-8.3669	0.0255
-0.014	-0.5585±i 2.1831	-8.3499	0.0332
0.0	-0.5762±i 1.1417	-8.3259	0.0447