

Table of Contents

List of Tables	xiii
List of Figures	xv
List of Algorithms	xxiii
1 Introduction	1
1.1 Motivation	1
1.2 Objectives	3
1.2.1 General Objective	3
1.2.2 Specific Objectives	3
1.3 Methodology	3
1.4 Structure of this Work	4
2 Theoretical Framework	5
2.1 Polygon Meshes	5
2.1.1 Smoothing	7
2.1.2 Delaunay Triangulation	7
2.1.3 Simplification	9
2.2 GPU Architecture	9
2.2.1 Programming model	11
2.2.2 Heterogeneous Computing	13
2.3 Cleap Library	16
2.4 Mesh File Format	18
2.4.1 .OFF Format	18
2.4.2 .PLY Format	19
3 Literature Review	21
3.1 Simplification Techniques	21
3.1.1 Vertex-Clustering	21
3.1.2 Vertex-Decimation	22
3.1.3 Vertex-Contraction	23
3.1.4 Edge-Collapse	24
3.2 Simplification Metrics	25
3.2.1 Edge length/Angle	25
3.2.2 <i>Quadric</i> error metric	26
3.2.3 Volume Error	28

3.2.4	Energy Function	28
3.3	Algorithms Review	29
3.3.1	Shontz-Nistor	29
3.3.2	Garland-Heckbert	33
3.3.3	Papageorgiou-Platis	34
3.3.4	Melax	37
3.3.5	Franc-Skala	38
3.3.6	Lee-Kyung	39
3.3.7	Hoppe et. al.	41
3.3.8	Hjelmervik-Leon	42
3.3.9	Grund et al	45
3.3.10	Cellier et al	46
3.3.11	Vad'ura	47
4	Algorithm Proposal	49
4.1	Simplification Scheme	49
4.2	Data structures	50
4.3	Candidate Selection	52
4.4	Mutual Exclusion Mechanism	56
4.5	Integrity Test	58
4.5.1	Inversion Test	60
4.5.2	Border-Edge Test	62
4.5.3	Neighbors Test	63
4.6	Simplification Algorithm	66
4.6.1	Elimination Phase	67
4.6.2	Triangle Repair Phase	68
4.6.3	Edge Repair Phase	70
4.6.4	Connectivity Repair Phase	72
4.7	Algorithm Output	75
4.7.1	Vertices Rearrange	75
4.7.2	Save into a File	76
5	Results	79
5.1	Quantitative Results	80
5.2	Qualitative Results	96
5.3	Analysis	113
6	Conclusions	115
6.1	Conclusions	115
6.2	Future Work	117
	Bibliography	119
	Appendices	123
A	Parallel Lock-down Mechanism Example	125
A.1	Example 1: Two threads compete for a shared area	125
A.2	Example 2: Two threads that do not compete for a shared area	133

B Adjacency Table Example	137
C Edge-Collapse Algorithm Example	141
D Vertices Array Rearrange Example	149