UNIVERSITY OF MACAU

ABSTRACT

MESH SIMPLIFICATION BASED ON FEATURE PRESERVATION AND TRIANGLE OPTIMASITION

by

Zhang Shixue

Thesis Supervisor: Prof. Wu Enhua

Software Engineering

Many applications in computer graphics and related fields can benefit from automatic simplification of complex polygonal surface models. Applications are often confronted with either very densely over-sampled surfaces or models too complex for the limited available hardware capacity. An effective algorithm for rapidly producing high-quality approximations of the original model is a valuable tool for managing data complexity.

In this dissertation, first I will introduce some popular 3-dimentional mesh simplification methods. I will discuss the advantage and the disadvantage of each of them and compare them with each other.

Then I will present a new simplification algorithm based on the quadric error metric(QEM) which can preserve the basic features of the original model. This kind of new algorithm is proved to be able to generate approximation with better quality. In our algorithm, we classify the edges into five types: complex edge, boundary edge, boundary incident edge, interior edge and sharp edge; also we classify the vertexes into four types: corner vertex, edge vertex, flat vertex and boundary vertex. We build the edge collapsing list according to the importance of each type of the edges and apply corresponding collapsing rules based on the different types of the vertex. Thus we can preserve most of the features of the original model. Also we evaluate the shape of the triangle in the generated approximations, we will try to avoid slim triangle to be

generated. We do the above by evaluating the compactness of each triangle.

Next I will show in detail how I implement the algorithm on windows platform. My algorithm is implemented under Microsoft Visual C++ 6.0 environment, using OpenGL API to render the mesh. I will give the source code of some of the key points while introducing the implementation of my algorithm. Then I will show some of the experimental results and make a comparison of the approximation quality with the previous algorithms.

At last I will summarize my conclusion and give the outlook of future work.

Keywords: Mesh simplification, Level of Detail, Edge collapse, Triangle, Sharp feature