Project M2R 2012-2013
IMAGINE team

Animation and manipulation of creased paper

fig : Static virtual creased paper from [1]

Advisors

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Context

Although physically-based simulation has become very popular to model deformable surfaces such as cloth [2], it is still not applicable to generate animations of creased paper. Due to the stiffness of this un-compressible material and to the complex changes of its mechanical behavior during creasing. As a result, this standard material in every-day life almost never appears in Computer Graphics applications such as movies or video games. Animating creased paper brings two main challenges: First, such surface needs to be deformed while preserving its length in every direction according to its original pattern. Secondly, sharp features, which are not commonly handled in numerical simulators, need to be generated on the surface.

Objectives

The objective of this internship is to explore a fully geometric approach to the animation of creased paper. Geometrical approaches such as [1] have already been successfully used to model static surfaces mimicking paper, but the animation of such particular surfaces is still an unsolved problem.

We recently developed in our team a new prototype of a deformation tool enabling to interactively manipulate a virtual sheet of paper. The approach is a procedural approach based on some geometrical a-priori knowledge of behavior of paper under deformation. But this first approach can only handle a limited number of deformations (as shown on fig.2).
The goal of this project is to develop a methodology enabling to animate more general deformations of a virtual sheet of paper, including the creations of creases.

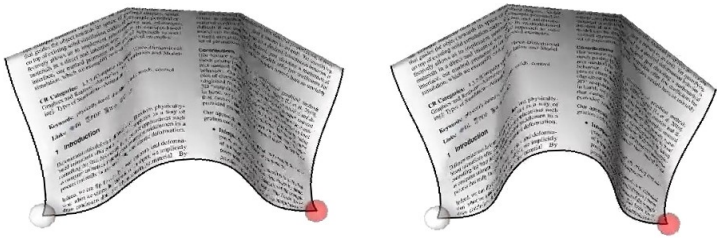

fig 2: interactive manipulation of a virtual sheet of paper

Methodology

In addition to the study of related work in the area, this internship will be organized as follows:

a- Ensuring the preservation of length on the surface during the procedural deformation of a sheet of paper. This step will require developing a tool enabling the detection of length defects such as [3], and developing a new approach to correct such defect, inspiring for instance from [4].

b- Generation of triangulated developable surface parts by geometrically detecting and fitting appropriate portions of surfaces such as cones, cylinders or planes [5].

c- Optionally and in preparation of a following PhD thesis, the method should be extended to handle free manipulation of the paper. Developing a hierarchical deformation procedure can approach this extension. First, the sheet of paper would be deformed locally between the interaction points using the geometrical approach. Secondly, the constraints would spread on the rest of the surface to ensure global preservation of developability.

Requirements

This research topic tackles an unsolved research problem. Therefore, the intern should be enthusiastic for the research area and willing to actively participate in the propositions of ways to improve the existing method. Technically, it requires a strong background in geometric modeling and graphics programming (OpenGL, C++). Knowledge on physical simulation is a plus.

Keywords

Paper, isometry preservation, geometry, creases.

References

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