**Name:** Samuel Acuña

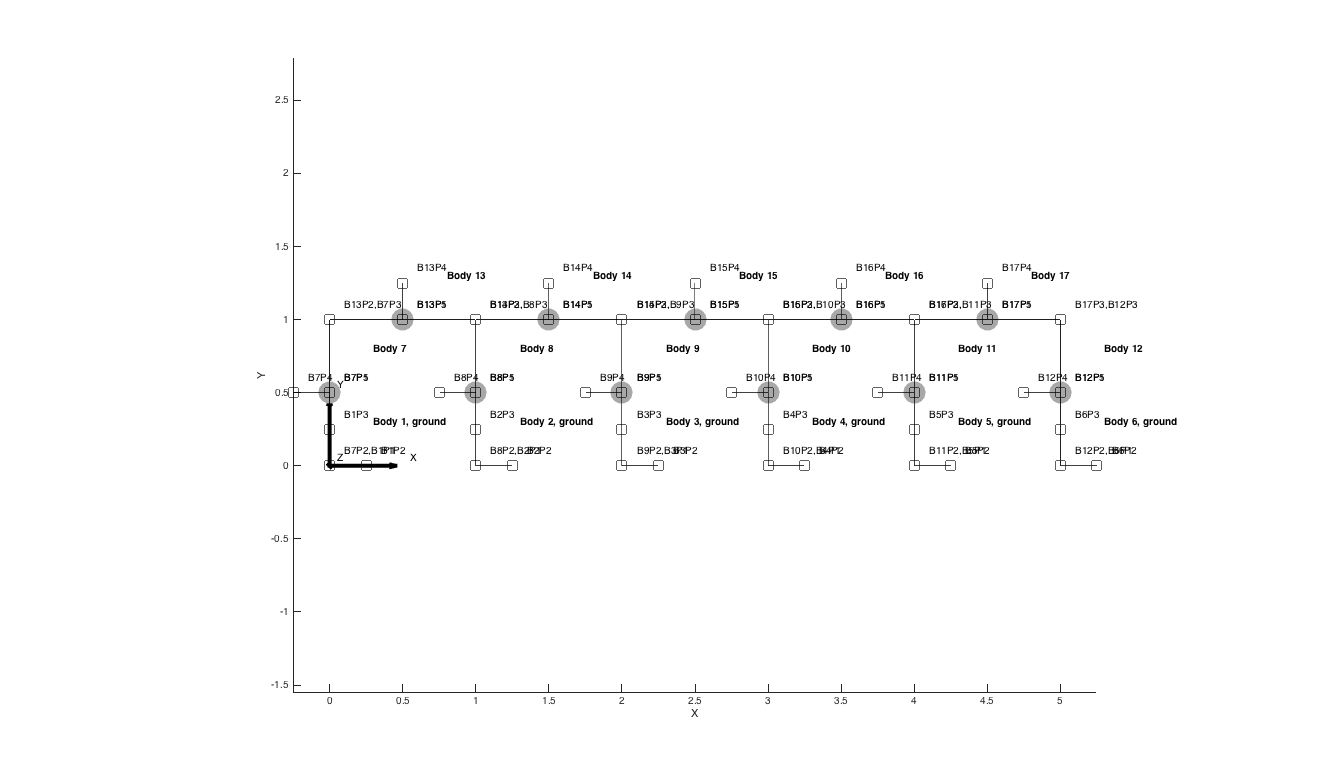
**Date:** 14 Nov 2016

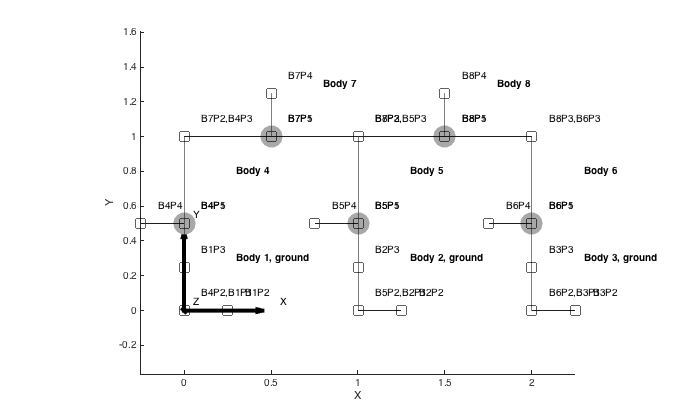
**Class:** ME 751

**Subj:** Final Project — simEngine3D benchmark — **N Four-bar mechanism**

My simEngine3D dynamics engine was successfully able to simulate the N four-bar mechanism benchamark (<http://lim.ii.udc.es/mbsbenchmark/dist/A02/A02_specification.xml)>.

All code to run the simulation, including plots and recorded animations, can be found at <https://github.com/saacuna/simEngine3D> under the *final\_project* folder. The driver file is called *simEngine3D\_n4BarMechanism.m*

**Plot of dynamic system: (N = 2, and N = 5)**

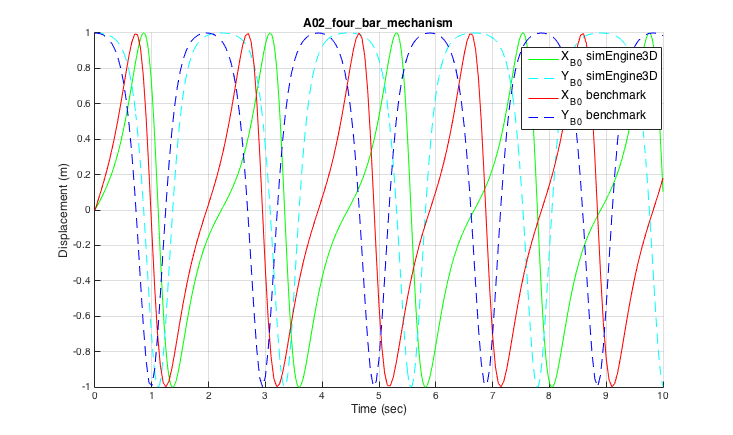


**Simulation Run Time:**

For step-size h=0.01 seconds, and N = 2, time to compute Quasi-Newton Solution: 253.9681 seconds

For step-size h=0.001 seconds, and N = 5, time to compute Quasi-Newton Solution: 2859.6378 seconds

**Comparison to benchmark solution:**



**Benchmark Tolerances: (comparing 201 data points)**

*Low Precision Error tolerance =* 1e-1

*X coordinate*: There are 184 entries outside of allowable low precision error

*Y coordinate*: There are 161 entries outside of allowable low precision error

*High Precision Error tolerance =* 1e-3

*X coordinate*: There are 184 entries outside of allowable high precision error

*Y coordinate*: There are 161 entries outside of allowable high precision error

***Thus, the simulation is NOT considered to have reached the benchmark.*** However, I think this is due to poorly specified initial conditions in my system. The swinging pendulum is periodic, offset from the benchmark solution, so my simulation is not completely wrong in motion. I was unable to figure out how to specify an initial velocity constraint in my dynamics engine, so I implemented a poor workaround in my code.