The Synthesis of Cloth Objects

Literature Review of Paper by Jerry Weft

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This paper takes on the problem of accurately modeling cloth materials on a computer. Previous methods only overlay a cloth-like texture onto a rigid model, whereas this paper proposes a system for modeling the fabric with a series of constraint points, allowing the rendering to look more realistic. The proposed solution is a two step algorithm. The first step, the surface approximation, creates catenary curves between all of the constraint points to model the physics behind the way cloth would drape between the points. In the case of overlapping catenary curves, the lower one is thrown out, as it would give an over-estimation of the realistic parameters for the draping of the cloth. This step creates a series of triangles with connected constraint points, which are added to a database of these triangles. These triangles are then subdivided from the constraint points, making the largest possible subdivision each time, and this information is passed on to the second step.

The second step, the relaxation step, is an iterative stage that propagates the displacement of points until they reach a certain threshold value. The displacement is determined using vectors from each neighbor to the point in question. By adding up these displacement vectors, the resulting vector gives the displacement of the central point. The algorithm can also handle cloth/fabrics of differing stiffness by changing the threshold value in the subdivision algorithm, as the distance between each point and the points 2 rows or columns away changes based off the stiffness of the material.

Rendering the cloth after the relaxation phase follows the assumption that even a texture-mapped naive rendering would lack the realism of actual fabric; for example, translucencies are difficult to achieve through such techniques. Rather, the authors use a coarse-approximation of a fine grid of lines representing individual threads in the cloth. As actual cloth is more accurately represented by cylinders than volume-less lines, the authors use a three-fold perturbed normal function with a ray tracer to simulate cylindrical width. A carefully developed distance/collision/function completes the cylinder-modelling.

The results are very impressive in modelling various types of cloth; equally impressive is the extensive room for improvement and available modifications that the authors enumerate throughout the paper.