

MS
035
ZHAIB

Mesh Simplification Based on Feature Preservation and Triangle Optimization

by

Zhang Shixue

Master of Science in Software Engineering

2005



**Faculty of Science and Technology
University of Macau**

Table of Contents

| | |
|---|------------|
| ABSTRACT..... | I |
| List of Figures..... | III |
| Acknowledgements | V |
| Chapter 1 Introduction..... | 1 |
| 1.1 Background and motivation..... | 1 |
| 1.2 Terminology..... | 3 |
| 1.2.1 Aspect Ratio..... | 3 |
| 1.2.2 Edge Swapping..... | 3 |
| 1.2.3 Levels of Detail | 4 |
| 1.2.4 Local Curvature..... | 5 |
| 1.2.5 Marching Cubes..... | 6 |
| 1.2.6 Topology | 7 |
| 1.2.7 Triangulation | 7 |
| 1.3 Problem statement and Contributions..... | 8 |
| Chapter 2 Mesh Simplification Overview | 10 |
| 2.1 Simplification rules and Error metric..... | 10 |
| 2.2 Method of polygonal simplification | 11 |
| 2.2.1 Vertex clustering | 11 |
| 2.2.2 Face clustering..... | 12 |
| 2.2.3 Re-sampling method | 13 |
| 2.2.4 Vertex removal..... | 13 |
| 2.2.5 Edge collapse | 14 |
| 2.2.6 Vertex pair contraction..... | 17 |
| 2.2.7 Simplification of topology | 18 |
| 2.2.8 View-dependent simplification..... | 19 |

| | |
|---|-----------|
| 2.3 Summary of simplification algorithm..... | 21 |
| Chapter 3 Method Based on Feature Preserving | 23 |
| 3.1 Shortage of the QEM method | 23 |
| 3.2 Classification of the edges and vertices | 24 |
| 3.3 Assigning edge weight for edge contraction | 26 |
| 3.4 Edge collapse rule based on classification of vertices..... | 29 |
| 3.5 Consideration of triangle shape..... | 31 |
| 3.6 Algorithm outline..... | 32 |
| Chapter 4 Implementation..... | 34 |
| 4.1 Programming language and environment..... | 34 |
| 4.2 Introduction of STL port..... | 34 |
| 4.3 Structure of *.ply file..... | 37 |
| 4.4 OpenGL overview | 39 |
| 4.5 Implementation details..... | 41 |
| 4.6 Experimental results | 56 |
| Chapter 5 Conclusion and Future work..... | 68 |
| Bibliography | 69 |