ME 530.676: Locomotion in Mechanical and Biological Systems
Problem Set 5
Updated 4/9/2014

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UPDATED Due: Friday, 11 April 2014

1. Derive the swing-phase dynamics of the simplest walking model and show that as $\beta \to 0$ you get equations (1) and (2) in the Simplest Walking Model paper.

2. Write code that numerically integrates the swing-phase dynamics. The interface should allow you to specify an initial condition, and should integrate exactly until the touch-down condition occurs. It should allow you to set γ (the slope of the hill). The function should be called as follows:

   ```
   >> [q,t] = swingPhase(q0,gamma)
   ```

   where $q = (\theta, \dot{\theta}, \phi, \dot{\phi})^T$.

3. Implement the heelstrike transition rule:

   ```
   >> qplus = heelStrike(qminus)
   ```

   using the same convention for q.

4. Reproduce Figure 2 in the Simplest Waling Model paper.

5. Find a numerical approximation to the linearlized return map using a central difference approximation. Take the section at heelstrike.

   ```
   >> [A,qstar] = simplestReturnMap(gamma)      [UPDATED 4/9 to include qstar]
   ```

6. Use the above function(s), reproduce "heavy line" in Figure 3. [UPDATED 4/9:] Also, make a similar plot, again with γ on the axis, but now with the magnitudes of all eigenvalues on the y axis. This will be similar to Figure 4 in the paper.