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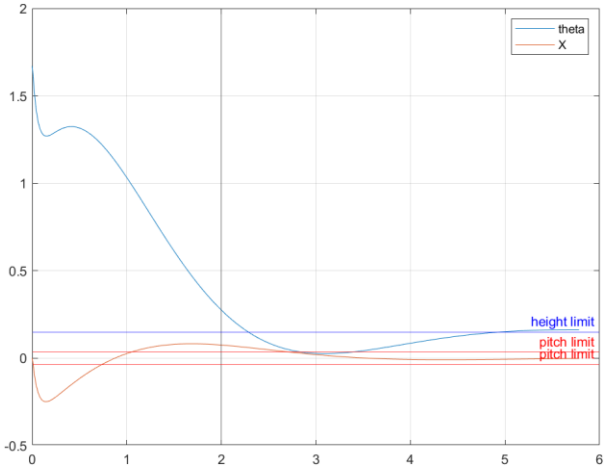
Optimal control – Assignment 3

The state vector are inputted as the following :

```
x0=[    0   0   -1.52   0];

A=[     0       1       0   0
        0       -0.4    0   -0.01
        0       0       0   1
        9.8     -1.43   0   -0.02   ];

B=[     0
        6
        0
        9.8 ];

C=[     1   0   0   0
        0   0   1   0   ];

D=[ 0
    0   ];
```

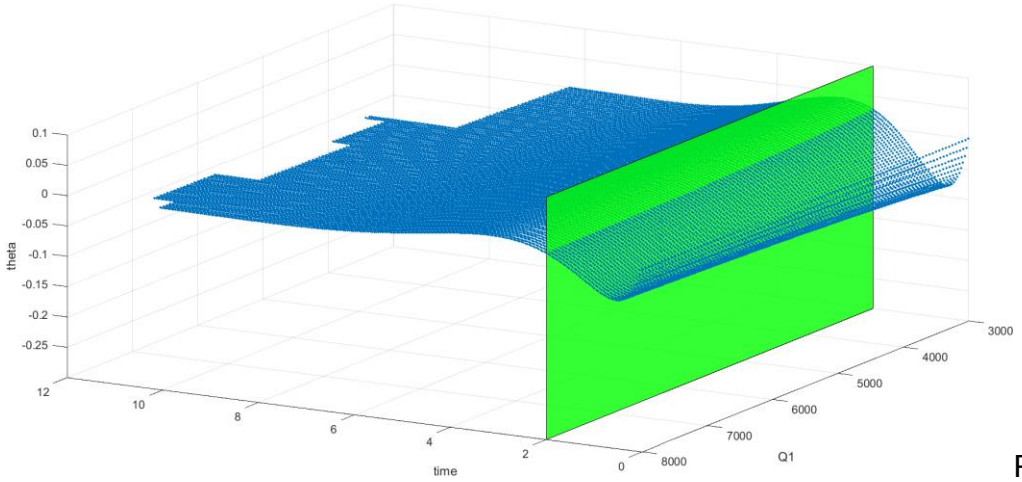
After that, with the initial Q and R, the height and pitch of the helicopter was computed as follows.

```
Q=diag([1000 1 50 1]);
R=0.001;

[Ko, Mo, E]=lqr(A, B, Q, R);


sysCL=ss(A-B*Ko, [B zeros(4,1)], [ zeros(1,4) ;C2],zeros(2,2));
[y,t,e ]=initial(sysCL, x0');
n=size(t,4);

Xdt = [0 0 0.15 0] ;
Xd = repelem(Xdt,n,1);
X=Xd-e ;
u=Ko*e';

X1=X(1:end,1);
X3=X(1:end,3);
```

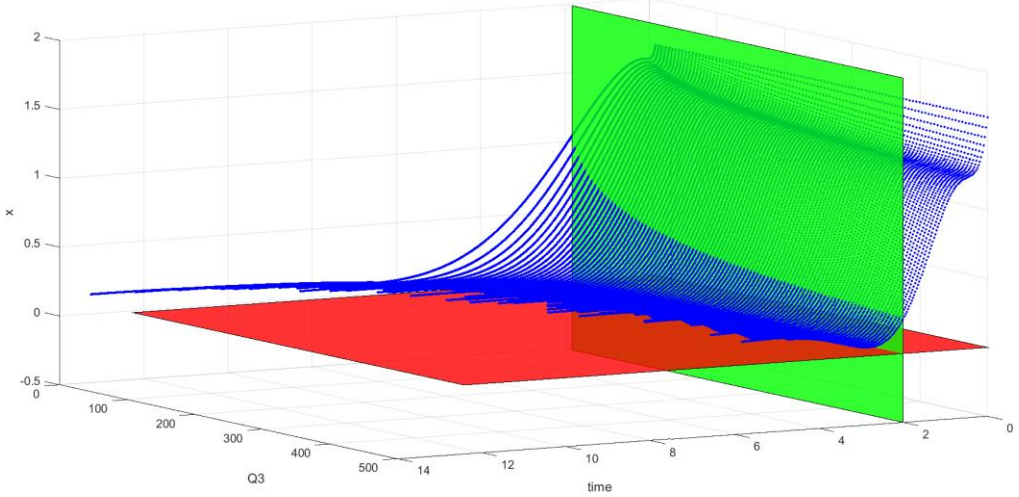


the resulted plot suggested that the helicopter went above height limit just after 2 seconds limit and briefly after 5 second. The pitch also still outside the limit after 2.5 seconds. Therefore, the system still need optimization.

Various solution has been tried to get the optimal value of Q and R. including brute forcing the value using for loop for x1 and x3 in Q resulting in this 3D graph.



R

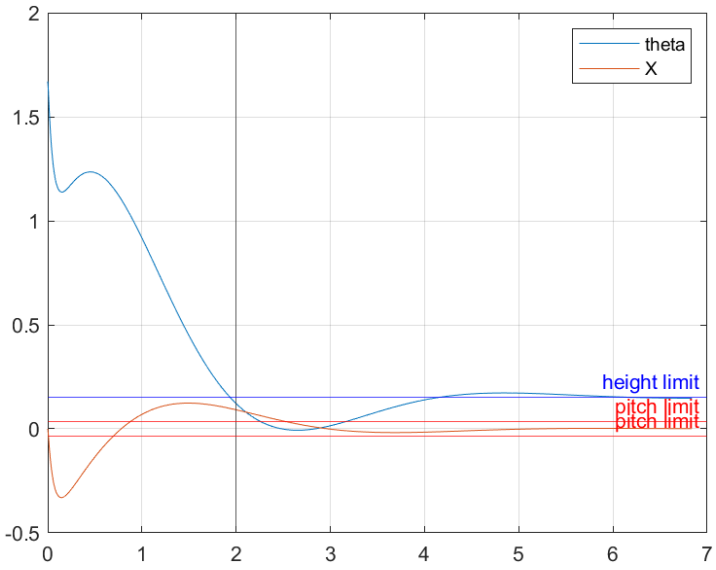


The closest value that has been attempted is

Q = [820 1 85 1]
R = 0.001

Which resulting in this graph.

The helicopter manage to reach the height target before 2 second but it went above it again after 4 second.



At the end I did not manage to reach the specification. I suspect that I made mistake in the computation of the state space. Otherwise, its simply my lack of understanding and experience.