% LOOPFLAG = 400
% L = [ 51 ( s + 19.11 ) / ( s (s - 1) ) ] [ 100 / ( s + 100 ) ]^2
% P = 1 / ( s - 1 )
% K = [ 51 ( s + 19.11 ) / s ] [ 100 / ( s + 100 ) ]^2
% THIS SCENARIO SHOWS THAT GIVEN THE FIXED CONTROLLER STRUCTURE
% AND FIXED HIGH FREQUENCY ROLL-OFF POLES at -100, -100,
% THE MAXIMUM ACHIEVABLE BANDWIDTH IS LIMITED.
% HIGH BANDWIDTH DESIGN - settling_time = 0.2, overshoot = 0.015
% Vary settling time between 0.2 and 20
% SEE LOOPFLAG = 300 - MODERATE BANDWIDTH (settling_time = 5/4 )
% LOOPFLAG = 400 - FAST DESIGN (settling_time = 20 )
% LOOPFLAG = 500 - SLOW DESIGN (settling_time = 0.2 )
% OBSERVATIONS
% If bandwidth (settling time) is too low,
% downward gain margin will be low
% (and peak complementary sensitivity high) and
% design will be will be unacceptable!
% THE RIGHT HALF PLANE (RHP) POLE
% LIMITS THE MINIMUM ACHIEVABLE BANDWIDTH !
% If bandwidth (settling time) is too high,
% upward gain margin and/or phase margin and/or peak sensitivity will
% be low and design will be unacceptable!
% The phase lag due to the high frequency poles
% (required for
%         high frequency sensor noise attenuation and
%         limit the peak KS)
% will limit the maximum achievable bandwidth.
%
% loop =
% 510000 (s+19.11)
% -----------------
\% s (s+100)^2 (s-1)
\%
\% GainMargin: [0.0321 2.3466]
\% GMFrequency: [5.6607 77.2235]
\% PhaseMargin: 16.9244
\% PMFrequency: 45.7123
\% DelayMargin: 0.0065
\% DMFrequency: 45.7123
\% Stable: 1
\%
\% cCLPs = -153.72
\% - 9.13 + 47.58i
\% - 9.13 - 47.58i
\% - 27.02
\%
\% Eigenvalue Damping Freq. (rad/s)
\%
\% -1.54e+002 1.00e+000 1.54e+002
\% -9.13e+000 + 4.76e+001i 1.88e-001 4.84e+001
\% -9.13e+000 - 4.76e+001i 1.88e-001 4.84e+001
\% -2.70e+001 1.00e+000 2.70e+001
\%
\% dloop = 0.034876 (z-0.8181) (z+1)^3
\% ----------------------------
\% (z-1.011) (z-1) (z-0.3127)^2
\%
\% Sampling time (seconds): 0.010472
\%
\% dCLPs = 0.8067 + 0.4295i
\% 0.8067 - 0.4295i
\% 0.7521
\% 0.1081
\%
\% mag_disc_CLPs = 0.9139 0.9139 0.7521 0.1081
\%
\% sen_maxdb = 11.3254 \text{ \textless\textgreater\textless \text{NOT ACCEPTABLE}!!!}
\% sen_max = 3.6836
\% sen_max_freq = 49.3593
\%
\% compsen_maxdb = 10.6756 \text{ \textless\textgreater\textless \text{NOT ACCEPTABLE}!!!}
\% compsen_max = 3.4181
\% compsen_max_freq = 46.7592
\%
\% ksen_maxdb = 44.2309
\% ksen_max = 162.7587
\% ksen_max_freq = 48.4583
% psen_maxdb = -22.3896
% psen_max = 0.0759
% psen_max_freq = 47.6286
%
% LOOPFLAG = 400

Figure 1: Plant Magnitude
Figure 2: Plant Phase

Figure 3: Controller Magnitude
Figure 4: Controller Phase

Figure 5: Loop Magnitude
Figure 6: Loop Phase

Figure 7: Sensitivity Magnitude
Figure 8: Complementary Sensitivity Magnitude

Figure 9: Try Magnitude
Figure 10: Control Action

Figure 11: Frequency Response for WKS with prefilter
Figure 12: Frequency Response for PS

Figure 13: Output Response to Step Reference
Figure 14: Control Response to Step Reference

Figure 15: Discrete Time Root Locus 1 (k = 0:.01:6000)
Figure 16: Discrete Time Root Locus 2 ($k = 0:.01:6000$)

Figure 17: Discrete Time Root Locus 3 ($k = 0:.01:6000$)
Figure 18: Discrete Time Root Locus 4 ($k = 0:.01:6000$)