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%This m file is used for mini project 1
% It contains the forward kinematics of the 3 link biped

syms q1 q2 q3 p_h p_v dp_h dp_v dq1 dq2 dq3 real
syms r m Mh Mt l g real

% Define parameters in a vector
params = [r,m,Mh,Mt,l,g];

% Include the util and autogen folder to use write_symbolic_term_to_mfile.m
% and export outputs to autogen folder
set_path

%Mh -  mass of hip, Mt - mass of torso, m - mass of legs
%l - length from hip to torso, r - length of legs

% Defining generalized coordinates:
% Angular positions:
%           q1: stance leg (absolute, w.r.t. y axis of
%           q2: swing leg (relative to q1)
%           q3: torso (relative to q1)
% Angular velocities dq/dt:
%           dq1: stance leg
%           dq2: swing leg
%           dq3: torso
q = [q1; q2; q3];
dq = [dq1; dq2; dq3];

% q1 is cyclic, and negative pre-impact using convention provided in the
% figure
theta1 = q(1);
theta2 = pi - q(1) - q(2);
theta3 = pi - q(3) + q(1);

% Forward Kinematics - position of point masses
% hip
pMh = [r*sin(theta1) ; r*cos(theta1)];
% torso
pMt = pMh + [l*sin(theta3); l*cos(theta3)];
% stance leg
pm1 = [r*sin(theta1)/2 ; r*cos(theta1)/2];
% swing leg
pm2 = pMh + [ r*sin(theta2)/2; r*cos(theta2)/2];
% center of mass
pcm = (Mh*pMh + Mt*pMt + m*pm1 + m*pm2)/(Mh + Mt + m + m);
% end of swing leg
P2 = pMh + [r*sin(theta2)/2; r*cos(theta2)/2];

%%
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write_symbolic_term_to_mfile(q,dq,params,pMh,pMt,pm1,pm2,pcm,P2)

%%

% Velocities - found by taking partial derivative w.r.t. q, then multiply
% by dq/dt
vMh = jacobian(pMh,q)*dq;

vMt = jacobian(pMt,q)*dq;

vm1 = jacobian(pm1,q)*dq;

vm2 = jacobian(pm2,q)*dq;

vcm = (Mh*vMh + Mt*vMt + m*vm1 + m*vm2)/(Mh + Mt + m + m);

write_symbolic_term_to_mfile(q,dq,params,vMh,vMt,vm1,vm2,vcm)
%%
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