UNIVERSITY OF SAN FRANCISCO

CHANGE THE WORLD FROM HERE

Mesh Simplification

Final Presentation

Keerti Sekhar Sahoo and Xiao Mao

- **Introduction**
- **Approach**
- **Methodology**
- **Demo and Results**
- **Discussion**
- **Conclusion**

Goal of The Project

Goal is to approximate a complex, high-resolution polygonal mesh with simper geometry that resembles the original but with fewer primitives.

Approach

Decimation of Triangle Meshes

- **Reduce the total number of triangles in a triangle mesh**
- **Preserve the original topology and a good approximation of the original geometry**

Methodology

Basically for each vertex, three steps are involved:

- **Characterize the local vertex geometry and topology**
- **Evaluate the decimation criteria**
- **Triangulate the resulting hole.**

Discussion

- **The overall approach was challenging in terms of testing the intermediary steps to check the success.**

- **One better approach will be to incorporate an efficient data structure e.g half-edge data structure.**

What did we learn ?

- **We learnt some good approaches/algorithms and data structure implementations.**

What would we have differently if we were starting the project again?

- **Probably a more efficient data structure.**
- **And use an efficient third party library to triangulate the holes.**

Approach

Vertex Clustering

- **Grading**
- **Clustering**
- **Synthesis**
- **Retriangulation**
- **Recalculating normals**

Grading

A weight value is computed for each vertex according to its visual importance (e.g. number of the faces bounded by the vertex and the inverse of the maximum angle between all pairs of incident edges on the vertex).

Clustering

Create clustering-cell for vertices synthesis

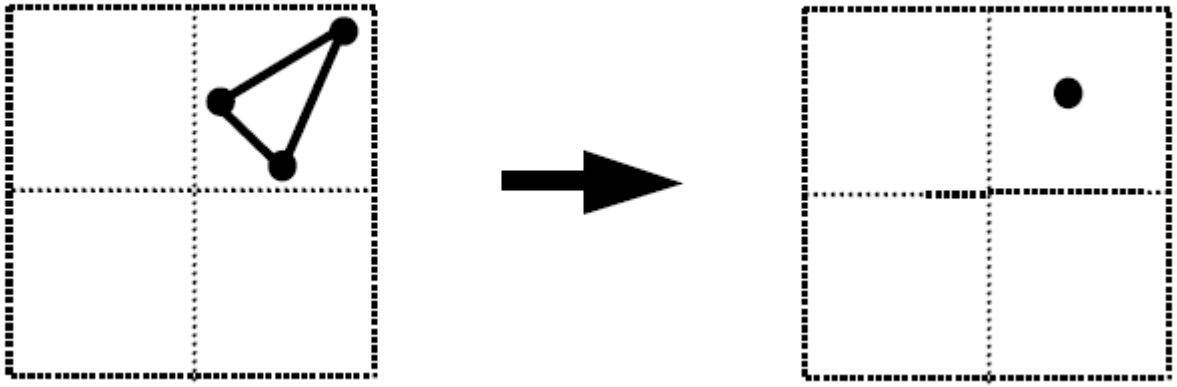
Keep a vertex representative per cell

Clusters $p \leftrightarrow \{p_0,\ldots,p_n\}$, $q \leftrightarrow \{q_0,\ldots,q_m\}$
Connect (p,q) if there was an edge (p_i,q_j)

Synthesis

The representative of $P_1, P_2, \ldots, P_k$ in the same cell is their weighted average:

$$\mathbf{P} = \frac{w_1\mathbf{P}_1 + w_2\mathbf{P}_2 + \ldots + w_k\mathbf{P}_k}{w_1 + w_2 + \ldots + w_k}$$



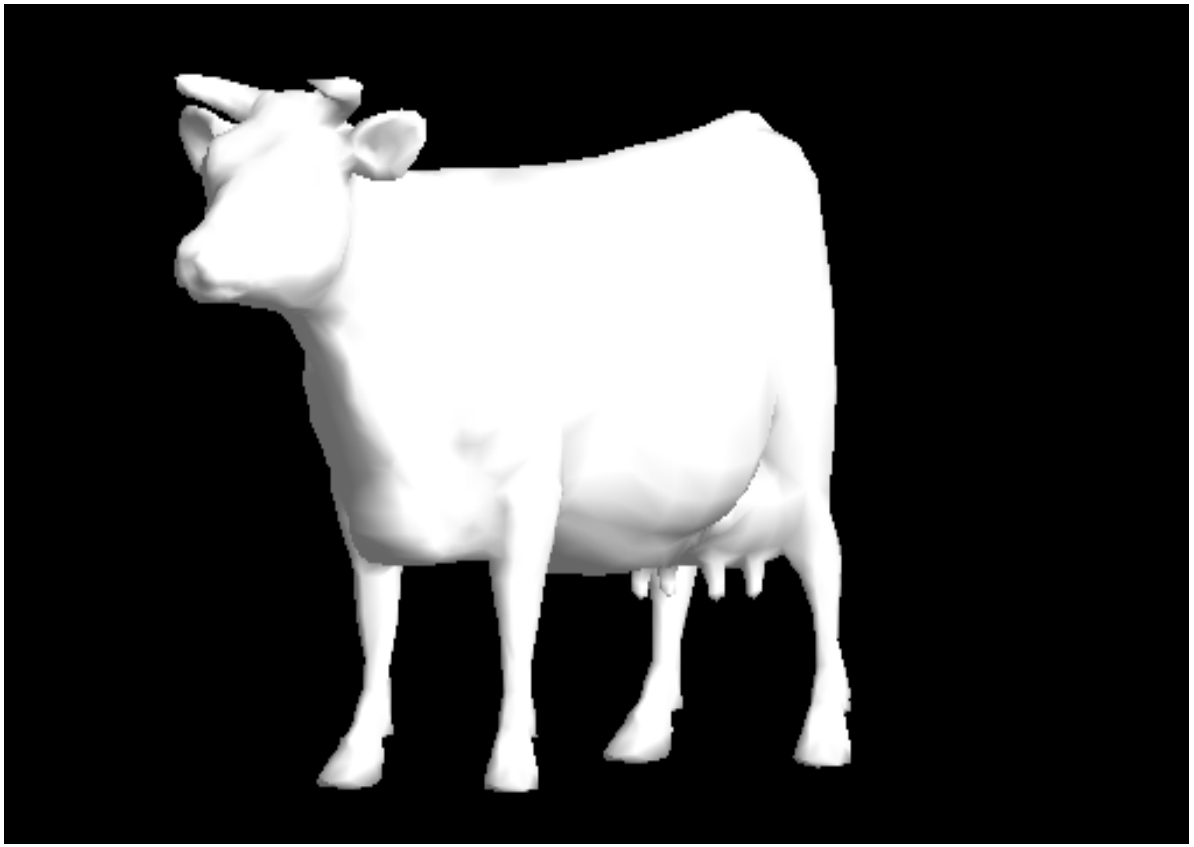
Retriangulation

Normals of resulting vertices and triangles are reconstructed.

Recalculation of Normals

Normals of resulting vertices and triangles are reconstructed.

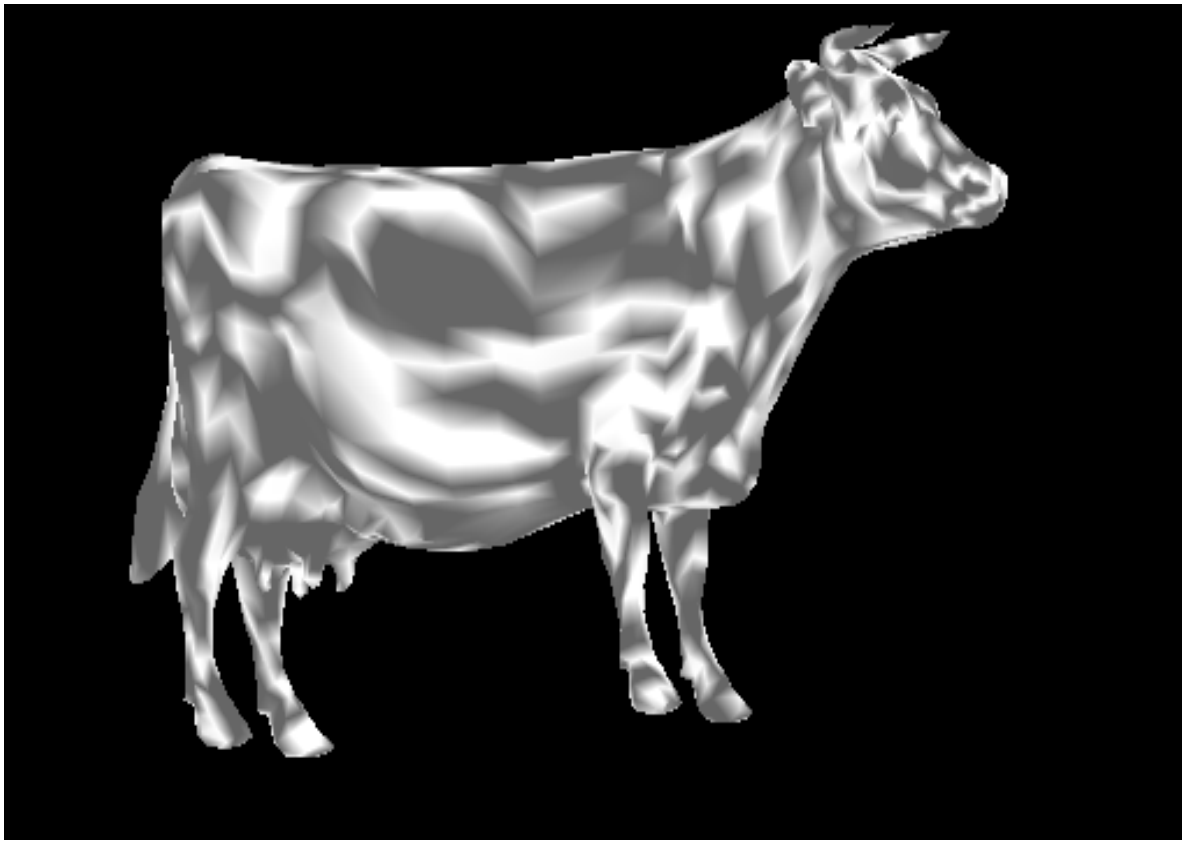
Previous Result



Original mesh

Faces: 5,804
Vertices: 2,903

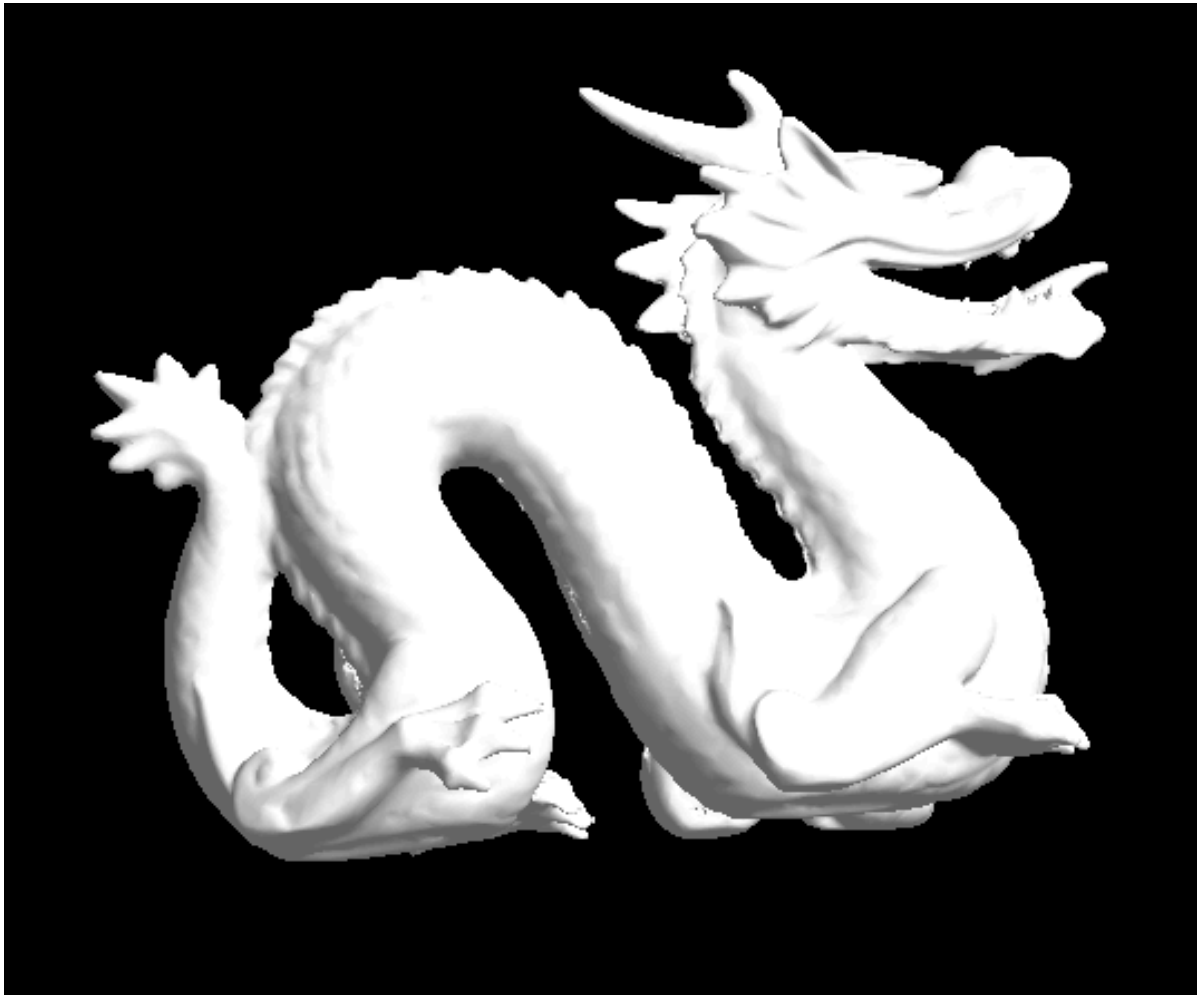
Previous Result



Simplified mesh

Faces: 3,359
Vertices: 1,660

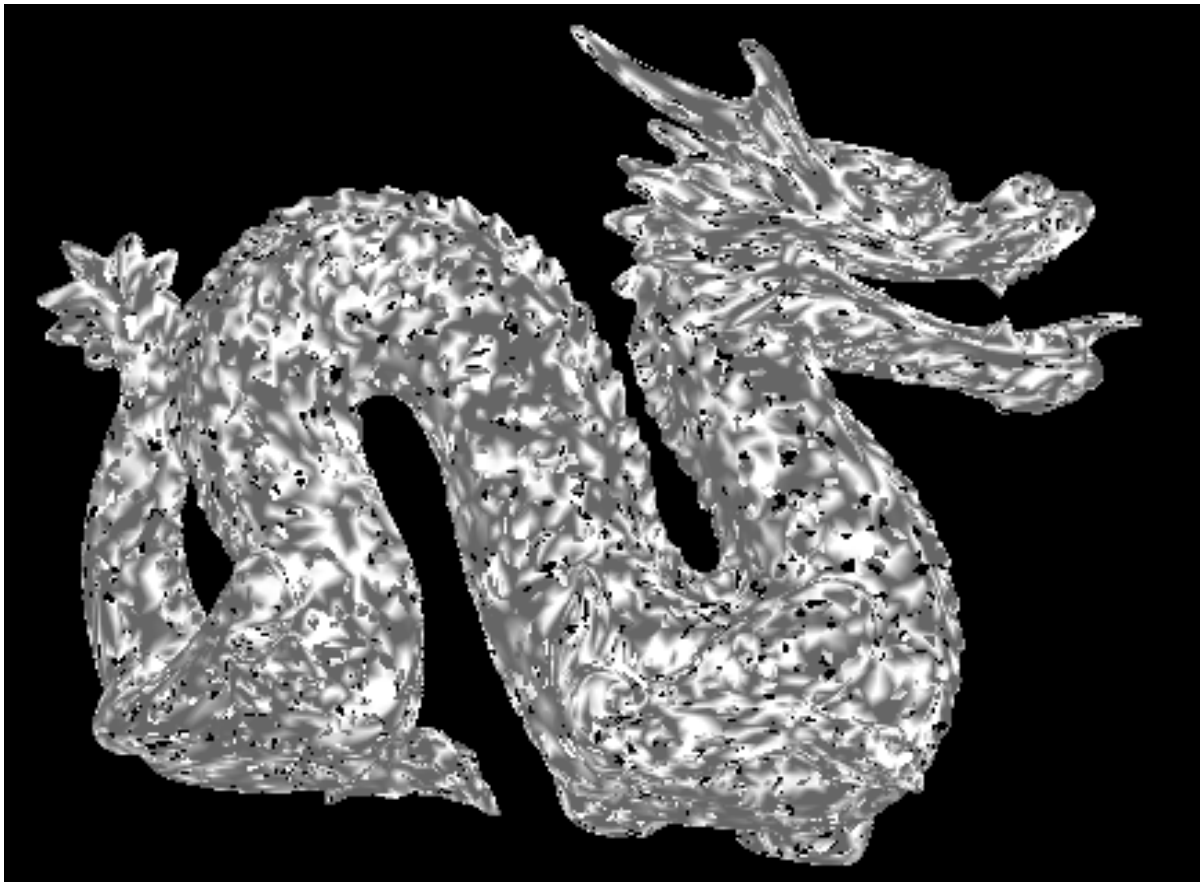
Previous Result



Original mesh

Faces: 100,000
Vertices: 50,000

Previous Result

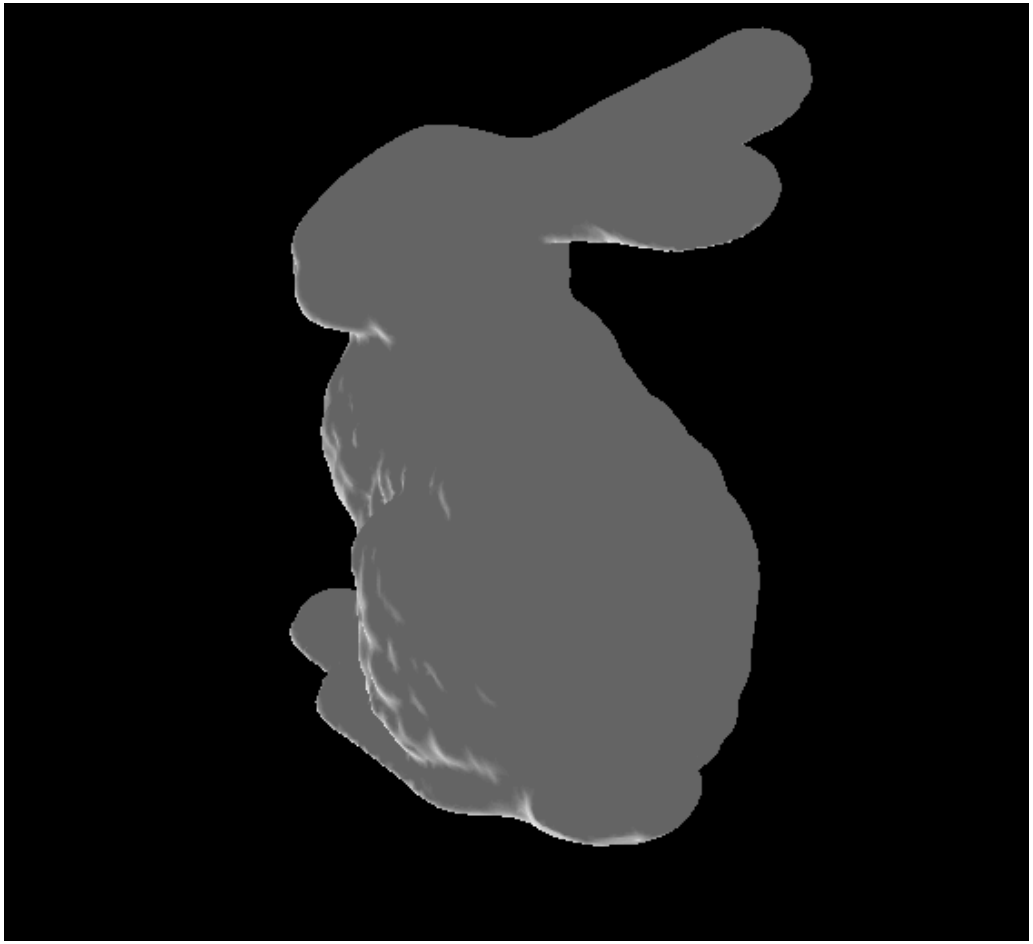


Simplified mesh

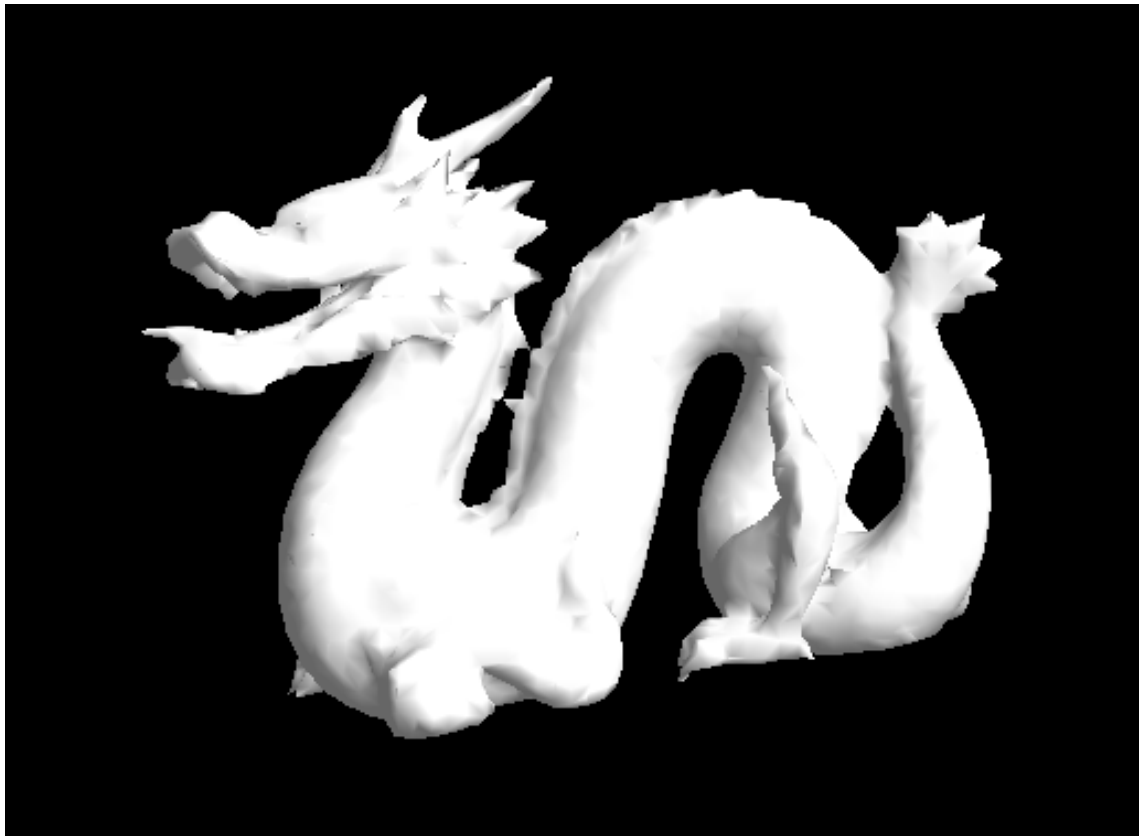
Faces: 52,987
Vertices: 31,232

MeshFix

MeshFix



Current Result



Simplified mesh

Faces: 10,957
Vertices: 5,304

Retriangulation

Using new generated vertex to replace old vertex index in old faces.

Old Faces:

1,3,4 2,5,6

Cell:

vertices: 1,2,3 index = 10

New Faces:

10,7,4 10,5,6

References

http://webdocs.cs.ualberta.ca/~anup/Courses/604_3DTV/Presentation_files/Polygon_Simplification/luebke01developers.pdf

https://www.comp.nus.edu.sg/~lowkl/publications/lowkl_i3d1997.pdf

http://www.cs.mtu.edu/~shene/COURSES/cs3621/SLIDES/Simplification.pdf

http://graphics.stanford.edu/courses/cs468-10-fall/LectureSlides/08_Simplification.pdf

References

http://www.cs.princeton.edu/courses/archive/fall08/cos526/lec/526-08-simplify.pdf

Mesh Simplification Viewer

http://www.jsomers.com/vipm_demo/meshsimp.html

MeshFix

https://code.google.com/p/meshfix/

Thank you!