

Ch_8_Lesson_8_Ex_2

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clear

m = 1000; % mass of car body
k = 10000; % spring constant for front and rear springs
c = 200; % damping coefficient for front and rear dampers

L = 1.5; % position of cm when car level and springs relaxed
wb = 2; % wheel base of car
M=m/12*wb^2; % moment of inertial for rod of mass m and length wb

dt = 0.001;
n=10000;

% program the road
V = 3; % velocity of car
rf = zeros(1, n+1);
rr = zeros(1, n+1);
for i=1:n+1
    d = V*(i-1)*dt; % x coordinate of rear axel
    if (d >= 10 && d < 11) % a bump of width 1 starting at 10 m
        rr(i) = .5; % with height .5 m
    else
        rr(i) = 0;
    end

    if (d + wb >= 10 && d + wb < 11) % now for front axel
        rf(i) = .5;
    else
        rf(i) = 0;
    end
end

p(1) = 1; % initial position of cm
v(1) = 0; % initial velocity of cm
t(1) = 0;

ang(1) = 0; % initial body angle
vang(1) = 0; % initial velocity of body angle

for i=2:n+1

    t(i) = t(i - 1) + dt;

    % compute vertical position and velocity of front and
    % rear of car at start of subinterval i-1

    pf = p(i-1) + (wb/2)*sin(ang(i-1));
    vpf = v(i-1) + (wb/2)*vang(i-1);
    pr = p(i-1) - (wb/2)*sin(ang(i-1));
    vpr = v(i-1) - (wb/2)*vang(i-1);

    % compute 'slope' of the road at the front and rear axel
    vrf = (rf(i) - rf(i-1))/dt;
    vrr = (rr(i) - rr(i-1))/dt;

    Ff = k*(L - (pf - rf(i-1))) + c*(-vpf - vrf); % force on front of car from
    sping/damper

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Fr = k*(L - (pr - rr(i-1))) + c*(-(vpr -vrr)); % force on rear of car from
spring/damper

p(i) = p(i-1) + v(i-1)*dt; % project vertical position of cm
a = (Fr + Ff)/m - 10; % compute vertical accel of cm
v(i) = v(i-1) + a*dt; % project velocity of cm

ang(i) = ang(i-1) + vang(i-1)*dt; % project angle of body
aang = (-Fr + Ff)*wb/2/M; % compute torques on body and angular
acceleration
vang(i) = vang(i-1) + aang*dt; % update angular velocity

end

plot(t, p - (wb/2)*sin(ang)) % plot vertical position of rear of car
hold on
plot(t, 3 + p + (wb/2)*sin(ang)) % plot vertical position of front of car offset by
3
hold off

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