Reproduction of the behavior of the wet cloths taking the atmospheric pressure into account

Wataru Yamada †, Taichi Watanabe †, Masanori Kakimoto †, Koji Mikami †, Ryota Takeuchi ‡
† Tokyo University of Technology, ‡ Silicon Studio Corporation.
g311103518@st.teu.ac.jp

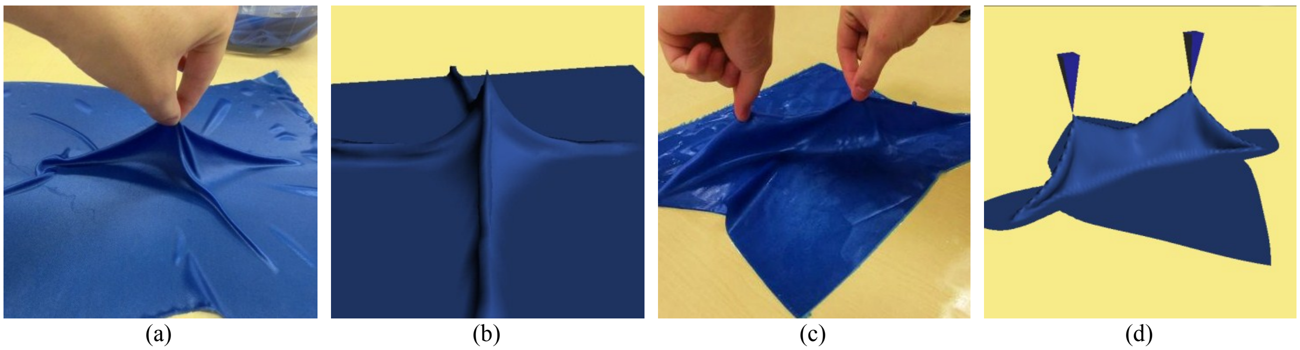

Figure 1. A real wet cloth being picked at one point (a) and at two points (c), and our respective simulation results (b) and (d).

1. Introduction

The property of cloth changes when it gets wet. Especially, wet cloth sticks to objects being touched. When expressing a wet cloth in computer graphics, pseudo representation is often used. As existing research, [Gascon et al. 2010] added a constrain to the part of cloth where it touches the base object. This constraint is a force which makes the cloth continue sticking to the position while the cloth is touching. In real-world situations, however, such sticking forces act even on the part which stays off the base.

We assume that the cause of this sticking force is a difference of air pressures. We observe that the air often does not pass through wet cloths and that wet cloths stick to the base object. As a result, the air between the wet cloth and the base object is often shut off from the open air. When an external pulling force acts on a point on the cloth, it lowers the internal pressure of the isolated air. The higher pressure from the open air presses the cloth toward the base object as is the case with a suction cup sticking to a wall. This pressing force causes a unique deformed shape of the cloth (Figure 1). By taking the air pressure into account, we realized a physically-based cloth simulation focusing on the case that the whole cloth is wet.

2. Our Method

We used a mass spring model [Choi and Ko 2002] to simulate the standard behavior of cloth. To reproduce the sticking of wet cloth, we applied forces of the pressures of both trapped air and the open air to each mass point, as well as other forces such as gravity, spring tensions, and external pulling forces. The internal pressure is determined by Boyle-Charle's law taking into account the volume change of the trapped air.

We assume that the amount of trapped air does not change. The volume of the trapped air is computed by integrating the volume of each triangular prism (v_t) whose base is a vertically-projected triangle from each element triangle (A_t) of the cloth (Figure 2). The height of the triangular prism is the height of the center of gravity of the polygon (h_t).

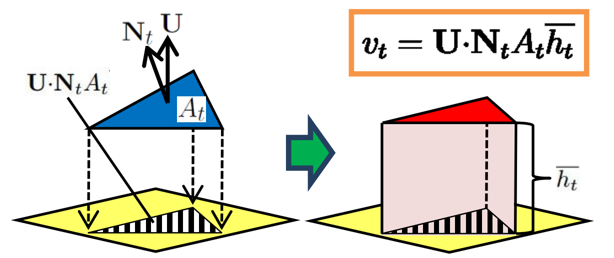

Figure 2. How the volume of each triangular prism v_t is computed.

3. Results

Figure 1 is a pair of comparisons between real wet cloth shapes and our simulation results. The overall frame rate is 64 fps for a cloth consisting of 5000 triangles, using a single core of Core i7 (2.93GHz) with 12GB main memory.

4. Conclusions

We have presented a physically-based simulation method for the behavior of wet cloths, taking air pressures into account. Currently, the base object shape is limited to a plane. Future work includes handling of more general situations such as the base shape variations.

References

Kwang-Jin Choi, AND Hyeong-Seok Ko. 2002. Stable but responsive cloth. *ACM Transactions on Graphics (SIGGRAPH 2002 Proceedings)* 21, 3, 604-611.

Jorge Gasc´on, Javier S. Zurdo, and Miguel A. Otaduy. 2010. Constraint-based simulation of adhesive contact. *In Proceedings of the 2010 ACM SIGGRAPH/Eurographics Symposium on Computer Animation*, SCA '10, 39–44.

SIGGRAPH 2013, July 21 – 25, 2013, Anaheim, California.

ACM 978-1-4503-2261-4/13/07