Computerized control - homework 5

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Due Tuesday 2016-05-03

Active suspension, contd.

In the last homework you studied the *quarter model* for the suspension of a car. In this homework, you will design a state feedback controller for the discretized state space model, and simulate a step-response.

Choose the closed-loop poles

The system is of order four, so you need to determine the placement of four closed-loop poles. Choose these poles (by trial-and-error), such that the system response to a step disturbance in w of 10 cm settles in less than 0.15 s with forces in the active suspension that does not exceed 20 kN. Remember that the poles must be real, or complex-conjugated pairs.

Matlab code to form and simulate the closed-loop system

```
[Phi, Gamma, C, D] = ssdata(sys_uy_d); % Get the system matrices from the discrete-time model

P = % Your choice of poles goes here

[L, prec] = place(Phi, Gamma, P)  % Calculate the feedback gain L
eig(Phi - Gamma*L) % Check that this is indeed the poles you specified in P

% Form closed-loop system and simulate. Simulate the system with input from the disturbance w
[Phi, Gammaw, C, D] = ssdata(sys_wy_d);
Phic = Phi - Gamma*L;
sys_c_d = ss(Phic, Gammaw, C, D, h); % Closed-loop system with input from disturbance w

w = 0.1*ones(100,1);
[y, T, x] = lsim(sys_c_d, w);

figure(1)
clf
subplot(211)
stairs(T, y)
title('Closed-loop response to disturbance of 10cm')
ylabel('z_1 -z_2 [m]')
xlabel('Time [s]')
subplot(212)
stairs(T, -L*x')
title('Feedback signal u=-Lx')
ylabel('Active suspension force [N]')
xlabel('Time [s]')
```