MATLAB Assignment 8

Due Date: November 29, 2011

Turning in your homework: place all your files in a directory called "lastNameDate"; zip that directory and drop it in the mailbox at Learn@UW.

Problem 1 [relatively straightforward]. Implement MATLAB code that opens a file, called "model.adm", and parses the text below in order to pick up all the information required to fully define the contribution of a point force in the context of 2D Dynamics analysis. The attributes that you have to pick up include: the body on which the force acts, point P on that body where the force is applied, the X-component of the force, the Y-Component of the force, and whether these two components of the force are expressed in the Global Reference Frame (GRF) or in the Local Reference Frame (LRF).

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
PointForce: 23                  % id of this force
BodyI: 3                        % id of the body on which the force acts
xPprime: 1.4                    % x of point P on body I
yPprime: 11.1                   % y of point P on body I
ForceFunctionX: sin(t + pi/3)   % provides expression for F_x(t)
ForceFunctionY: 0.0             % provides expression for F_y(t)
RefFrame: GRF                   % indicates if expressed in GRF or LRF
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
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Important Observation: Note that if the force is provided in the LRF, then whenever you deal with this force and compute the generalized force it induces you'll have to first multiply by the orientation matrix **A** so that you express the generalized force in the GRF.

Problem 2 [relatively straightforward]. Implement MATLAB code that opens a file, called "model.adm", and parses the text below in order to pick up all the information required to fully define the contribution of a torque in the context of 2D Dynamics analysis. The attributes that you have to pick up include: the body on which the force acts and the expression of the torque.

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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Torque: 7                   % id of this torque
BodyI: 2                    % id of the body on which the force acts
TorqueFunction: 10*t        % provides expression for n(t)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
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Problem 3 [not straightforward]. Consider the double pendulum in Fig.6.5.2 (page 233). Notice that a horizontal force is specified on the second body. Assume that this concentrated force always stays horizontal, and its magnitude is always 5 N. Although not shown, assume that a positive torque $n = 2.5\ N \cdot m$ is applied to body 1. Additionally, take $l_1 = l_2 = 1$, and $m_1 = m_2 = 2$ (all units are SI). The mass moment of inertia should be computed based on information in Table 6.1.1 (page 208). The bodies are moving in a gravitational field with $g = -9.81 m/s^2$. Use for this problem Cartesian generalized coordinates in conjunction with centroidal reference frames as shown in the textbook.

(a) How many degrees of freedom does this mechanism have?

(b) What is the dimension of the Lagrange Multiplier vector λ for this mechanism?

(c) Determine a set of initial positions and initial velocities for this mechanism. Assume that the two pendulums are horizontal and stretched out to your right (along the global OX axis), and that the bodies are at rest.

(d) Using the initial conditions determined above, generate a pair of files doublePend.acf and doublePend.adm that you would use to carry out Dynamics analysis of this mechanism in simEngine2D. The length of the simulation should be 5 seconds, the time step $\Delta t = 0.0005$, while the number of output steps is 100.

(e) For the initial configuration of the mechanism, report on the forum the content of the matrix that you use in order to compute the acceleration $\ddot{\mathbf{q}}$ and Lagrange Multipliers λ (the coefficient matrix in Eq.6.3.18 at page 224).

(f) For the initial configuration of the mechanism, report on the forum the content of the right-hand size that you use in order to compute the acceleration $\ddot{\mathbf{q}}$ and Lagrange Multipliers λ; i.e., the vector $\begin{bmatrix} \mathbf{Q}^A \\ \gamma \end{bmatrix}$ in Eq.6.3.18 at page 224. Remember that there is a $\mathbf{Q}_1^A \in \mathbb{R}^3$ acting on body 1, $\mathbf{Q}_2^A \in \mathbb{R}^6$ acting on body 2, and $\mathbf{Q}^A = \begin{bmatrix} \mathbf{Q}_1^A \\ \mathbf{Q}_2^A \end{bmatrix} \in \mathbb{R}^6$.