## ME751: Assignment 8

Problem 1 [**simEngine3D track**]. For the simple pendulum of Problem 1 in the previous assignment (Assignment 7), perform a dynamic analysis using a Quasi-Newton approach. Use a BDF method of order 2, seeded at the beginning of the simulation by a BDF method of order 1. For this problem please provide a plot that displays the value of the torque as a function of time for $t \in [0,10]$. On the forum, under the topic Assignment 8-Run Times, list the amount of time it took your simEngine3D solver to finish the simulation. Indicate the step size you used to generate the results (make sure the results are converged and not garbage).

Upload your results in a zip file at Learn@UW.

Post any questions on the ME751 Forum.

Problem 2 [**simEngine3D track**]. This problem builds on simple pendulum of the previous problem. The schematic of the mechanism is shown in the below.
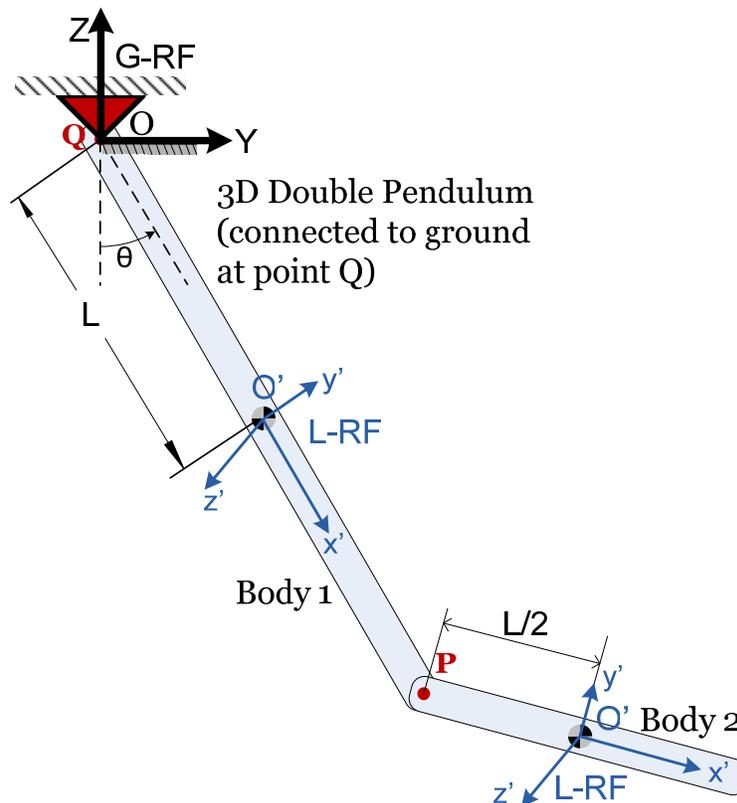
You will have to carry out a Dynamics Analysis for the mechanism for 10 seconds of its evolution using a BDF method of order 1 in conjunction with a Quasi-Newton method for solving the resulting discretization nonlinear system of equations. For initial conditions consider the first pendulum (Body 1)

to be horizontal; i.e., according to the figure, $\theta = \dfrac{\pi}{2}$, while the second pendulum (Body 2) is hanging down, making a $\dfrac{\pi}{2}$ angle with the first pendulum. Both bodies have zero velocity at time $t = 0$. The bodies move in a gravitational field.

- In the solution folder include seven plots. The first three will display the location (distance) of Body's 1 point O' in the G-RF as a function of time, the second one its velocity in the G-RF as a function of time, and the third one will display its acceleration in the G-RF. The next three plots will display the same information for Body's 2 point O'. The last plot will display the norm-2 of the violation of the velocity constraint equations for the revolute joint between Body 1 and Body 2 (you'll have five scalar velocity constraint equations, you need to compute the norm-2 of this vector; i.e., the violation of the velocity kinematic constraint equation).
- On the forum, under topic Assignment 8-Run Times, list the amount of time it took your `simEngine3D` solver to finish the simulation. Indicate the step size you used to generate the results (make sure the results are converged and not garbage).

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Problem 3 [**Chrono track**]. Go to http://lim.ii.udc.es/mbsbenchmark/docs/specifications.html. Pick up Andrew's mechanism and carry out the analysis whose results are reported under the "View results" link. For this problem (http://lim.ii.udc.es/mbsbenchmark/dist/A03/A03_specification.xml):

- Generate a movie of the motion of the mechanism
- Generate a plot that shows the time evolution of the force in the spring
- Generate a plot that shows the distance from point D to the origin O as a function of time
- Generate a plot that show the magnitude of the velocity of point D in the GRF

Upload your results in a zip file at Learn@UW.

Post any questions on the Chrono Forum.