LOD +: Augmenting LOD with Skeletons

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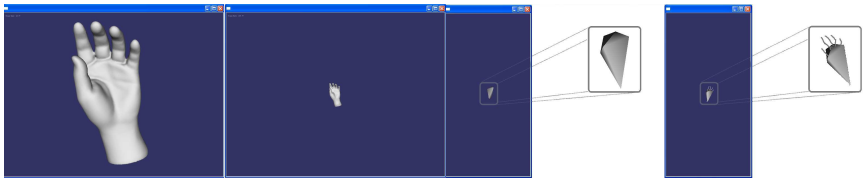

(a) Hand at full resolution (b) Hand at a lower resolution (c) Hand with 10% of edges (d) Hand with LOD+

Figure 1: Hand model

1 Introduction

Until now computer graphic researchers have tried to solve visualization problems introduced by the size of meshes. Modern tools produce large models and hardware is not able to render them in full resolution. For example, the digital Michelangelo project extracted a model with more than one billion polygons. One can notice hardware has become more and more powerful but meshes have also become more and more complex. To solve this issue, people have worked on many solutions. We can find solutions based on space subdivision, or based on visibility of objects like the use of a Z-buffer. But in 1976, Clark [Clark 1976] introduces the level of detail concept (LOD). The principle of LOD is the construction of several versions of the same 3D model at different resolutions. This is achieved by removing some object features. Luebke provides in [Luebke 1997] a very complete survey of LOD algorithms. The main issue with the simplification is that the mesh does not preserve appearance of the original mesh. Indeed, important features tend to disappear. For example, with the Quadric Error Metrics (QEM) algorithms and the cow mesh, the tail, horn and other characteristic points merge with the mesh at a low resolution. Our approach allows the simplified mesh to preserve important details.

2 Our Approach

Our approach is based on Reeb graph theory. A Reeb graph is a data structure that extracts the critical points of a surface and produces a skeleton. This kind of simple structure is commonly use to classify a mesh. Skeleton are also used in mesh animation. The most important use for a Reeb graph is shape analysis ([Tierny et al. 2006]). In fact this solution is the most powerful method to extract object critical points. In our approach we extract the Reeb graph in pre processing. In fact the complexity of Reeb graph extraction is cost expensive. Once the skeleton has been computed, we merge it on the mesh only when the model has been too much degenerated. At present, the solution is based on a threshold but in the future, we hope to find a more adapted metric. The simplification algorithm used is [Garland and Heckbert 1997]. Our solution is called LOD+; it is one of the first solutions to improve LOD low resolution meshes. The first results which allow good shape recognition. The parts of the mesh who are decimate with other algorithms are kept. The main issue of our solution are the bones of the skeleton because they cross the mesh. We need also to improve skeleton visualization. Thickness of the bones made necessary to define a covering strategy. We have tried some solutions (cylinders and boxes) but this affects performance. It stays one of the main open problems to solve in LOD+.

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