8 VELOCITY FEEDBACK CONTROL

Velocity feedback control concept consists of two controls:

- P-control with gain Kp
- velocity control with gain Kh

The advantage of this control combination is that one can use the P-control gain Kp to improve the response time by increasing the natural frequency and then use the velocity feedback gain Kh to reduce the overshoot by increasing damping.

The initial values for the model are Kp=1/114, Kh=0. With these values, the SIMULINK model for velocity feedback looks like Figure 35.

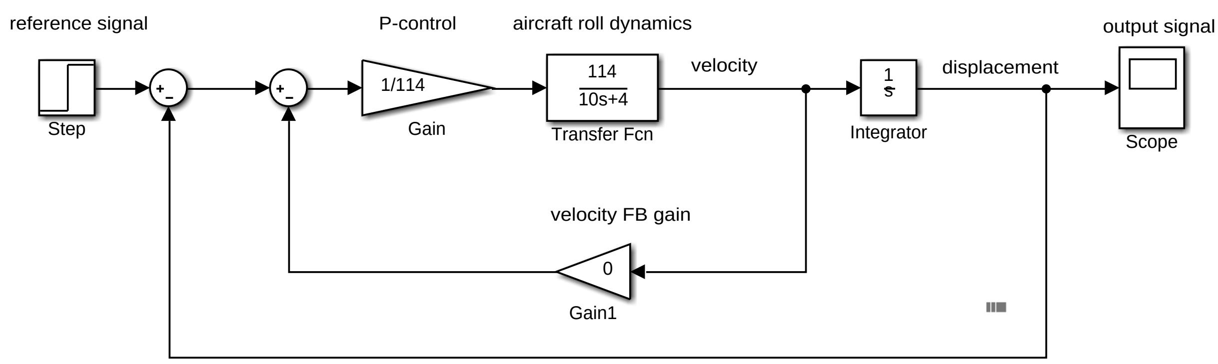

Figure 35

Note: when inserting ‘Gain1’ for velocity FB, use right click to flip the box to point backward.

The aircraft response is sluggish with $t_p \approx 9$ sec, as shown in Figure 36.

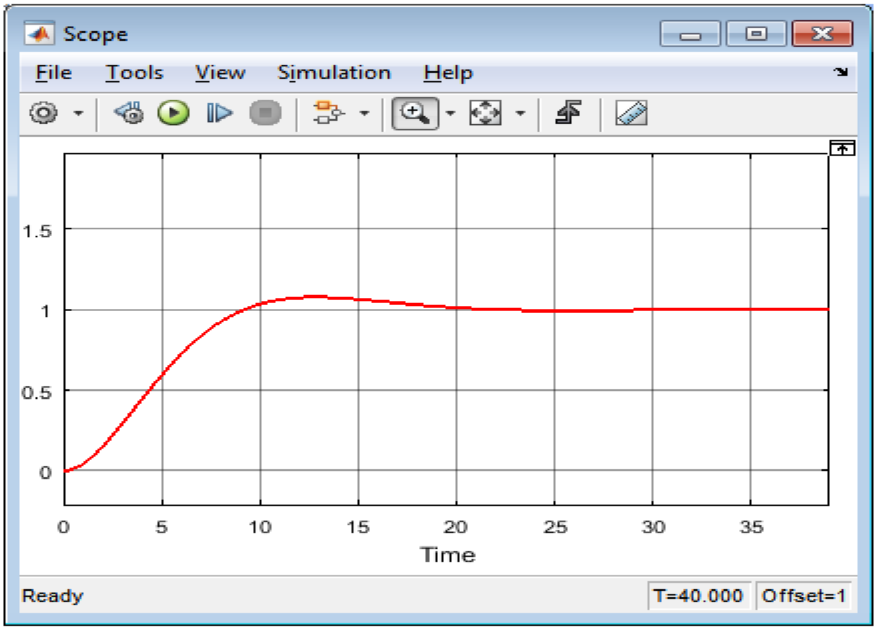

Figure 36

To accelerate the aircraft response, increase the P-control gain to Kp=50/114 (Figure 37).

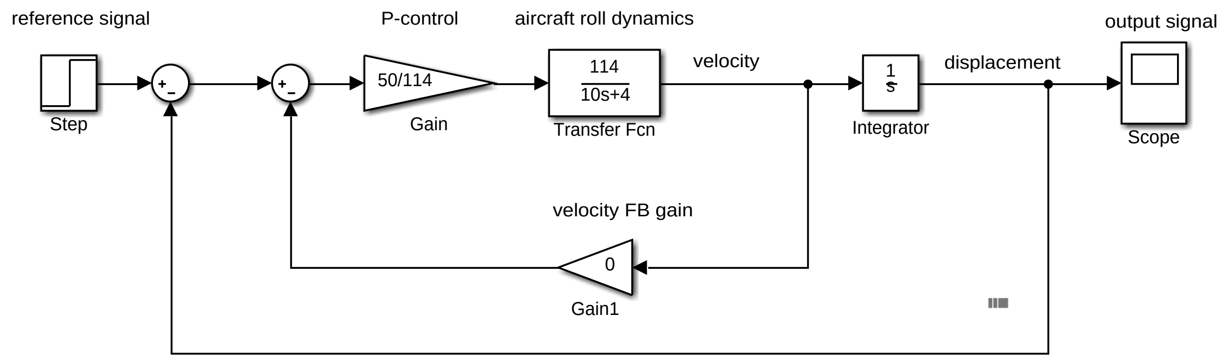

Figure 37

The aircraft response now looks like Figure 38.

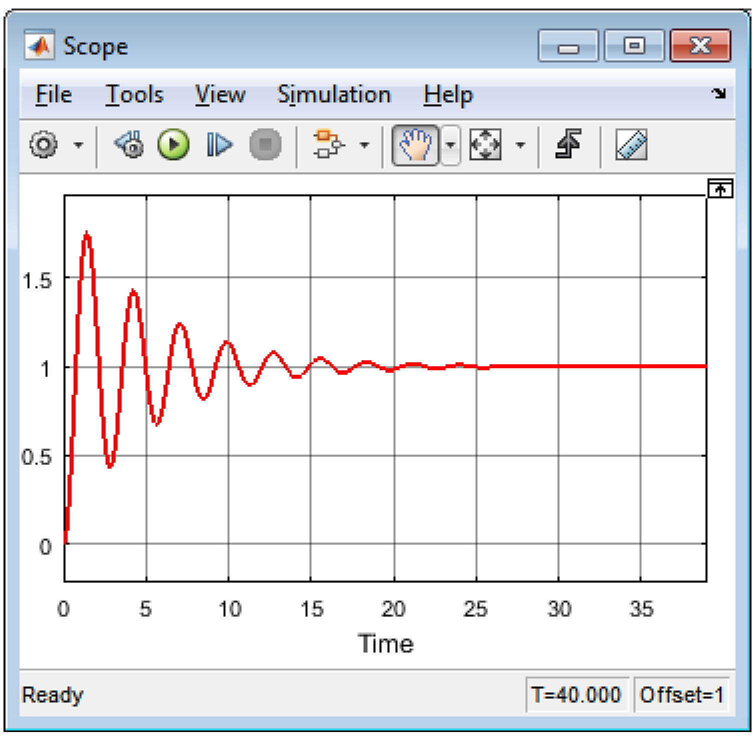

Figure 38

Notice that the aircraft response is much more rapid now. However, it has a large overshoot which must be reduced.

To reduce the overshoot, increase the velocity feedback gain to Kh=0.2 (Figure 39).

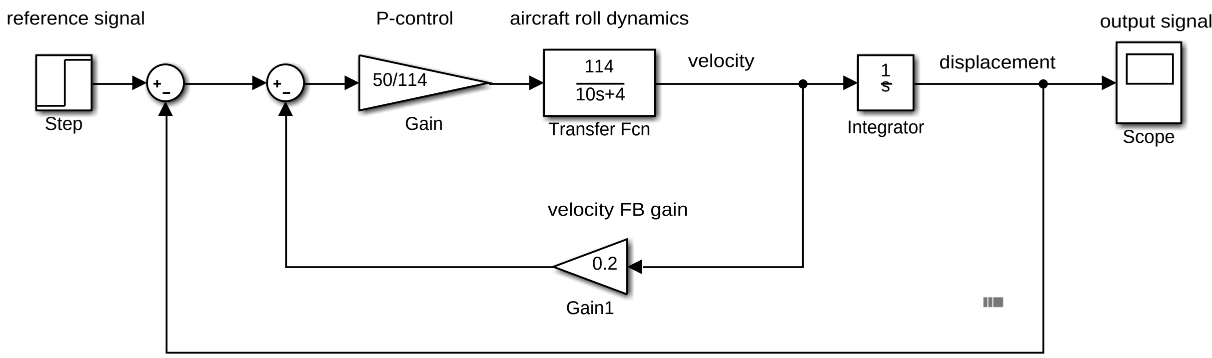

Figure 39

The response has become less oscillatory while remaining relatively fast (Figure 40).

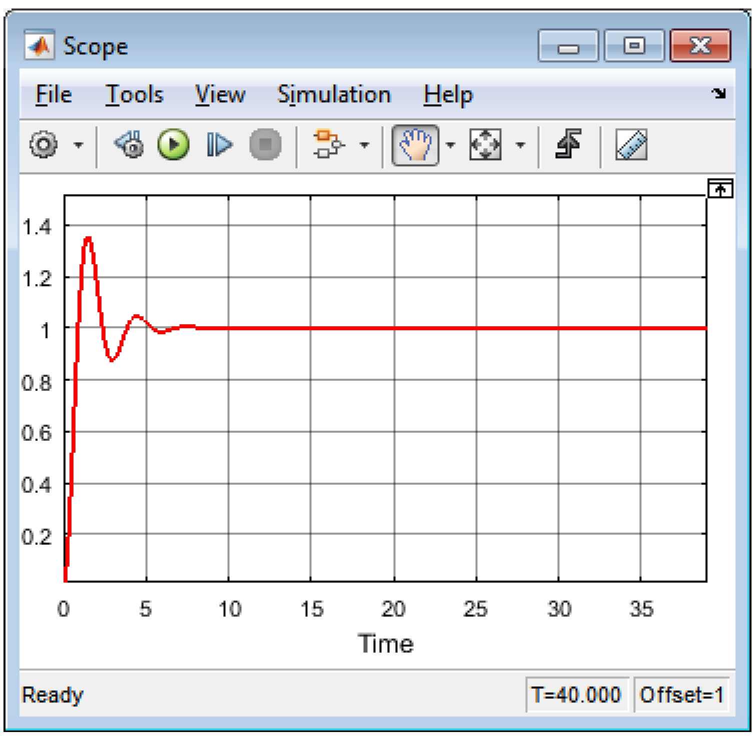

Figure 40

Further adjustments of Kh can ensure that the design specifications are met.

Reduce the computation time to 6 sec in order to expand the initial response zone and get a better reading of rise time and overshoot.

Increase Kh to various values until a satisfactory reduction of overshoot is obtained. For Kh=0.35, we get Figure 41:

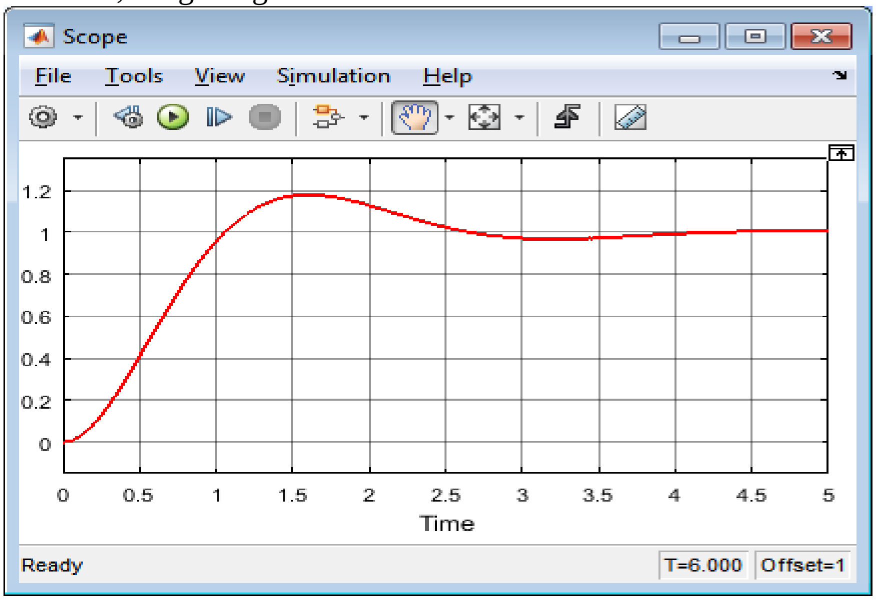

Figure 41

Open the cursors to read the rise time and overshoot(Figure 42).

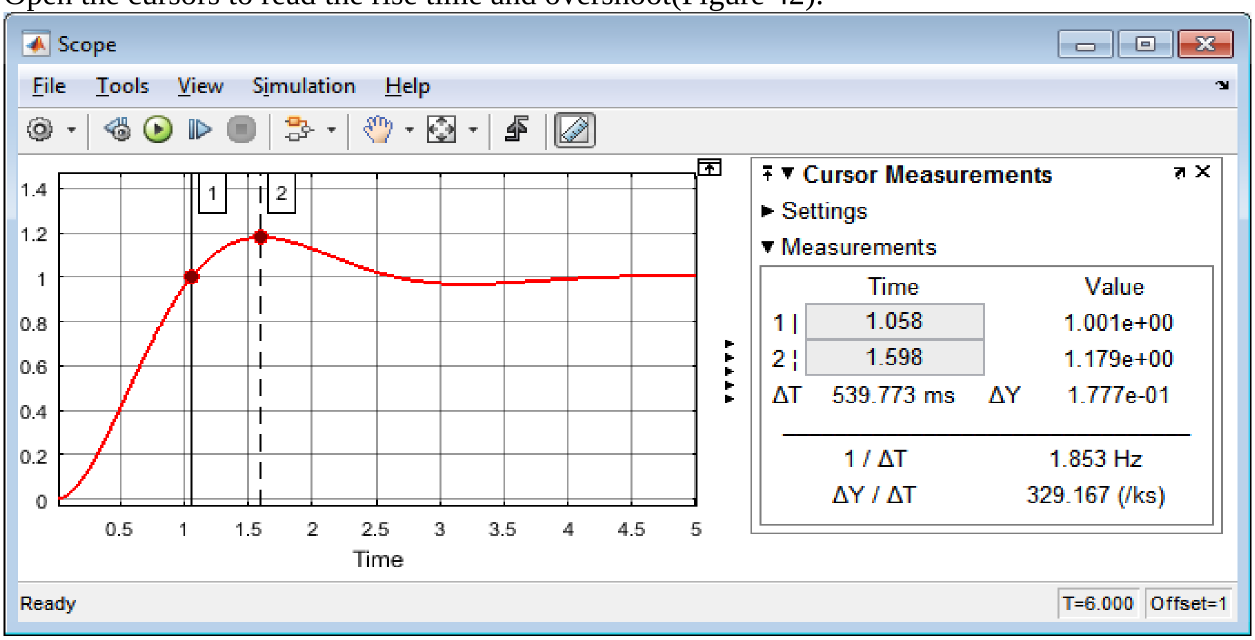

Figure 42

The readings indicate satisfactory results, i.e.,

- $t_r = 1.058 < 1.5$ sec
- $M_p = 17.9 < 20\%$