University of California, Los Angeles

MAE 259B - Advanced Topics in Solid Mechanics

Simulation of Card Spring Process

Team #5

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1 Overview

When we watch some gambling-related movies, we always see some fancy moves that can be designed to show the gambler's superb gambling skills. For example, multiple shuffle methods, one-handed or two-handed cut.

Some of the cardistry skills are easy to learn, since they may not need much practice. However, there is one trick that looks pretty cool, much cooler than other skills, and really hard to learn. It is called card spring.

There are definitely many people who fell straight into this technique when we first saw it as a child, just like us.But they failed no matter how much they practiced, and over time lost their enthusiasm for the skill.

After getting familiar with knowledge about simulation of discrete elastic structures, we believe that even if we are not able to use the skill by our hands, we can still simulate it in the computer.

Such a simulation may be helpful in some anime creation situations, and the physical process can be deeply understood by this sim. Also, our long-cherished wish can be realized.

2 Basic Principle

a. before springing
    Firstly, the performer should put his/her finger on the specific place of a deck of cards. Thumb should be on a corner place and little finger should be on the diagonal corner.The other three fingers should go on the top.

b. when springing

When the card is about to spring, the performer should tighten his/her hands and force the deck to bend, which will make cards hold the elastic potential energy. The only reason for the card to still remain in its position is the friction from the fingers. So, if the performer slowly reduces the friction that his/her hand exert on the cards to a threshold, the card will be ejected.

c. after springing

The ejected cards will be caught by the other hand. The hand functions as a compliant slot, catching the cards and canceling their remaining energy of the card.

3 Simulation Methods

a. Discrete elastic rods
Since the real card spring process is a bit complicated, we plan to firstly consider it as composition with multiple rods and every rod bears bending force and friction.
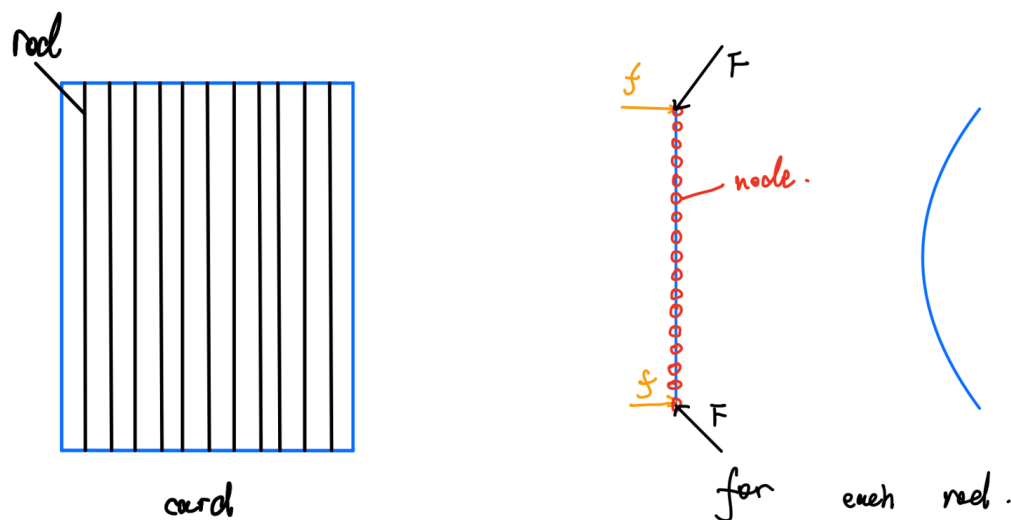
Then remove the friction at a specific time step, and decrease the bending force at next several time steps. Also, free the fixed value of the node's position. Those rods will be ejected from the initial position.

b. Discrete elastic shells

This method is much more reliable than other methods above. However, we haven't learned anything about it, so we are not sure that we can successfully use this method. Once we learn how to use this method, we can create a load distribution at the edge of the card, which is in line with the hand-triggered situation.

4 Expected Results

We hope to get deliverables below:
a. a video clip about discrete elastic rods method with constant load distribution.

b. a video clip about discrete elastic rods method with function controlled load distribution.

c. a video clip about discrete elastic shell method with constant load distribution.

5 Resource

We decided to use Python to realize those simulations. And the following library may help us :

Numpy - it can provide comprehensive mathematical functions, random number generators, linear algebra routines, which may make it easier for us to translate functions we used in matlab to function in python.

Mayavi - an application and library for interactive scientific data visualization and 3D plotting in Python.

Other libraries may also be found required in the future.