Flight Control 3F1

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November 15, 2018

Abstract

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I. Introduction

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II. Results and Discussion

i. 2.0 Manual control

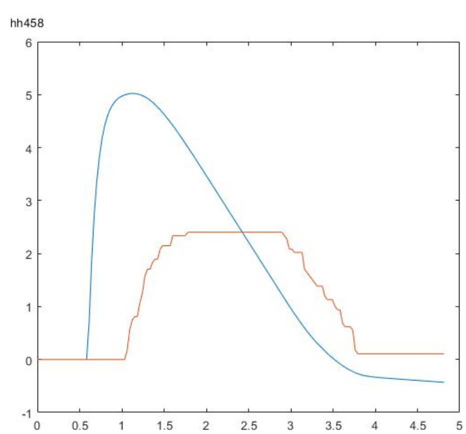

Figure 1: *Typical response of manual control with a impulse disturbance of 5*

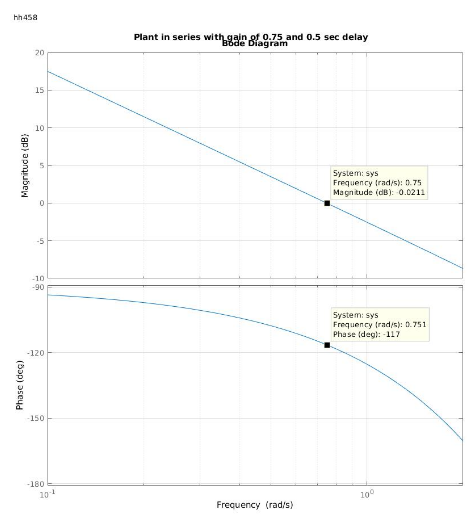

Figure 2: *Bode plot of the controller with time delay 0.5 and gain 0.75*

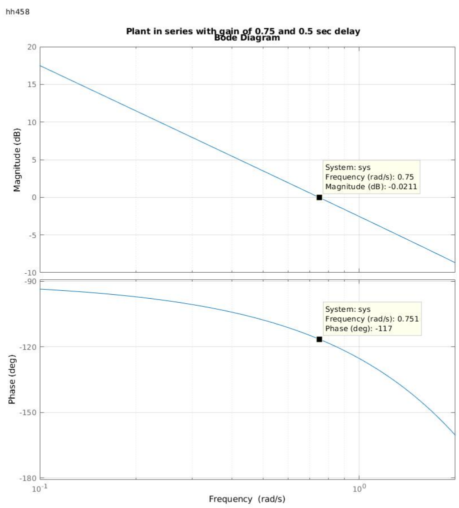

Figure 3: *Nyquist diagram sketch based off the response in figure 2*

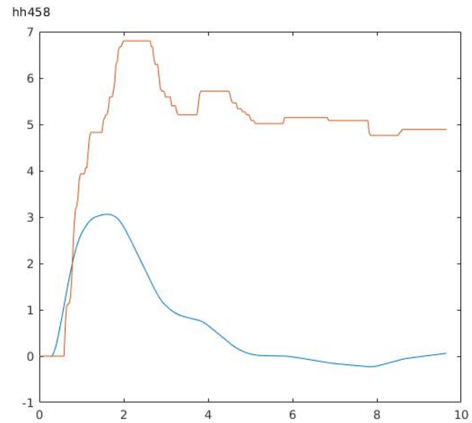

Figure 4: *Typical response of manual control with a step disturbance of 5*

ii. 2.1 Pilot induced oscillation

iii. 2.2 Sinusoidal disturbances

iv. 2.3 Unstable aircraft

v. 3.0 Autopilot

vi. 3.1 PID controller

vii. 3.2 Integrator wind-up

III. Conclusion

IV. Appendix

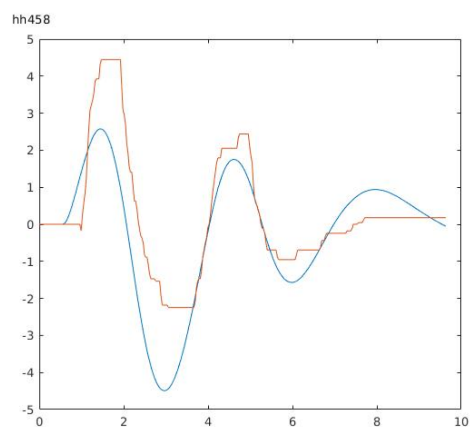

Figure 5: *Typical response of pilot induced oscillations caused by attempting to stabilise the plane*

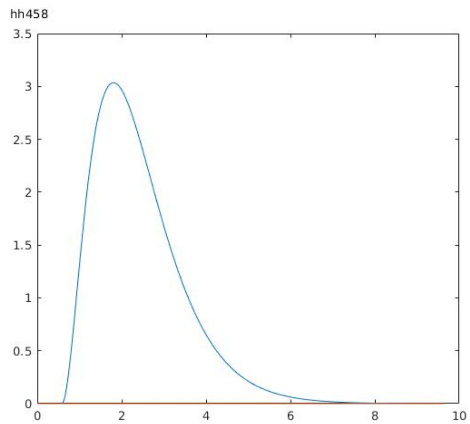

Figure 6: *Typical response of when no input is provided by the pilot, showing no oscillations*

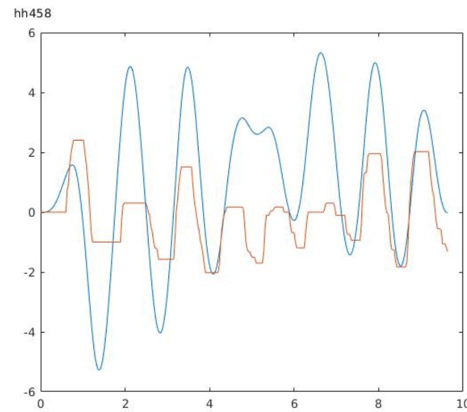

Figure 8: *Typical response of attempting to stabilise a sinusoidal disturbance*

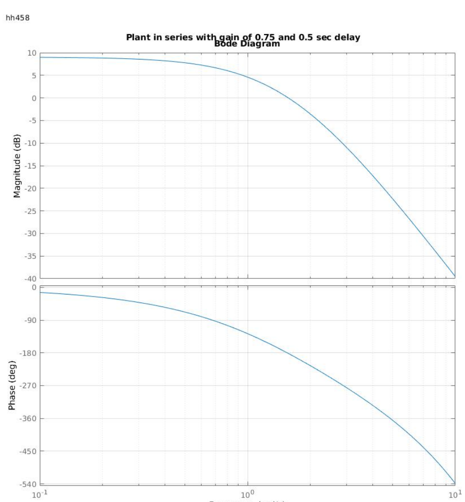

Figure 7: *Bode plot of the open loop response of the controller that caused PIO*

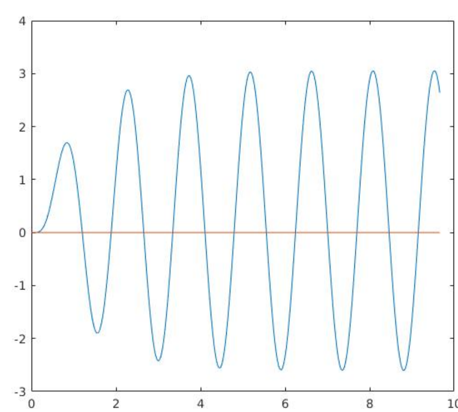

Figure 9: *Typical response of a sinusoidal disturbance with no pilot input*

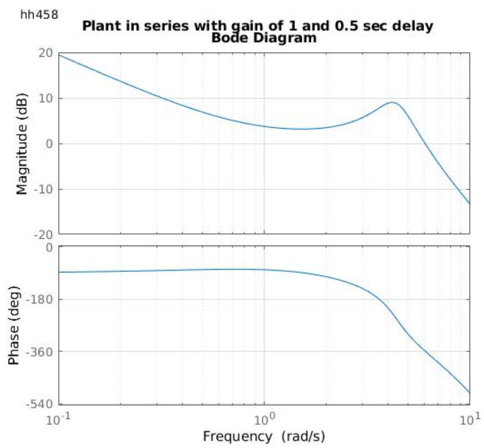

Figure 10: *Bode plot of the aircraft used for sinusoidal disturbances with gain 1 and delay 0.5*

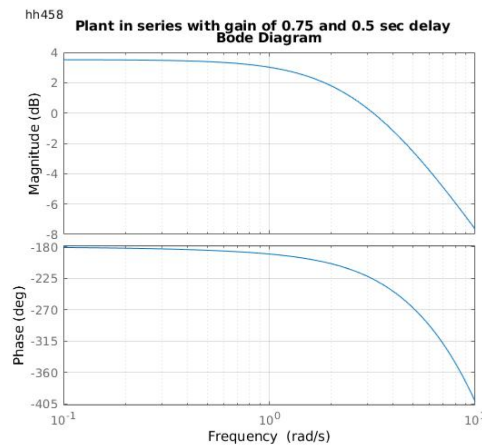

Figure 12: *Nyquist diagram for the unstable aircraft*

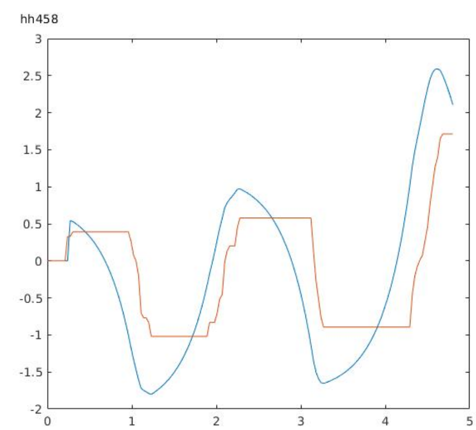

Figure 11: *Response of stabilising the fastest pole in an unstable aircraft, with pole at T=0.35*

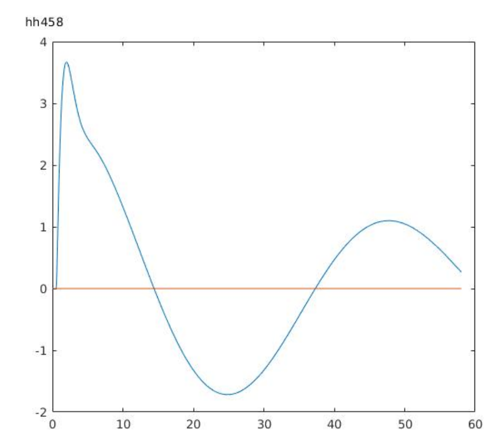

Figure 13: *Lightly damped phugoid motion under no input observed before an autopilot is constructed*

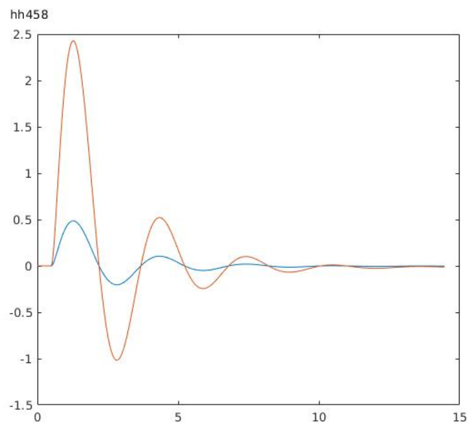

Figure 14: *Typical response when a proportional controller with gain 5 is implemented*

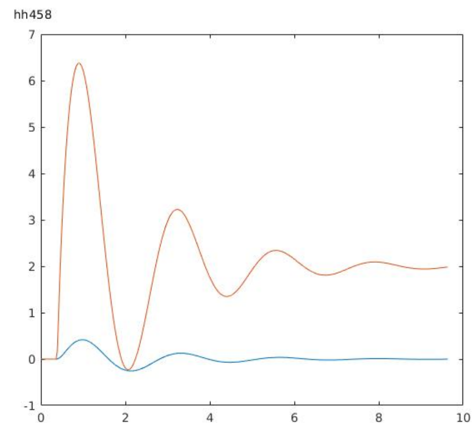

Figure 16: *Typical response when a PID controller is implemented with $K_p = 10.44$, $T_i = 0.9$, $T_d = 0.225$, the disturbance is an impulse and step of magnitude 2*

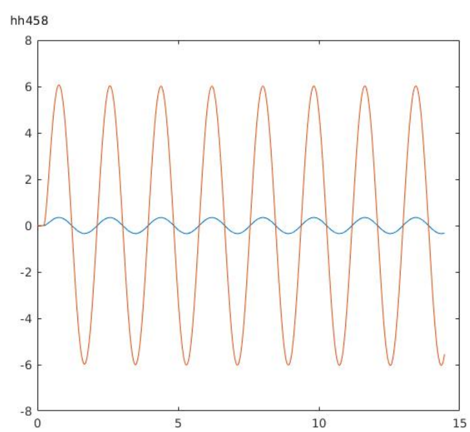

Figure 15: *Typical response when a proportional controller with gain 17.4 is implemented*

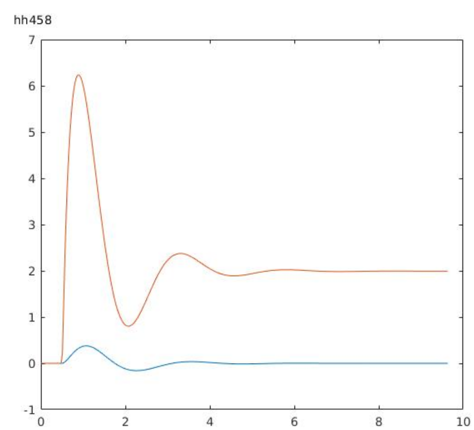

Figure 17: *Typical response when a PID controller is implemented with $K_p = 10.44$, $T_i = 0.9$, $T_d = 0.315$ which is a 40% increase to derivative gain, the disturbance is an impulse and step of magnitude 2*

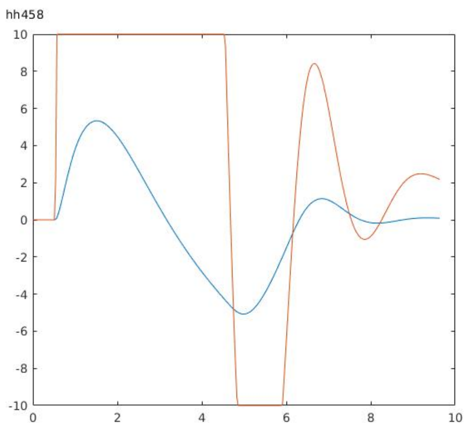

Figure 18: *Typical response when a PID controller is implemented with $K_p = 10.44$, $T_i = 0.9$, $T_d = 0.315$, to a step disturbance of magnitude 2 and impulse magnitude 20*

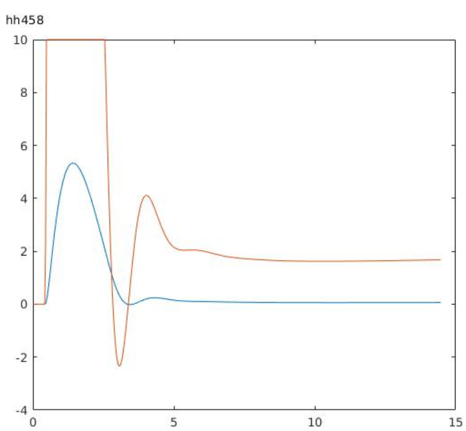

Figure 19: *Typical response when a PID controller is implemented with $K_p = 10.44$, $T_i = 0.9$, $T_d = 0.315$, to a step disturbance of magnitude 2 and impulse magnitude 20 with integrator wind up capped at 0.086*