

lqr test script.m

```
%% Desired response
des_dom_poles = [-2/3+0.6991j, -2/3-0.6991j];
num = abs(des_dom_poles(1))^2;
den = poly(des_dom_poles);
Gd = tf(num,den);

%% Current system
% Kr example
% [A,B] = linearizedCartPend2(1,1,1);
% C = [1 0 0 0;
%       0 1 0 0];
%
% Q = 100*C'*C;
% R = eye(2);

% [K,S,CLP] = lqr(A,B,Q,R)
% Kr = 1 ./ (-C*inv(A-B*K)*B)

% Servo-comp example
% mc = 1; ml = 4; L = 1;
% [A,B] = linearizedCartPend(mc,ml,L);
mball = 0.5; Rball=1; mbeam = 4.8990; L = 2.4746;
[A,B] = linearizedBeamBall(mball,Rball,mbeam,L);
C = [1 0 0 0];
Aaug = [A, zeros(4,1); C, 0]; Baug = [B;0]; Caug = [C,0];
Cz = [0 0 0 0 1];

Qx = Caug'*Caug;
Qz = Cz'*Cz;
a = 6.0988e3; b = 6.8267e3;
% a = 10e3; b = 50e3;
Q = a*Qx + b*Qz
R = 1;

[K,S,CLP] = lqr(Aaug,Baug,Q,R);

Kx = K(1:4); Kz = K(5);
Acl = [A-B*Kx, -B*Kz; C, 0]; Bcl = [zeros(4,1); -1]; Ccl = Caug; Dcl = 0;

%% Test
G = ss(Acl, Bcl, Ccl, Dcl);
step(G)
hold on;
step(Gd)
legend('G', 'G_{desired}');
grid on;

resp_err(G,Gd,10)
```

Functions:

```
function [err] = err_from_Q_a_b(X)
a = X(1); b = X(2);

if a<0 || b<0
    err = 1e3;
    return
end

% mc = 1; ml = 4; L = 1;
% [A,B] = linearizedCartPend(mc,ml,L);
mball = 0.5; Rball=1; mbeam = 4.8990; L = 2.4746;
[A,B] = linearizedBeamBall(mball,Rball,mbeam,L);
C = [1 0 0 0];
Aaug = [A, zeros(4,1); C, 0]; Baug = [B;0]; Caug = [C,0];
Cz = [0 0 0 0 1];
Qx = Caug'*Caug;
Qz = Cz'*Cz;

Q = a*Qx + b*Qz;
R = 1;

[K,S,CLP] = lqr(Aaug,Baug,Q,R);

Kx = K(1:4); Kz = K(5);
Acl = [A-B*Kx, -B*Kz; C, 0]; Bcl = [zeros(4,1); -1]; Ccl = Caug; Dcl = 0;
G = ss(Acl, Bcl, Ccl, Dcl);

des_dom_poles = [-2/3+0.6991j, -2/3-0.6991j];
num = abs(des_dom_poles(1))^2;
den = poly(des_dom_poles);
Gd = tf(num,den);

Tend = 10;
err = resp_err(G,Gd,Tend);

% dom_poles = eig(G);
% dom_poles = dom_poles([1,2]);
% err = norm(dom_poles - des_dom_poles)^2;
end

function [err] = resp_err(G,Gd,Tend)
t = linspace(0,Tend,1001);
y = step(G,t);
yd = step(Gd,t);
err = norm(y-yd)^2;
end
```