MATLAB Assignment 6

November 6, 2014

Due: November 13, 2014

When working on this assignment you might want to take a look at MATLAB code that was developed by students who took ME451 in previous years. The students back then did not come up with identical solutions. Take a look at their solutions and develop your own.
2010: `http://sbel.wisc.edu/Courses/ME451/2010/SimEngine2D/index.htm`
2011: `http://sbel.wisc.edu/Courses/ME451/2011/SimEngine2D/index.htm`

Turning in your assignment: place all your files in a directory called "lastName_Matlab_06", zip that directory, and upload the resulting file "lastName_Matlab_06.zip" in the appropriate Dropbox Folder at Learn@UW.

Problem 1. Assume that $\mathbf{q} = [x, y]^T$ and

$$\mathbf{\Phi}(\mathbf{q}) = \begin{bmatrix} 3x + \sin(xy) - 4 \\ x - e^{cos(y)} \end{bmatrix}$$

1. Compute the Jacobian (matrix of partial derivatives) $\mathbf{\Phi}_{\mathbf{q}}$.
2. Write a MATLAB program that implements the Newton-Raphson method for solving the nonlinear system $\mathbf{\Phi}(\mathbf{q}) = \mathbf{0}$. For the stopping criteria, use the condition that the norm of the correction should be less than 10^{-8}.
3. Post on the forum the results that you get when you run the MATALB program above using as a starting point $\mathbf{q}^{(0)} = [1.5, 1.5]^T$.

Problem 2. Consider the pendulum at page 60 of the textbook (Example 3.2.1). Use the pair of files simplePend.acf and simplePend.adm that you generated in a previous assignment.

a. Write a MATLAB program that parses the ADM file and then calculates the following quantities: $\mathbf{\Phi}$, $\mathbf{\Phi}_{\mathbf{q}}$, ν, and γ, all evaluated at time $t = 0$, with $\mathbf{q}(0) = \mathbf{q}_0$ and $\dot{\mathbf{q}}(0) = \dot{\mathbf{q}}_0$ consistent with the given motion at $t = 0$. Post on the forum the values you obtain for these four quantities.

b. Write a MATLAB program that does the following: first, it parses the ADM and ACF files to read in the model and type of analysis. Next, it runs a loop over time from $t_0 = 0$ to the final time in increments specified in the ACF file; i.e., $t_{end} = 1$ and $\Delta t = 0.01$. At each time step $t_1, t_2, \ldots, t_{end}$, it prints out the values of $\mathbf{\Phi}(\mathbf{q}, t)$, $\mathbf{\Phi}_{\mathbf{q}}(\mathbf{q}, t)$, and $\nu(\mathbf{q}, t)$. On the forum, report the value that you get at $t_{37} = 0.37$.

Notes:

- As time is incremented, the values of x, y, and ϕ change so that they satisfy the constraints. Make sure you work with the correct values when you compute $\mathbf{\Phi}$, $\mathbf{\Phi}_{\mathbf{q}}$, and ν. For this assignment, you can hard-code the analytical solution of the Position Analysis Problem or simply use your simEngine2D.