Cloth Simulation

Team 22

Chaitanya Jain and Rahul Jaiswal (2020044, 2020109)

1 INTRODUCTION

This project focuses on developing a cloth simulation program to express its behavior in a realistic manner using a spring-mass system. There is also wind force acting on the cloth. Combining this with the movement of the camera and cloth presents an intuitive demonstration of cloth simulation. Since computing and rendering a cloth object is remarkably challenging and time-consuming, the level of detail in the cloth has been optimized to achieve performance.

2 LITERATURE REVIEW

In the paper titled "Parallel Cloth Simulation Using OpenGL Shading Language", written by Hongly Va, Min-Hyung Choi, and Min Hong, the focus is on expressing the cloth simulation in a realistic manner with performance using the mass-spring system. In a mass-spring system, the main idea is particle/vertex simulation.

The mass-spring system treats the cloth as a grid of nodes, where the grid acts like a spring. A spring resists forces both internal and external forces. To make cloth simulation realistic, the mass-spring model uses three types of springs, namely, structural, shear, and bending.

Force acting on both nodes is known as spring force, which can be computed using Hooke's law.

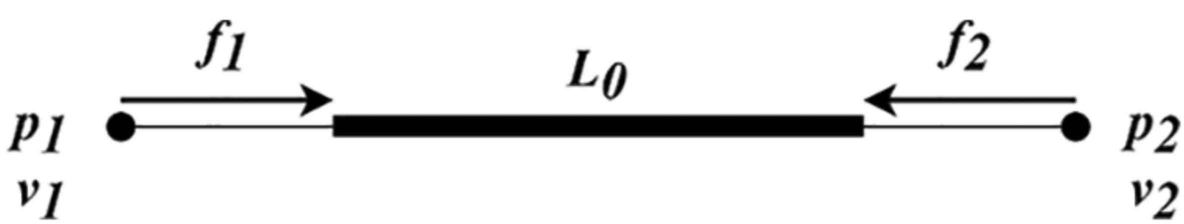

Figure 2: Stretching behavior of a single spring

$$f_1 = -\left[k_s(|p_1 - p_2| - L_0) + k_d\left(\frac{(v_1 - v_2)\cdot(p_1 - p_2)}{|p_1 - p_2|}\right)\right]\frac{p_1 - p_2}{|p_1 - p_2|}$$
$$f_2 = -f_1$$

The figure and equation is taken from [1]

In the equation, f1 is force on vertex 1 (p1) and f2 on vertex 2 (p2).

Parameter ks is the spring stiffness coefficient, and together with the damping coefficient kd is used to compute the spring force.

We also added the effect of wind on the cloth. For this we applied the acceleration due to wind on each triangle in the cloth's mesh.

Force on triangle (F) = - Fd * Cd * $|V|^2$ * A * N/ 2 [2]

Here Fd is the fluid density, Cd is drag coefficient, V is the relative velocity of triangle to the wind, A is the cross sectional area of triangle and N is the normal of the triangle.

Then we apply the force F / 3 on each vertex of the triangle.

We have fixed the top vertices of the cloth mesh so it doesn't get blown by the wind or fall down due to gravity.

3 MILESTONES

S.No.	Milestone	Member	Progress
1	Create basic structure (classes, makefile, etc.)	Rahul Jaiswal	✔️
2	Implement shader code (.frag, .vert files)	Rahul Jaiswal	✔️
3	Implement small classes (Vertex, Triangle)	Chaitanya Jain	✔️
4	Implement mass-spring system	Chaitanya Jain	✔️
5	Create objects and link them to shader	Rahul Jaiswal	➖*
6	Implement camera and projection viewing	Rahul Jaiswal	✔️
7	Applying mass-spring to cloth for simulation	Chaitanya Jain	✔️

8	Implement cloth movement with input	Chaitanya Jain	✔️
9	Implement wind effect on cloth	Chaitanya Jain	✔️

*Implemented but not fully working

4 RESULTS

The scene is being rendered. The camera and object movement are functional. The wind is affecting the cloth as expected.
The simulation is working but sometimes the cloth object is not created and causes segmentation error.

5 REFERENCES

[1] Hongly Va, Min-Hyung Choi and Min Hong (2021), [online]: https://www.techscience.com/csse/v41n2/45194/html

[2] cranberrymuffin (2020), [online]: https://github.com/cranberrymuffin/cloth-simulation