

Evaluation of an Appearance-Preserving Mesh Simplification Scheme

Rasmus Hedin

Department of Electrical Engineering
Linköpings Universitet

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Outline

Introduction

Implementation

Quadric Error Metric

Improving Texture Atlas

Results

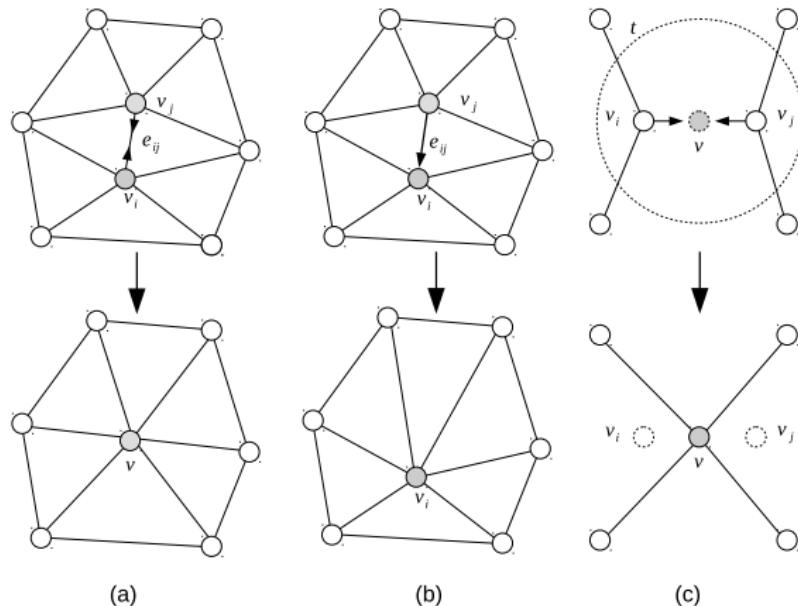
Problem

Only considering geometry during simplification give poor results for textured meshes



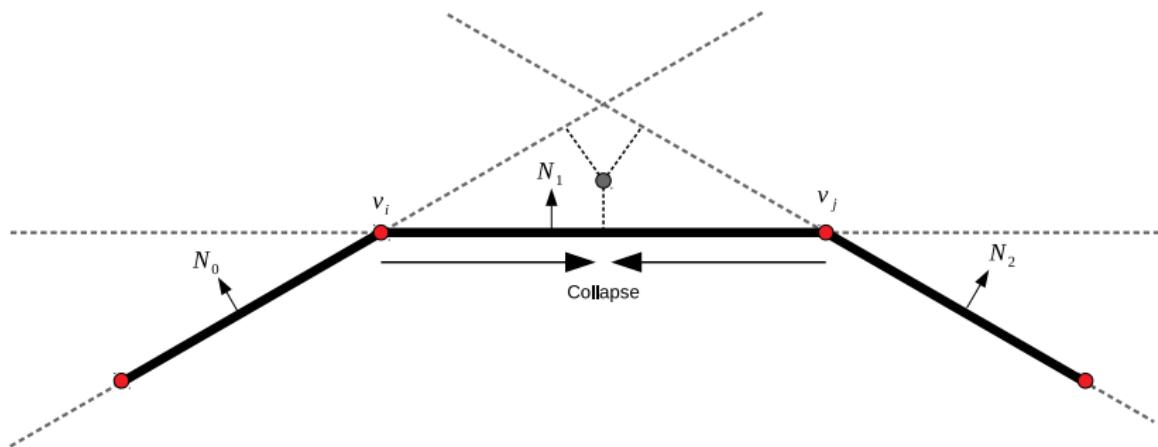
Vertex Merging

- ▶ Mesh can be simplified by merging vertices
 - ▶ (a) edge collapse, (b) vertex removal, and (c) pair contraction

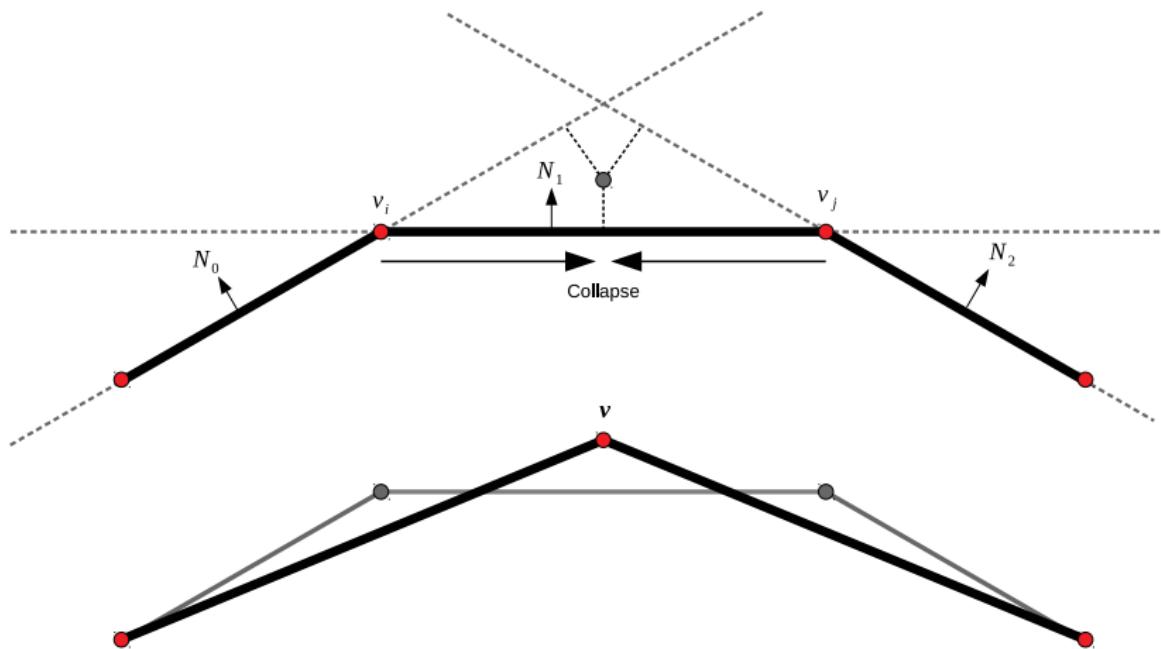


Quadric Error Metric

- ▶ Iteratively perform edge collapses $(\mathbf{v}_i, \mathbf{v}_j) \rightarrow \mathbf{v}$
- ▶ Cost based on distance to neighboring faces' planes



Quadric Error Metric



Overview of Algorithm

Initialization

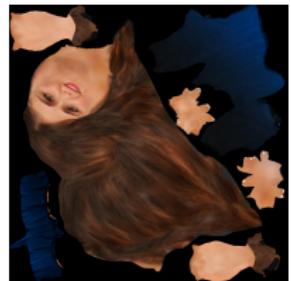
1. Compute matrix Q for each vertex
2. Compute optimal vertex position for each edge collapse
3. Compute *cost* of each edge collapse
4. Store edge collapses in min-heap with *cost* as key

Simplification

1. Collapse edge on top of min-heap
2. Recompute optimal positions and costs
3. Repeat

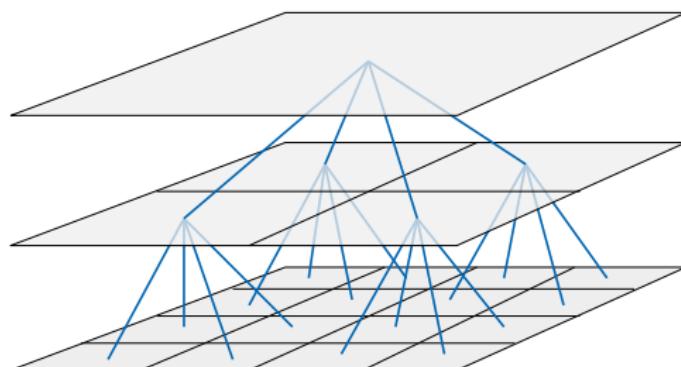
Problem with Texture Atlas

Bad texture values in seams



Improving Texture

- ▶ Use a pull-push algorithm to fill invalid pixels
- ▶ Creates a pyramid of images with decreasing resolution
- ▶ Each pixel is assigned weight w_i and color x_i



Find valid pixels (method 1)

- ▶ Create mesh with UV-coordinates as vertices
- ▶ Cast rays toward the mesh to find valid pixels



Find valid pixels (method 2)

- ▶ Could also be obtained with a threshold-filter
- ▶ Apply edge-filter to trim edges



Pyramid in Pull Phase



Pyramid in Push Phase



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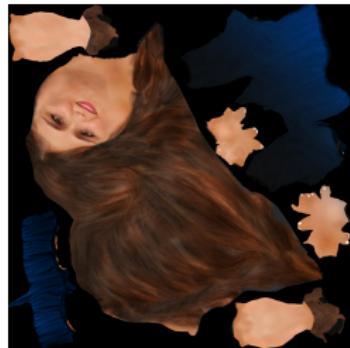
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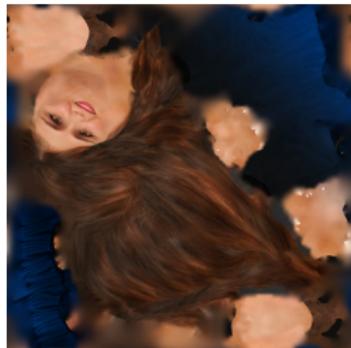
Improving Texture



Original



Bound

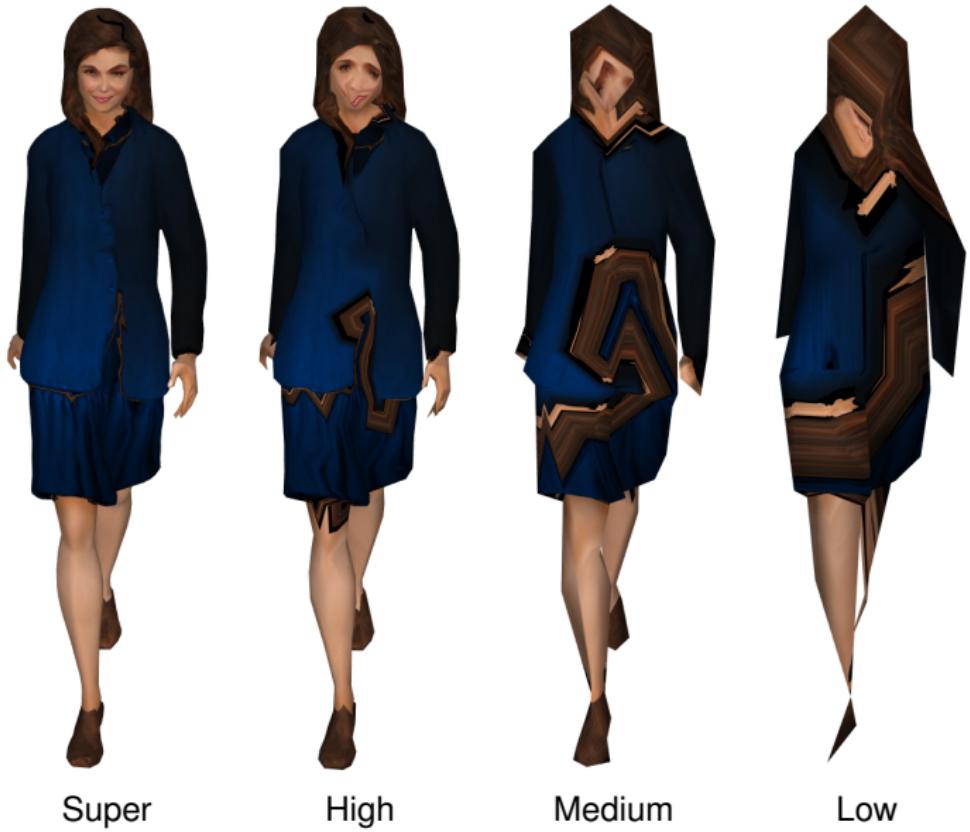


Improved

Improving Texture



LoD:s (only geometry)



Super

High

Medium

Low

LoD:s (geometry and texture)



Super

High

Medium

Low

LoD:s (geometry and texture)



Super

High

Medium

Low



Summary

- ▶ The appearance can be preserved by simplifying with extended QEM
- ▶ Using a pull-push method the texture can be improved
- ▶ Future work
 - ▶ Submeshes with different materials
 - ▶ Initial computations on GPU