Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

computer graphics laboratory

PHYSICALLY-BASED SIMULATION COURSE 2018

EXERCISE 4 - MASS-SPRING SYSTEM

Handout date: 17.10.2018

General Rules

Setup. Please go to our gitlab repository (https://gitlab.vis.ethz.ch/cglphysics/PBS18-Exercises) and carefully follow the instructions to update and run your forked project.

Goal of this exercise

In this exercise, you will implement a mass-spring system to simulate a cube colliding with the ground floor. We have a cube that is dropped on the floor, which location is $y = 0$. Each pair of vertices on each edge of a cube is connected by a spring, and these are not fixed. Collision response should be applied with the penalty-based method, i.e. a repulsive spring force in the ground, with $k_{floor} = 100$. This will result in an elastic ground response. The total force including elastic, damping and gravity is defined as follows (same as Exercise 1):

$$\mathbf{f} = -k(||\mathbf{p} - \mathbf{p}_0|| - L)\frac{\mathbf{p} - \mathbf{p}_0}{||\mathbf{p} - \mathbf{p}_0||} - \gamma\mathbf{v} + m\mathbf{g} \tag{1}$$

Please fill in `advance()` method of `MSSSim.h` in order to update the position of cube vertices with Semi-Implicit Euler integration.

Relevant functions. Spring information (i.e., spring positions and its length) is stored in `m_edges` and `m_lengths`. The stiffness of the ground is saved in `m_floor_stiffness`.

Goal. You should see a colliding cube with the ground as seen in Fig. 1. Test with different cubes where its springs are connected in a different way (Fig. 2).

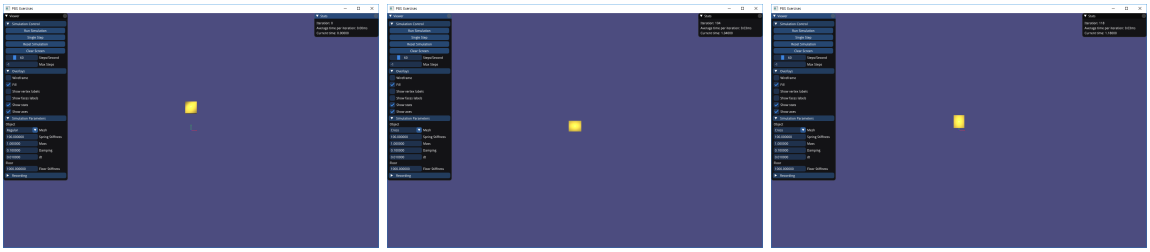

FIGURE 1. Screenshot of an example result.

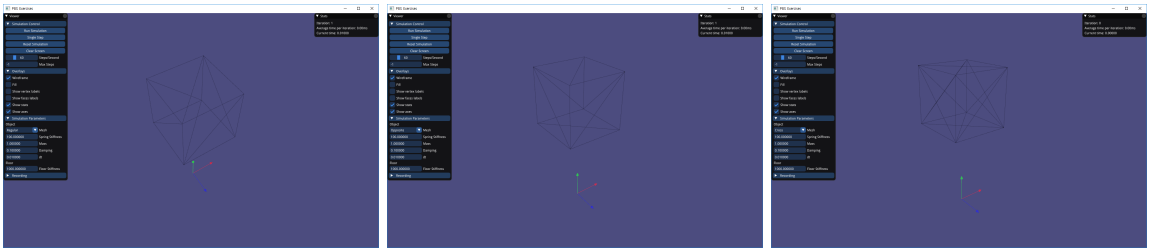

FIGURE 2. Different spring connections. What is the difference? Which one is the most stable?