Evaluation of an Appearance-Preserving Mesh Simplification Scheme

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Outline

Outline

Make Titles Informative. Use Uppercase Letters.

Subtitles are optional.

- Item 1
- Item 2

Outline

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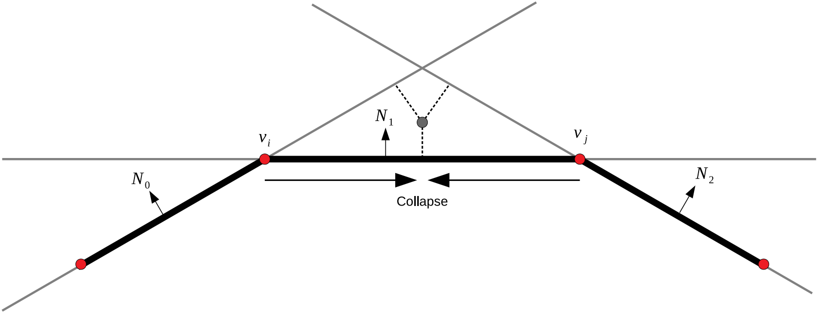
Make Titles Informative.

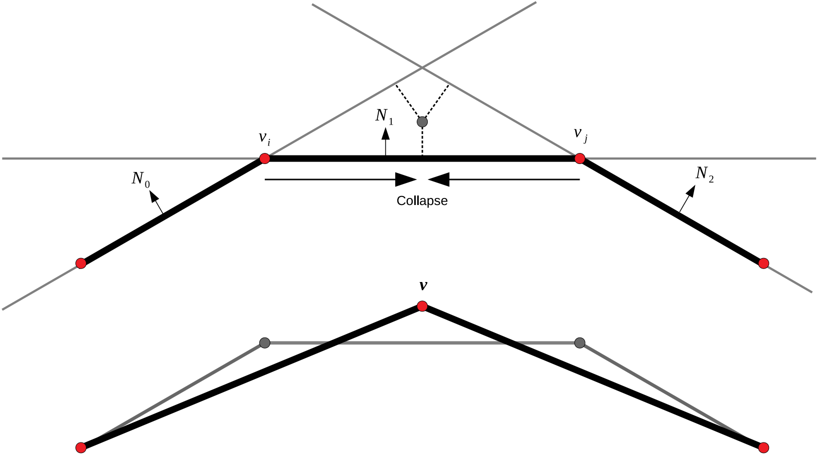
Make Titles Informative.

Quadric Error Metric

- Iteratively perform edge collapses
- Cost based on distance to neighboring faces' planes



Quadric Error Metric



Quadric Error Metric

Squared distance from point v to plane f

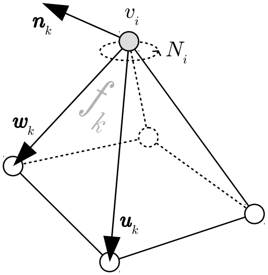
$$\mathbf{v} = [x, y, z, 1]^\mathsf{T}, \ \mathbf{f} = [a, b, c, d]^\mathsf{T}$$

$$\begin{aligned} D^2 &= (\mathbf{f}^\mathsf{T}\mathbf{v})^2 \\ &= \mathbf{v}^\mathsf{T}(\mathbf{f}\mathbf{f}^\mathsf{T})\mathbf{v} \\ &= \mathbf{v}^\mathsf{T}\mathbf{Q}\mathbf{v} \end{aligned}$$

$$Q_f = \begin{bmatrix} a^2 & ab & ac & ad \\ ab & b^2 & bc & bd \\ ac & bc & c^2 & cd \\ ad & bd & cd & d^2 \end{bmatrix}$$

Sum of distances to planes f_k of triangles in v_i's neighborhood

$$
\begin{aligned}
D^2 &= \sum_k \mathbf{v}_i^\mathsf{T} \mathbf{Q}_k \mathbf{v}_i \\
&= \mathbf{v}_i^\mathsf{T} \left(\sum_k \mathbf{Q}_k \right) \mathbf{v}_i \\
&= \mathbf{v}_i^\mathsf{T} \mathbf{Q}_i \mathbf{v}_i
\end{aligned}
$$



Finding optimal position for v_i

$$\begin{bmatrix} q_{11} & q_{12} & q_{13} & q_{14} \\ q_{21} & q_{22} & q_{23} & q_{24} \\ q_{31} & q_{32} & q_{33} & q_{34} \\ 0 & 0 & 0 & 1 \end{bmatrix} \bar{\mathbf{v}}_i = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

Quadric Error Metric

Initialization

1. Compute 4x4 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

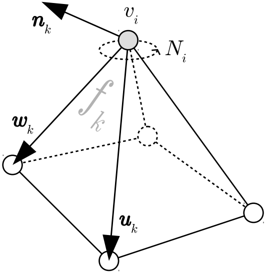
1. Collapse edge on top of min-heap
2. Recompute optimal positions and costs
3. Repeat

Quadric Error Metric

$$\mathbf{f}_k : \mathbf{n}_k^\mathsf{T}\mathbf{v}_i + d = 0 \qquad (1)$$

$$\mathbf{Q}_i = \sum_{f_k \in N_i} \mathbf{f_k}\mathbf{f_k}^\mathsf{T} \qquad (2)$$

$$\Delta(\mathbf{v}) = \mathbf{v}^\mathsf{T}\mathbf{Q}\mathbf{v} \qquad (3)$$



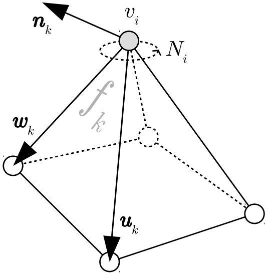
Quadric Error Metric

$$\begin{aligned} D^2 &= (\mathbf{n}^\mathsf{T}\mathbf{v} + d)^2 \\ &= \mathbf{v}^\mathsf{T}(\mathbf{n}\mathbf{n}^\mathsf{T})\mathbf{v} + 2d\mathbf{n}^\mathsf{T}\mathbf{v} + d^2 \end{aligned} \tag{4}$$

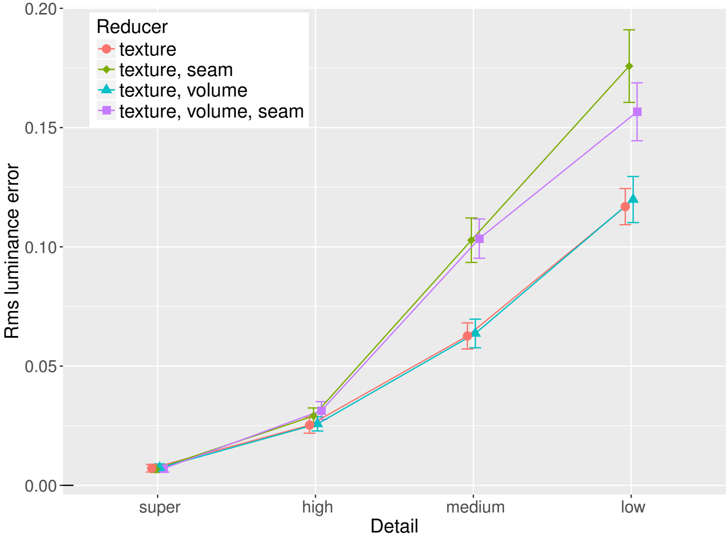
$$\begin{aligned} Q &= (\mathbf{n}\mathbf{n}^\mathsf{T}, d\mathbf{n}, d^2) \\ &= (\mathbf{A}, \mathbf{b}, c) \end{aligned} \tag{5}$$

$$\mathbf{A}\mathbf{v} + \mathbf{b} = 0 \tag{6}$$

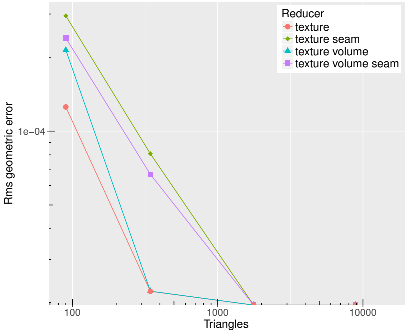
$$Q(\mathbf{v}) = \mathbf{v}^\mathsf{T}\mathbf{A}\mathbf{v} + 2\mathbf{b}^\mathsf{T}\mathbf{v} + c \tag{7}$$



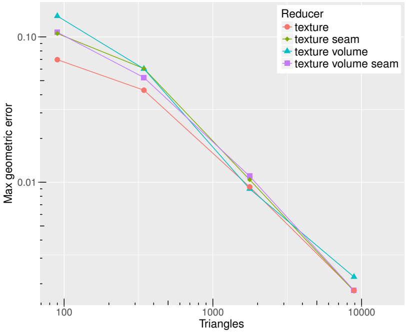
Rms Luminance Error



Geometric Error

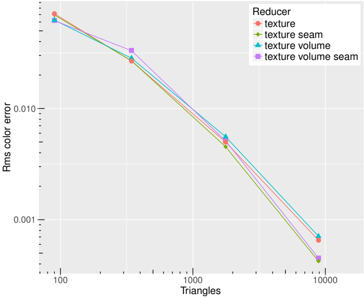


Rms geometric error

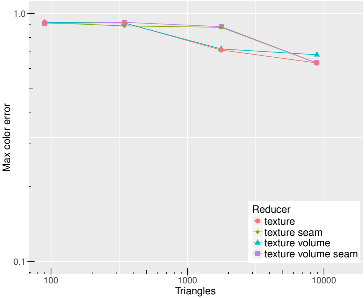


Max geometric error

Color error

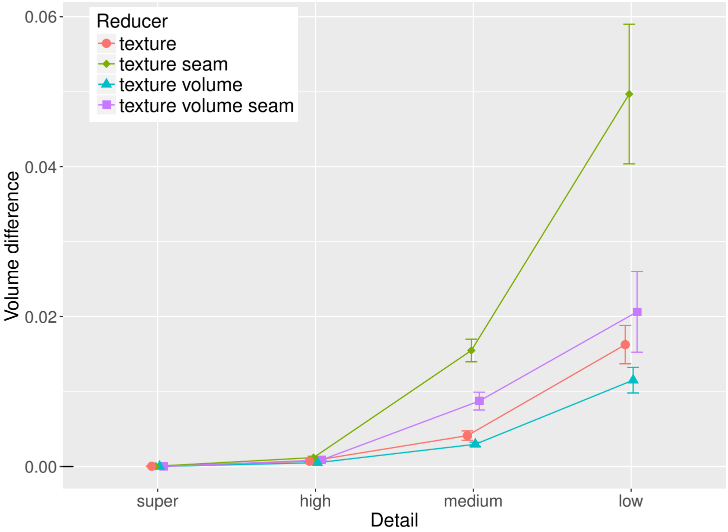


Rms color error



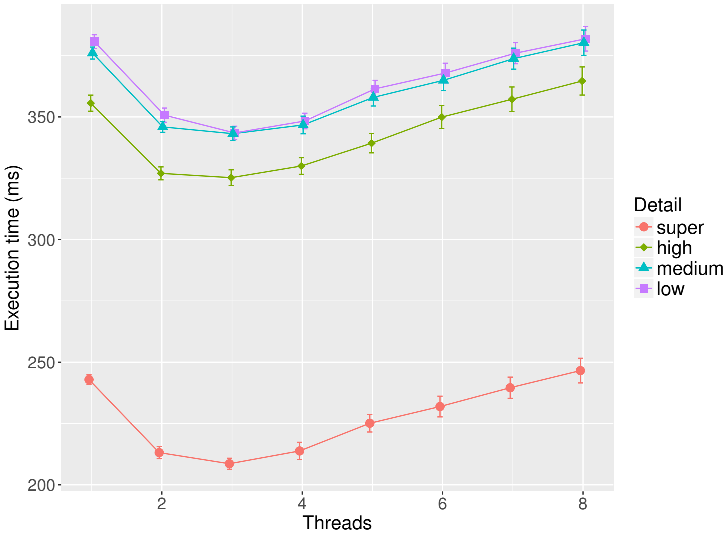
Max color error

Volume



Reducer
texture
texture seam
texture volume
texture volume seam
0.06
0.04
0.02
0.00
Volume difference
super
high
medium
low
Detail

Execution Time



Original

Bound

Improved

Super High Medium Low

Super High Medium Low

Summary

- The first main message of your talk in one or two lines.
- The second main message of your talk in one or two lines.
- Perhaps a third message, but not more than that.

- Outlook
  - Something you haven't solved.
  - Something else you haven't solved.