Assignment 1 Handout

Simulation and Modeling (CSCI 3010U)

Faisal Qureshi

Due back on Oct. 10, 11:59 pm

Introduction

You are asked to simulate a slinky, falling under the influence of gravity. Consider the figure shown below (Fig. 1). Here (A) shows the slinky at rest length and (B) shows the same slinky hanging from a rigid support under the influence of gravity. Notice how the slinky is now stretched. Sometime after the slinky has reached a stable state— i.e., the top and the bottom ends of the slinky are at rest—as seen in (B), the slinky is released as shown in (C). Here a curious phenomenon is observed. The slinky doesn't start falling down immediately. Instead the top end of the slinky first collapses on the bottom end (C)-(E) and then the slinky begins to fall down (F). This phenomenon is also observed in the Youtube video available here http://www.youtube.com/watch?v=bDaDHbTfpzg.

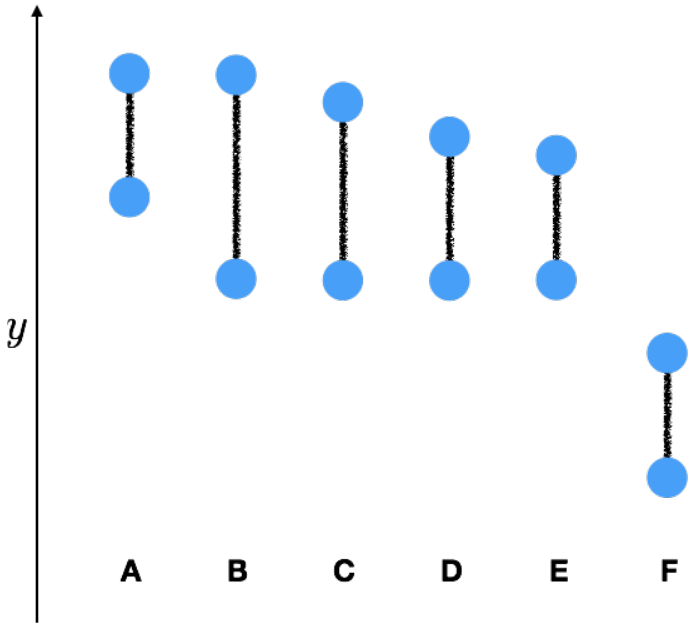

Figure 1: Slinky falling under the influence of gravity

We will use your simulation to figure out whether or not the bottom end of the slinky moves at all during phases (C)-(E). Does it move up, does it move down or does it stay at the same height. We will further investigate different models of a slinky to identify a suitable model for this slinky. We will also investigate the behavior of this slinky under

different conditions: different values of gravity, drag, spring constants, damping coefficients, etc.

Possible models of a "slinky"

The following figure shows two possible models of a slinky (Fig. 2). The model on the left is the simplest possible model, containing two masses connected by a spring. The model on the right; however, might be a more realistic model. It contains n masses connected via n-1 springs. You can (and should) also add dampers to these models.

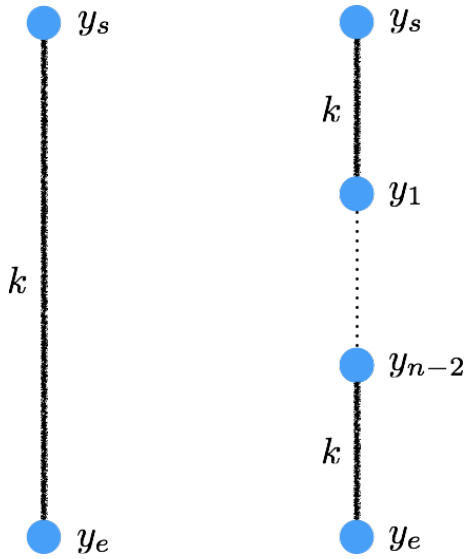

Figure 2: Two possible models for slinky

Task

- Create a simulation for a 2 mass, 1 spring slinky falling freely under the influence of gravity.
- Create a simulation for n mass, $n-1$ spring slinky falling freely under the influence of gravity.
- Add dampers to the above model.
- Evaluate the following four models to determine the most appropriate model for a slinky. A model that most closely mimics the behavior observed in the above video.
  - 2 mass, 1 spring
  - 2 mass, 1 spring + damper
  - n mass, $n-1$ spring
  - n mass, $n-1$ spring
- Now use the selected model to ascertain if the bottom end of the slinky moves during phases (C)-(E)
- Document your findings in a two page technical report

Important

- Don't forget to let the slinky come to rest before releasing it.

- Each of the above solutions inlcude a “simple” animation.
- Feel free to choose appropriate values for masses and spring constants.

Submission

Submit the following files via Blackboard

- model1.py
- model2.py
- model3.py
- model4.py
- report.pdf