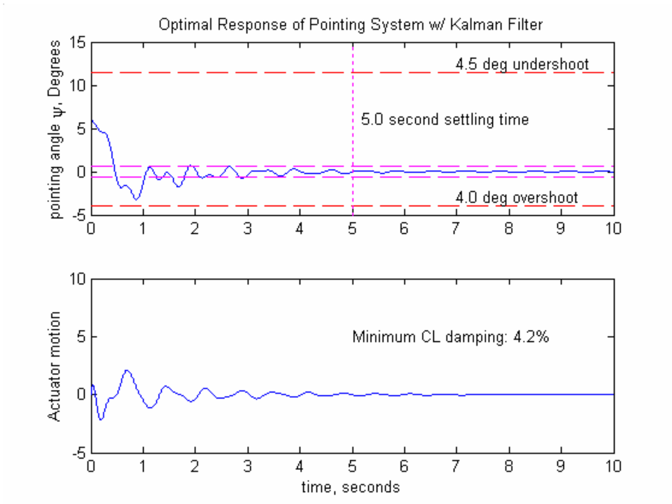
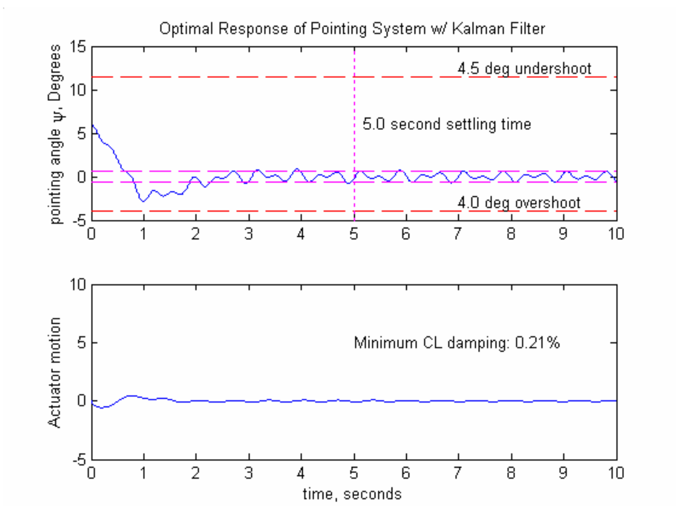


W=10000*diag([1 1 1]);
V=1;
Q=1*diag([1 1 1 1 1 1]);
R=.010;

Wow! Great performance with scaled identity matrices!

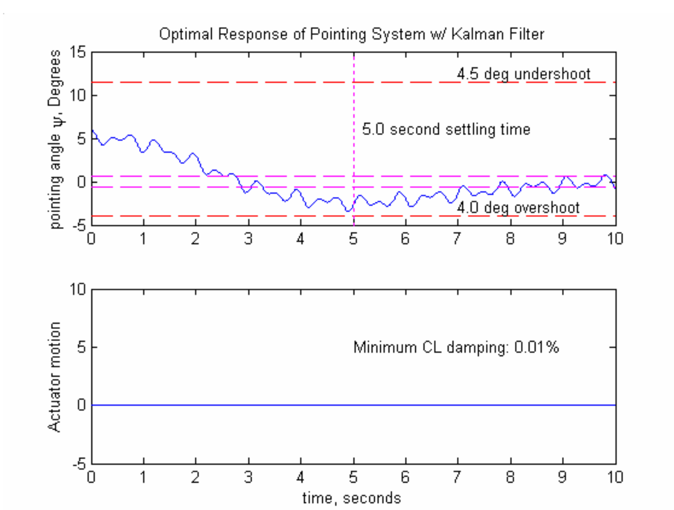
Base Score: 88 (Meets all specs)
Improved undershoot: +4
Improved settling time: +4
Improved actuator usage: +4
Total Score: 100



q = 500; Q = transpose(C)*q*C;
R = 1;
V=10;
W=200*eye(3);

This one needs a lot more control effort – does not damp the structural modes

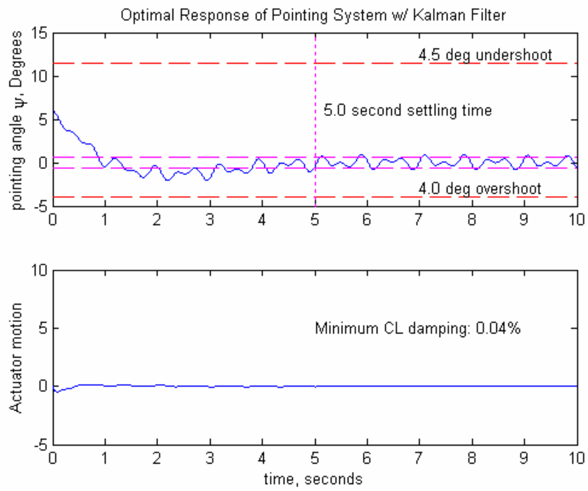
Base Score: 84 (Does not meet damping spec)
Improved undershoot: +4
Does not meet settling time: -4
Actuator usage: should have used more!
Total Score: 84



q= transpose(C)*C;
r = 1;
w = [0.1,0,0;0,0.1,0;0,0,0.1];
v = 1;

Honorable mention for least control effort used...

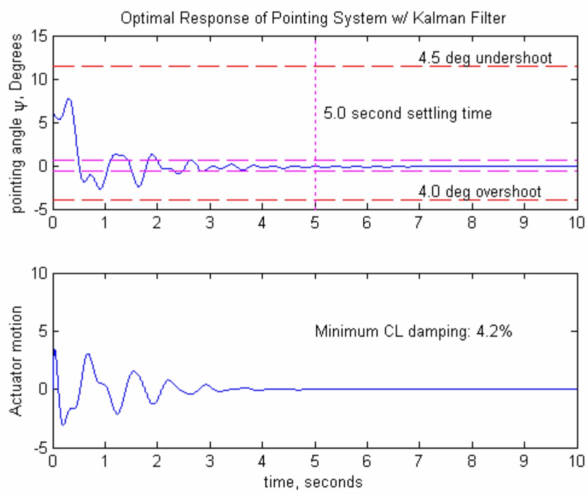
Base Score: 84 (Does not meet damping spec)
Improved undershoot: +4
Does not meet settling time: -4
Actuator usage: should have used more!
Total Score: 84




```
temp = 10000;
Q = C'*temp*C;
W = diag([.1 .1 .1]);
v = 0.1;
```

Needs more control effort!

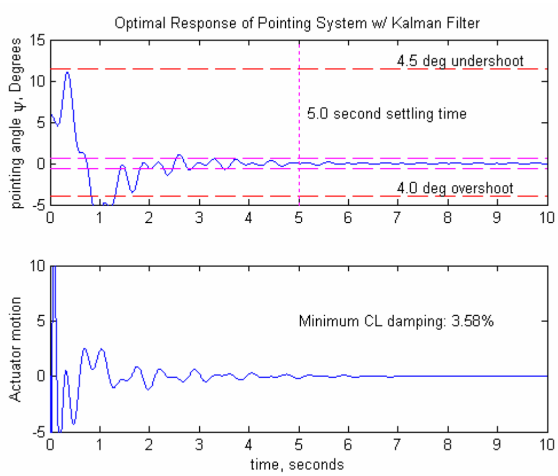
Base Score: 84 (Does not meet damping spec)
Improved undershoot: +4
Improved overshoot: +4
Does not meet settling time: -4
Actuator usage: should have used more!
Total Score: 88




```
% Q & R matrices
Q(6,6) = 100000;  Q(5,5) = 5000;
Q(4,4) = 5000000; Q(2,2) = 1000000;
Q(3,3) = 10000;  Q(1,1) = 10000;
R = 1;
W=10*eye(3),V=.001;
```

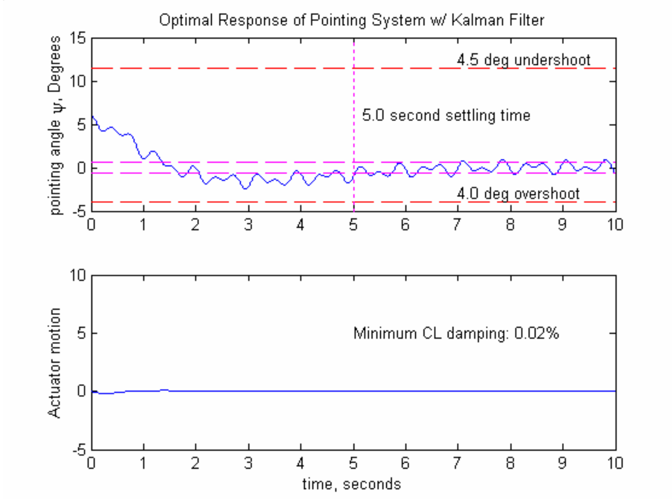
Nice result after what appears to be some heavy iteration.

Base Score: 88 (Meets all specs)
Improved undershoot: +4
Improved overshoot: +4
Improved settling time: +4
Actuator usage: Ok, I'll give you +2 (but 100 is the max)
Total Score: 102



This student used a pole placement approach – strangely enough, the damping requirements aren't quite met, which should be the first thing you get right when placing poles...

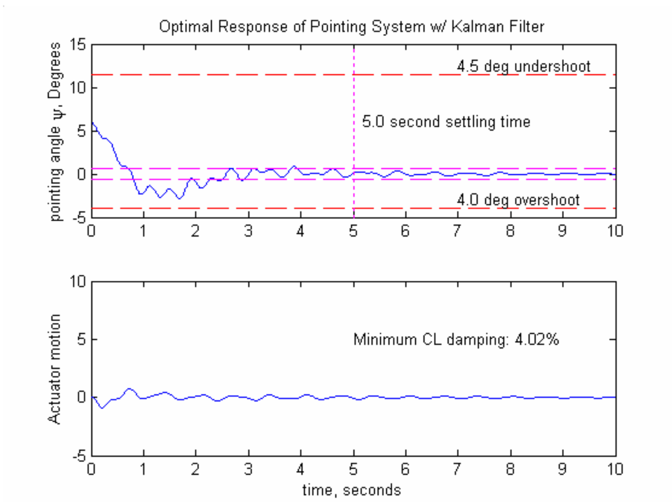
Base Score: 82 (Misses overshoot spec, ~damping spec)
Improved settling time: +4
Actuator usage: -4 (typical problem in pole placement)
Total Score: 82



W=[.3 0 0;0 .3 0;0 0 .3];
v=1;
R = .05;
var = 10; Q = C'*var*C;

Another low-actuation usage case…

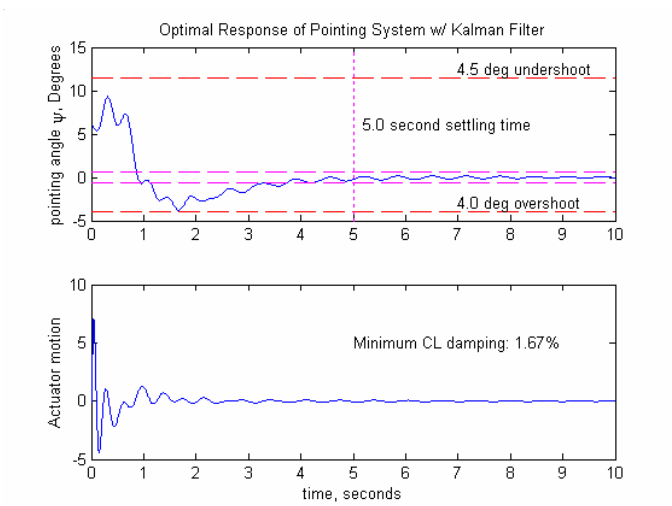
Base Score: 84 (Does not meet damping spec)
Improved undershoot: +4
Improved overshoot: +4
Does not meet settling time: -4
Actuator usage: should have used more!
Total Score: 88



Q = [1 0 0 0 0 0; 0 0.5 0 0 0 0; 0 0 1 0 0 0
0 0 0 10 0 0; 0 0 0 0 1 0; 0 0 0 0 0 0.5];
R = 0.35;
W = [1 0 0; 0 4.1 ; 0 0 300];
V = 0.04;

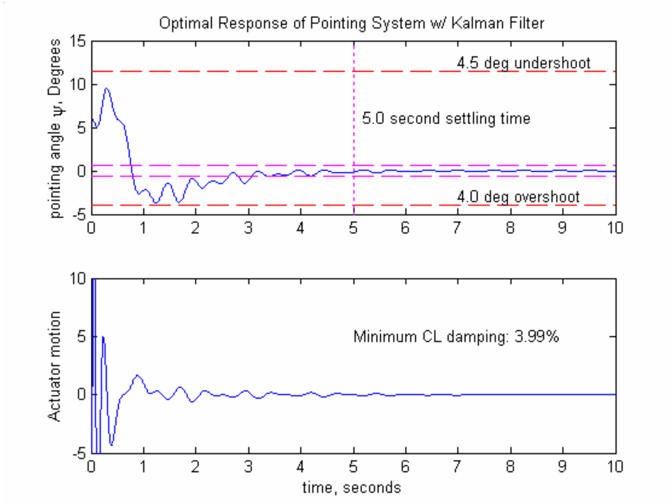
This one gets the 'most bang for the buck' award – excellent response with very little control usage!

Base Score: 88 (Meets all specs)
Improved undershoot: +4
Improved settling time: +4
Improved actuator usage: +4
Overshoot: don't be greedy now…
Total Score: 100



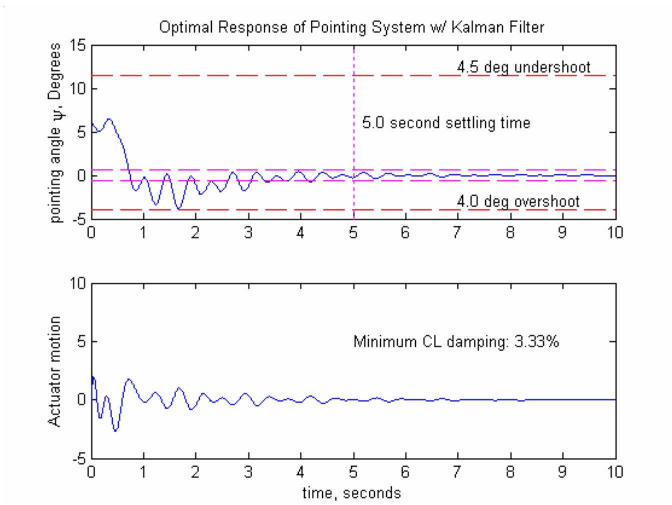
This student used pole-placed eigenvalues for the observer, and an lqr controller. Again, there is a slight problem with damping but otherwise a respectable solution.

Base Score: 84(Misses the damping spec)
Improved settling time: Just sneaks in… +4
Total Score: 88



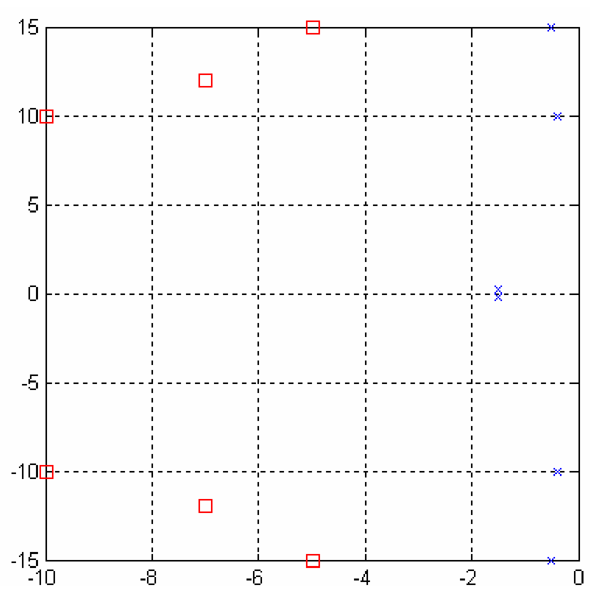
Another pole placer… Here all the specs are met but at the price of high actuation levels, also fairly high frequency actuation.

Base Score: 88 (meets all the specs)
Improved settling time: +4
Too much actuation: -4
Total Score: 88



And finally! Proving it is possible to meet all of the specifications (almost) using pole placement, without using much actuation.

Base Score: 86 (*just* misses the damping spec!)
Improved undershoot: +4
Improved settling time: +2 (peeks out at 4.2 sec)
Actuator usage: +4
Total Score: 96



Here are the poles that were used for this pole placement – the structural modes very judiciously placed along a 4% damping line, at about the same frequencies as the open loop poles – unfortunately numerical error pushed them slightly to the right, if my guess is right. Hence only 2 pts off for a near miss on this spec.

The observer poles are placed at somewhat higher frequencies, but not so high that they will pass a lot of noise. The roll-off characteristics (noise rejection) appear to be pretty good in the bode plot.