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function bicycle_multi_input

% Goal is to design controller u = -Kx for bicycle dynamics using model
% given in Minor Test 1, Problem 1

% Parameters (rounded to one decimal place)
M = [80.8 2.3; 2.3 0.3];
g = 9.8; %m/s^2
v = 2; %m/s in range 2-7 m/s, for example
C1 = [0 33.9; -0.9 1.7];
K0 = [-81 -2.6; -2.6 -0.8];
K2 = [0 76.6; 0 2.7];

% State-space matrices
B = [0 0; 0 0; 1 0; 0 1];

iM = inv(M);
A21 = -iM*(g*K0 + v^2*K2);
A22 = -iM*v*C1;
A = [B';A21 A22];

% Note that the system is stable
eig(A)

% Can the eigenvalues be arbitrarily placed?
rank([B A*B A*A*B A*A*A*B])
% % or equivalently
% Wc = ctrb(A, B);
% rank(Wc)

b1 = B(:,1);
rank(ctrb(A,b1))

b2 = B(:,2);
rank(ctrb(A,b2))

% Desired eigenvalues can be written in p
p = 10*[-1, -2, -3, -4];

% The Gain matrix is
K = place(A, B, p)

% Note: Typically, the faster the desired response, the larger is the K matrix,
% meaning that even for small deviation, larger control input is required
```