

Lecture 23: Texture Mapping

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Computer Imaging & Graphics

The Roadmap

Theoretical Preliminaries

Human Visual Systems

Display and Camera

Modeling and Rendering



3D Modeling

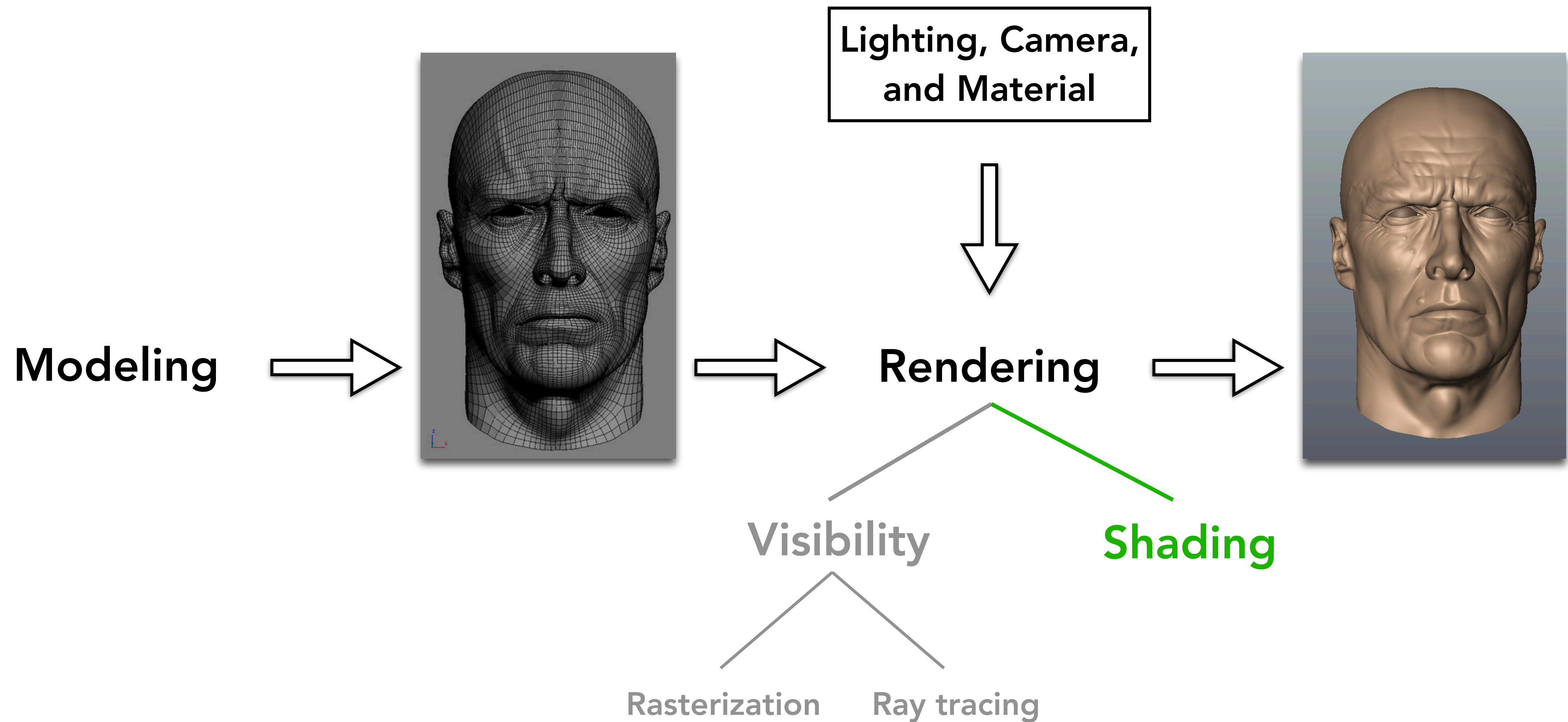
Rasterization and GPU

Ray Tracing

Shading

Rendering in AR/VR

Graphics







Chocolate Wrappers

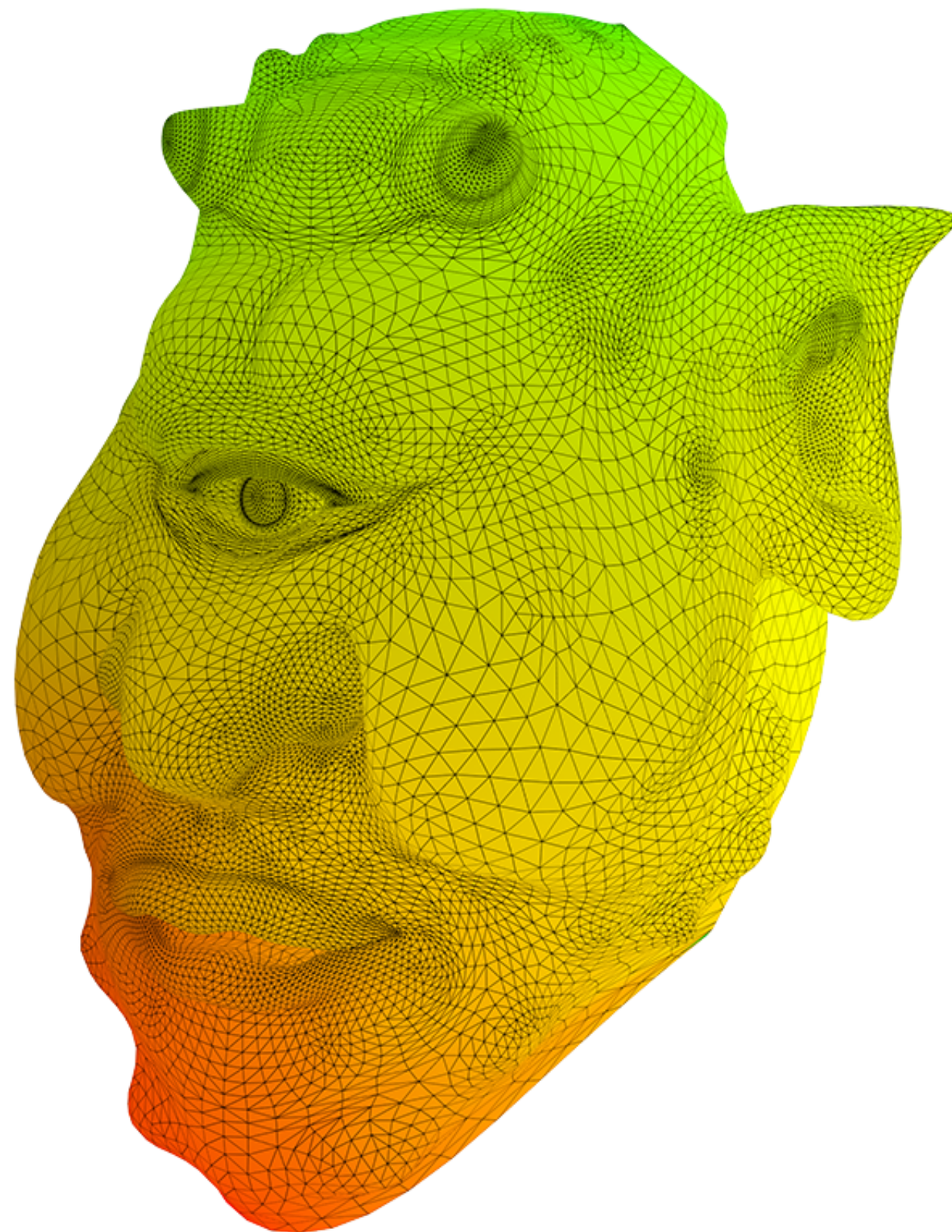


Texture image



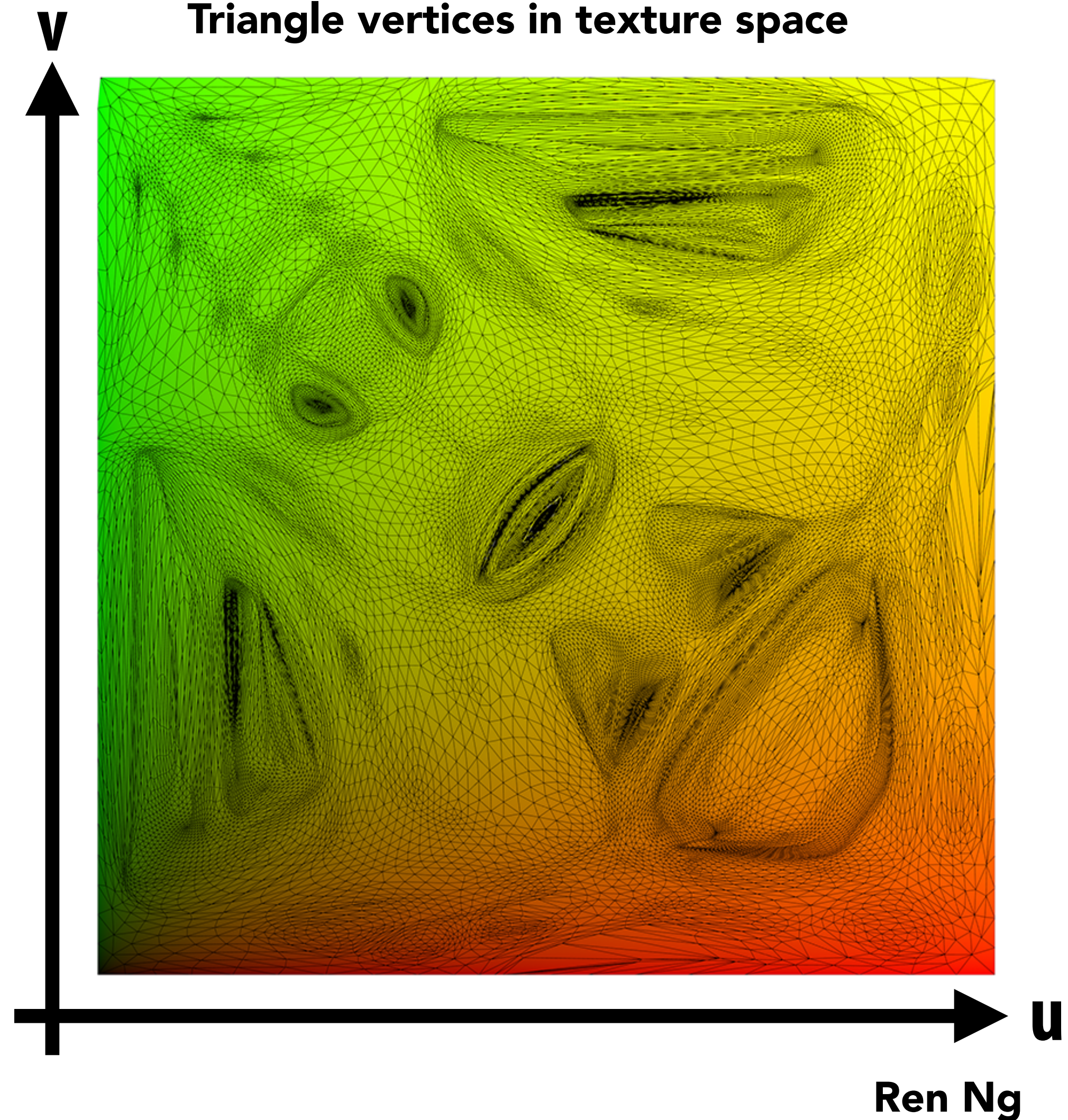
Rendering Using Texture

Visualization of texture coordinates



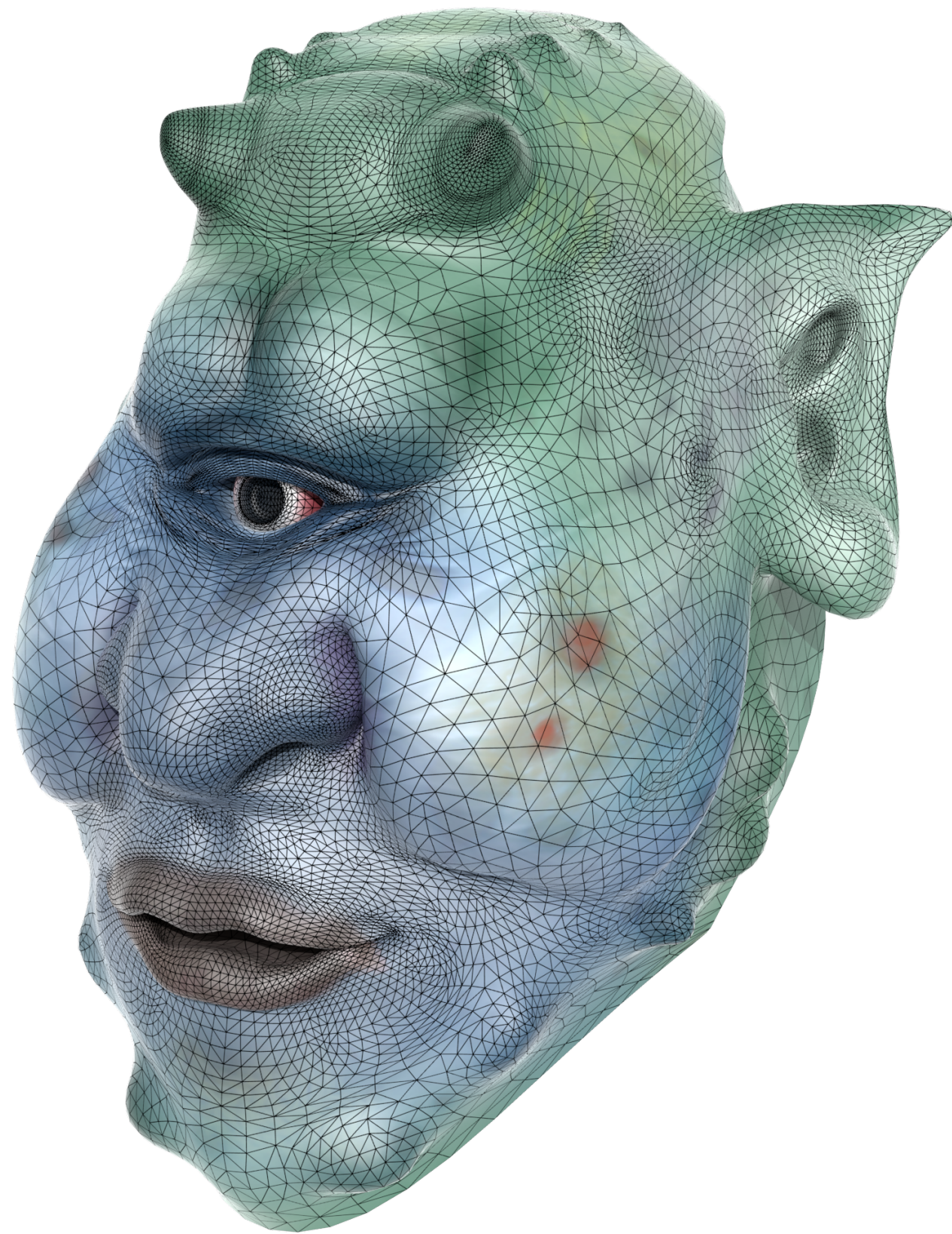
CS184/284A

Triangle vertices in texture space

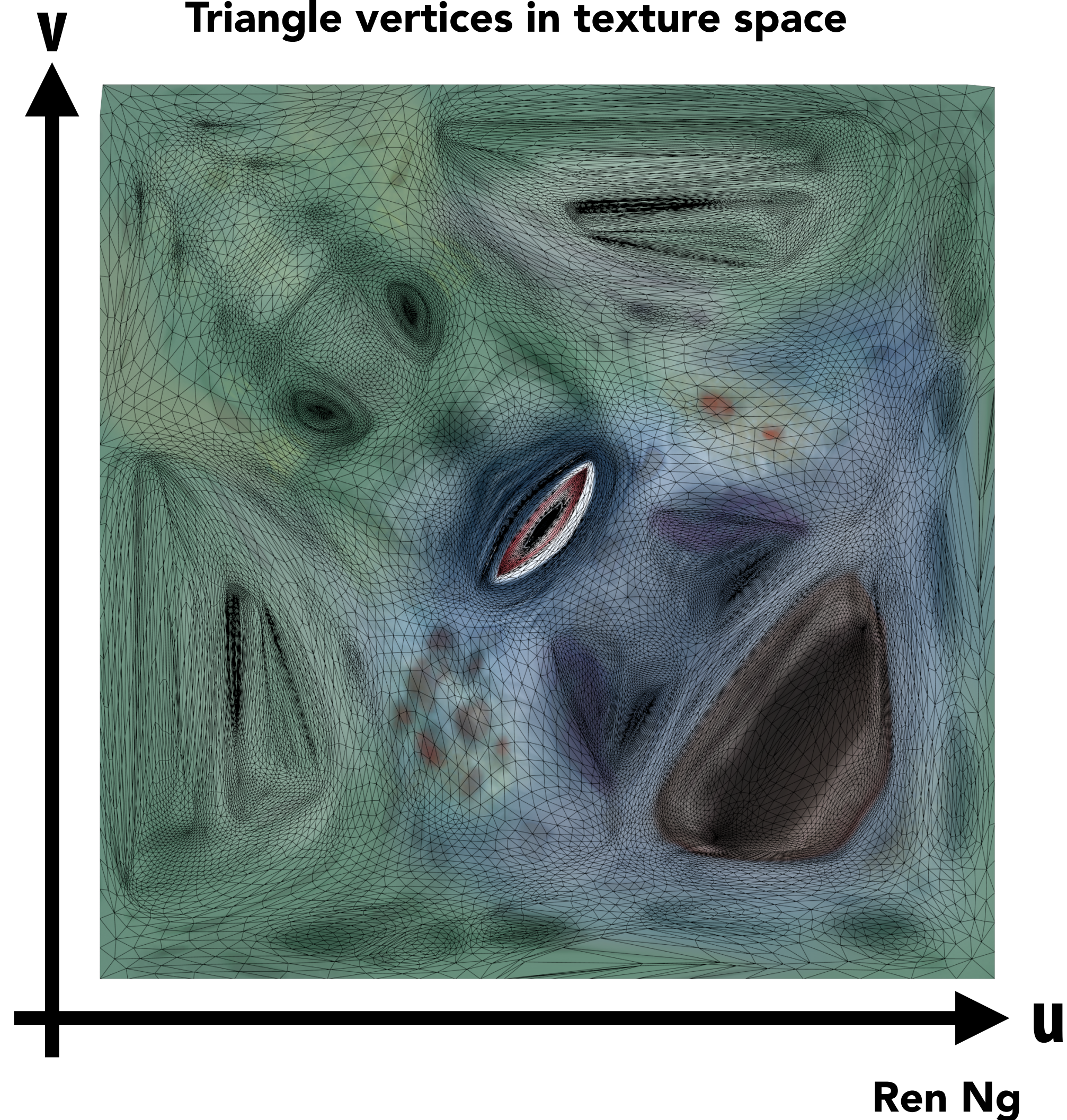


Rendering Using Texture

Rendered result



Triangle vertices in texture space

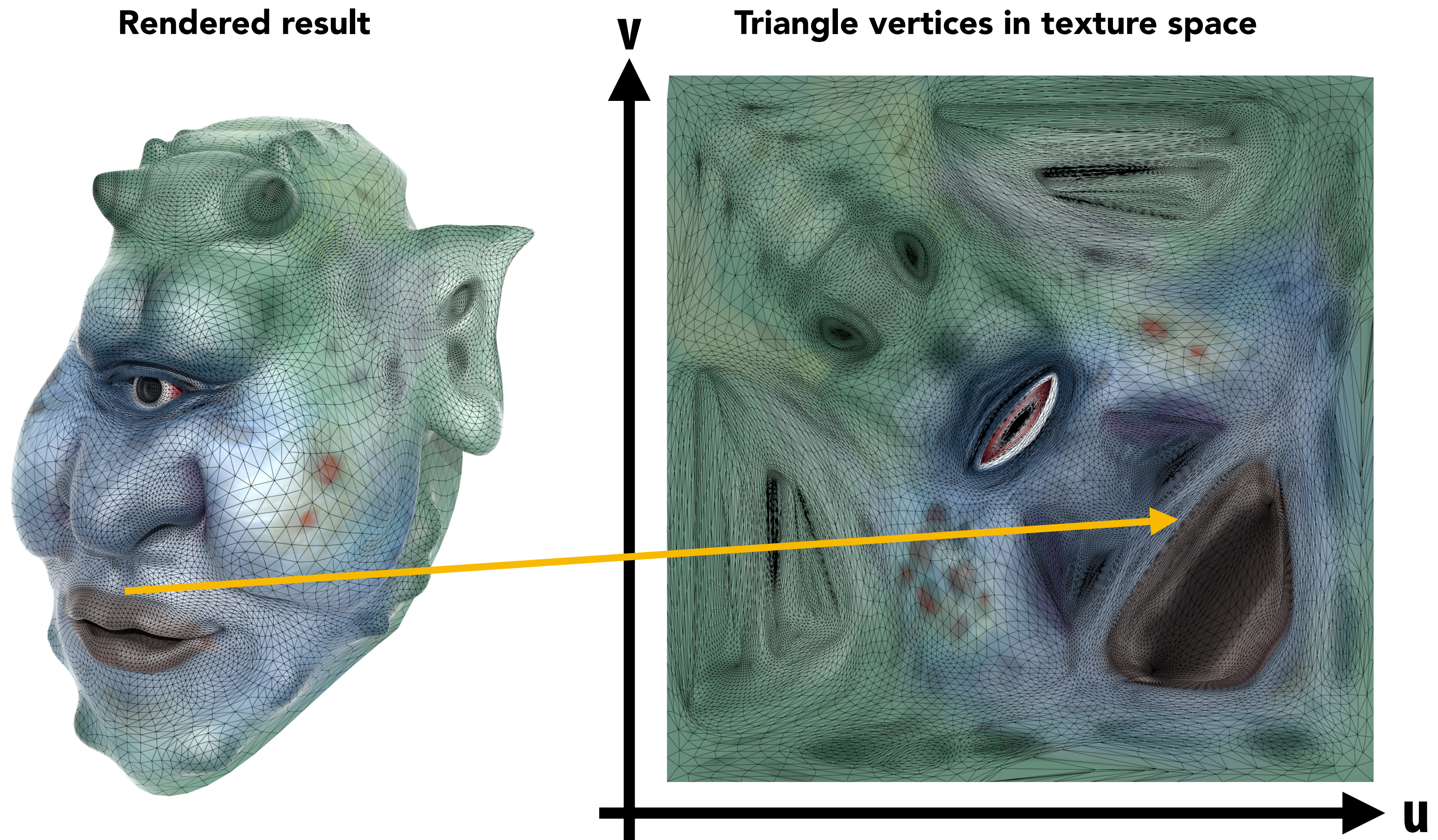


Main Idea (Ideal Scenario)

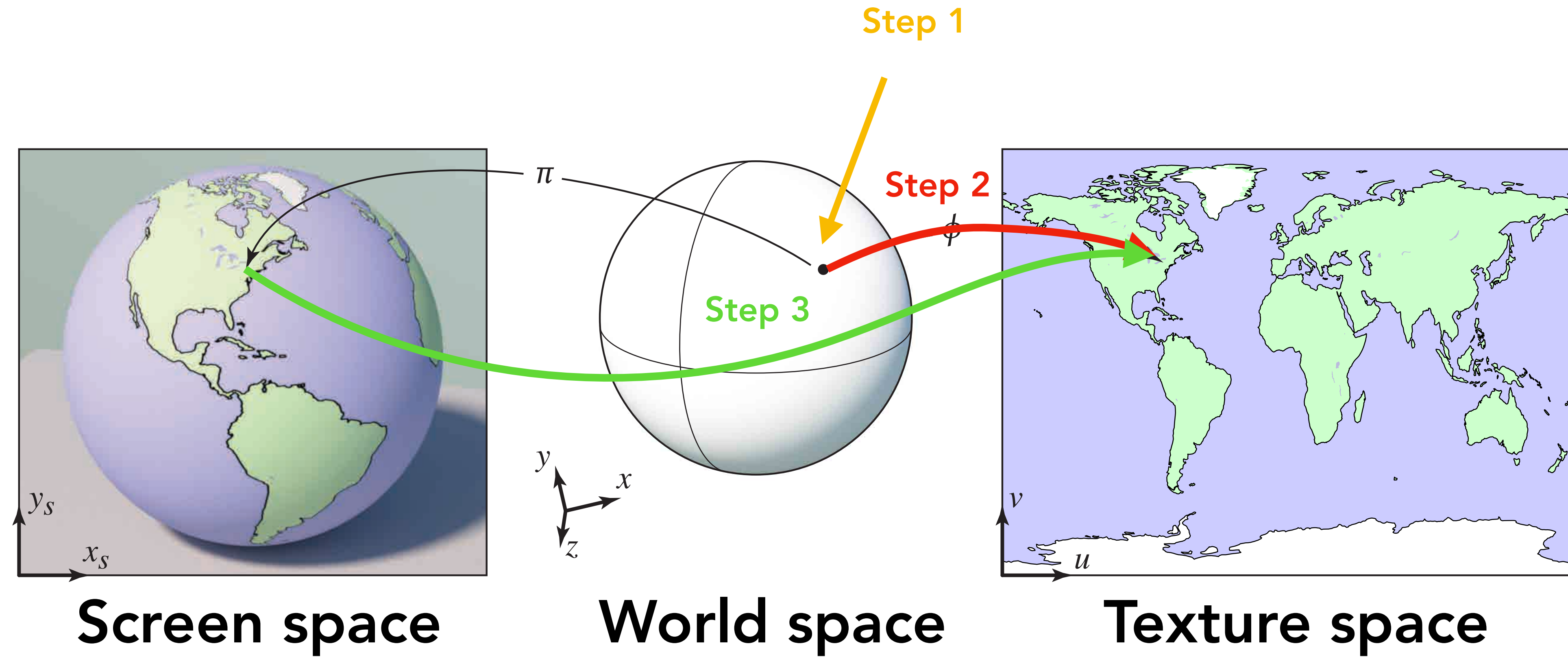
Step 1: pre-compute color information of each point of the scene/mesh.

Step 2: map the 3D scene to a 2D image (a.k.a., **texture map**); record the vertex to texel mapping (e.g., in mesh).

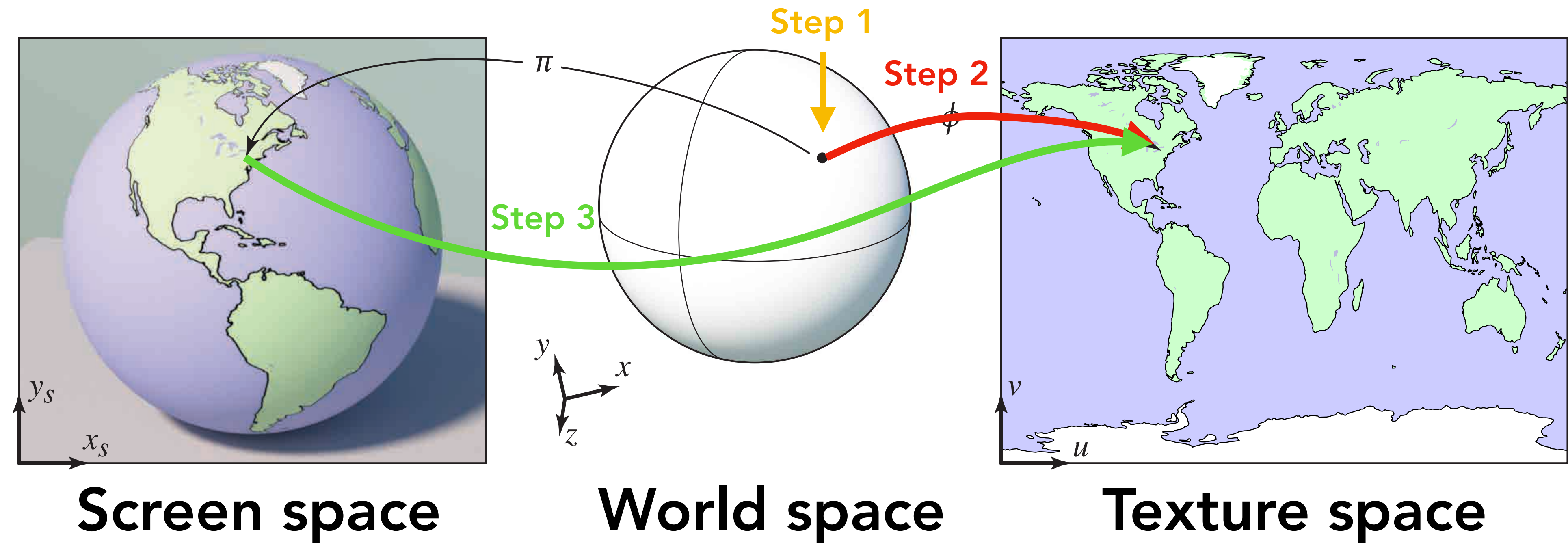
Step 3: during rendering, for each triangle, find the vertices, and then "find" the triangle in the texture map and "copy" it!



Main Idea

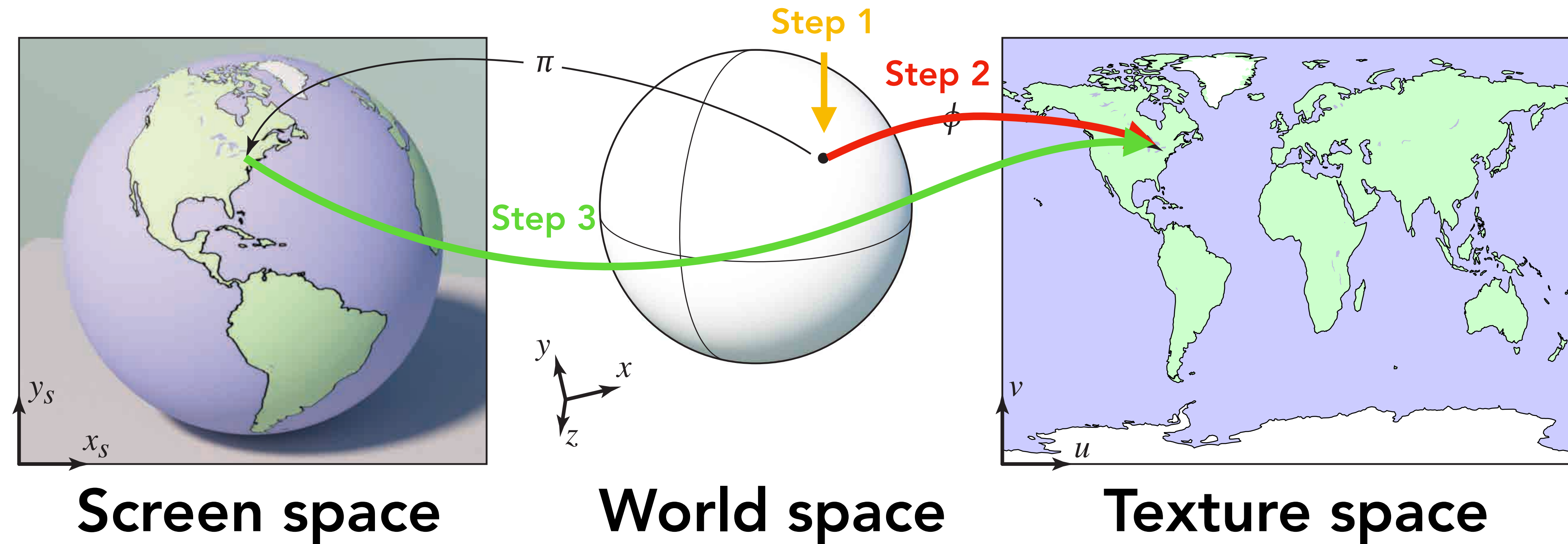


Texture Mapping is (Re-sampling)



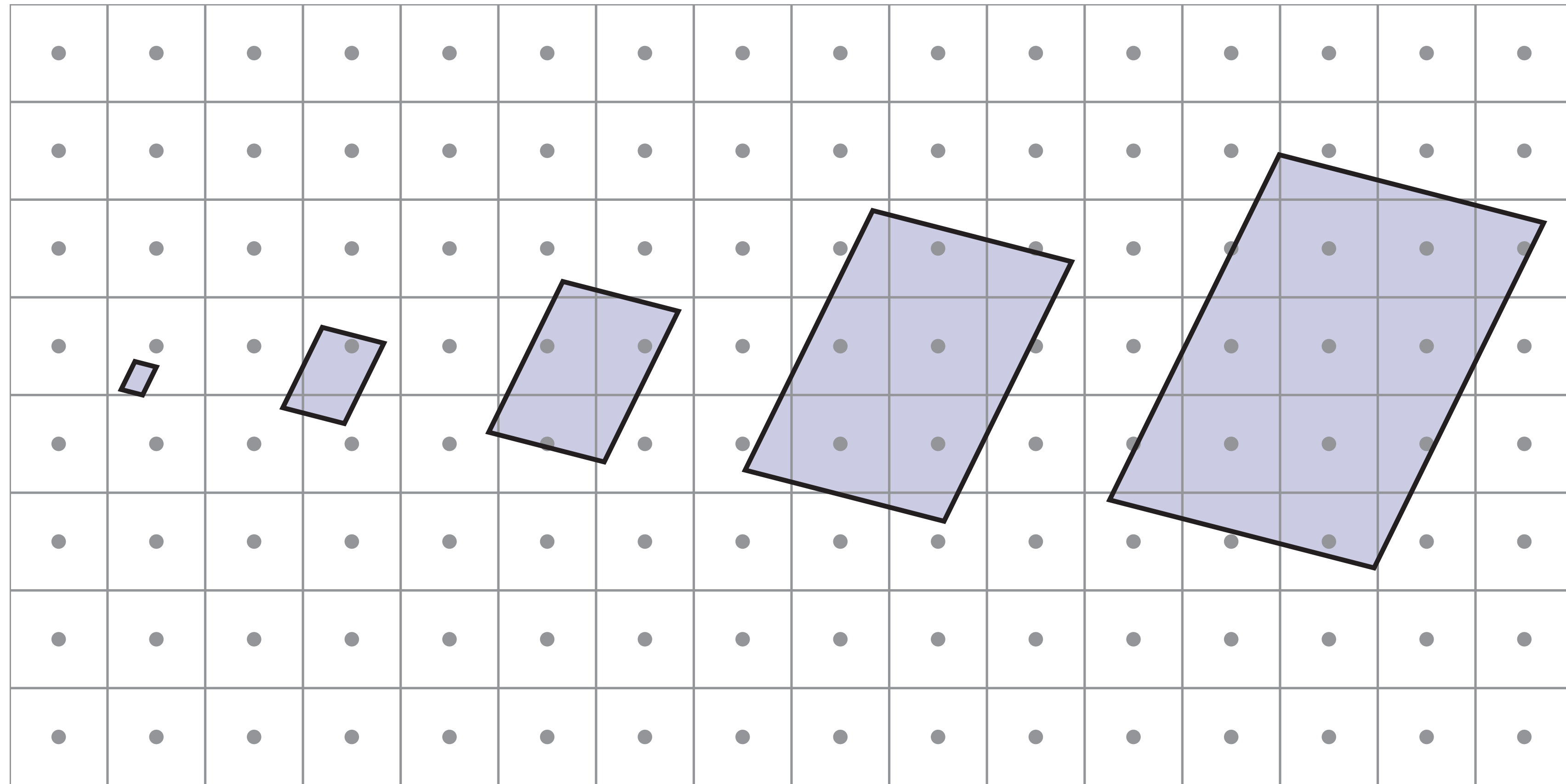
Step 1 necessarily has to sample the mesh, since we can't possibly calculate color (or any other information) for infinitely many points.

Texture Mapping is (Re-sampling)



Step 3 again has to sample, because a screen space point most likely won't be a point whose information is calculated in Step 1.

Screen Pixel Footprint in Texture

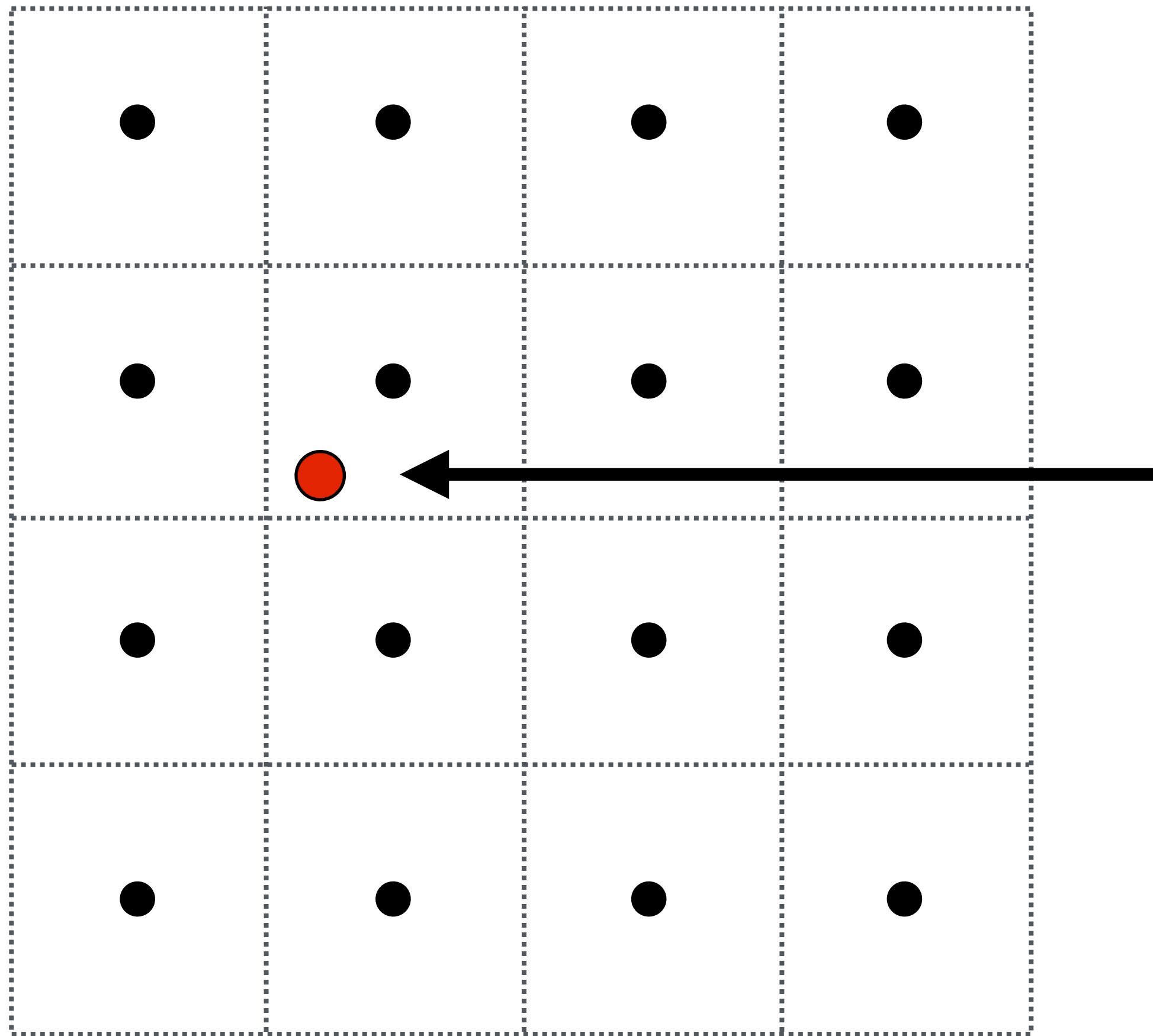


**Upsampling
(Magnification)**



**Downsampling
(Minification)**

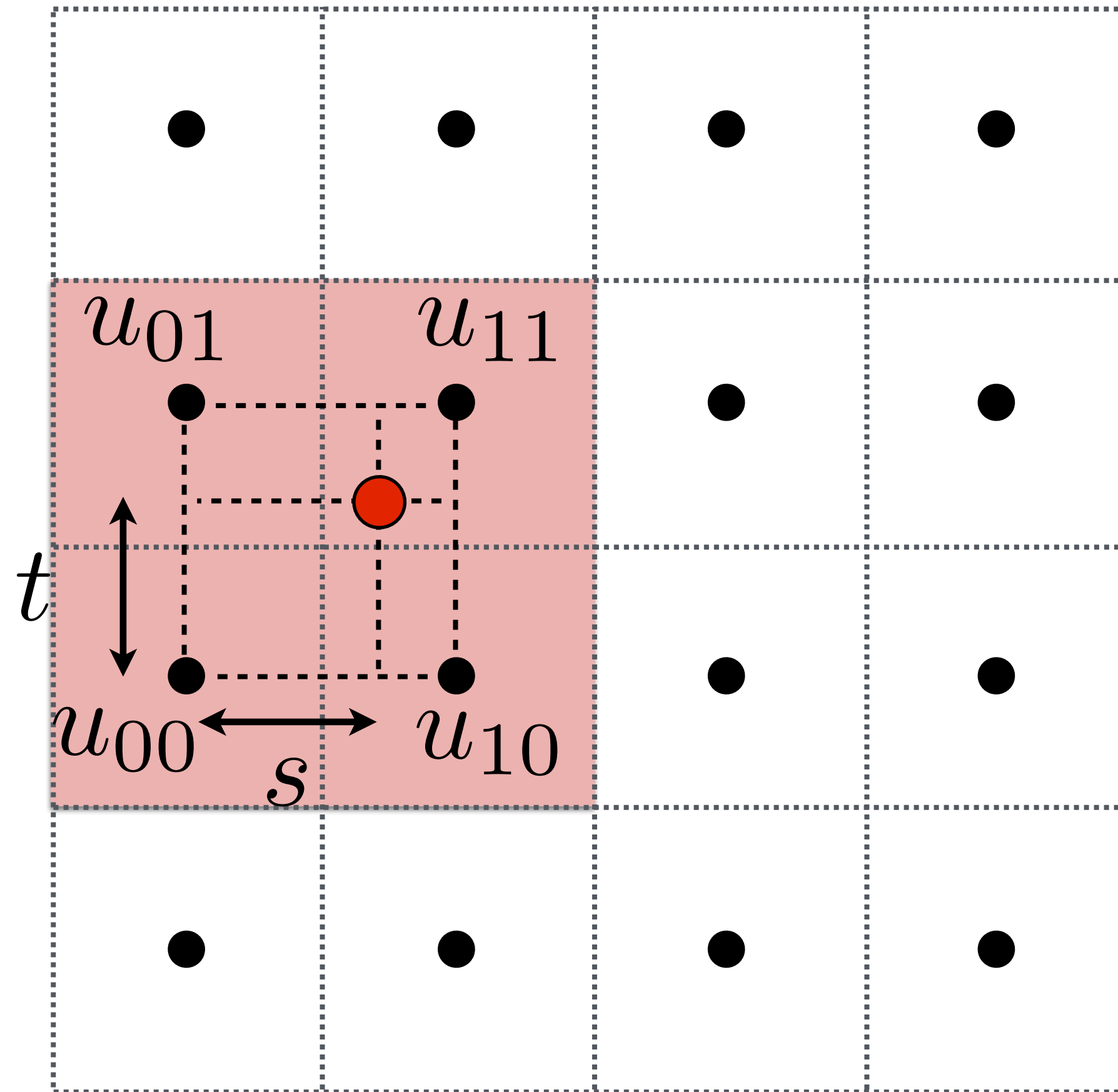
Bilinear Filtering



Want to sample
texture value $f(u,v)$ at
red point

Black points indicate
texture sample
locations

Bilinear Filtering

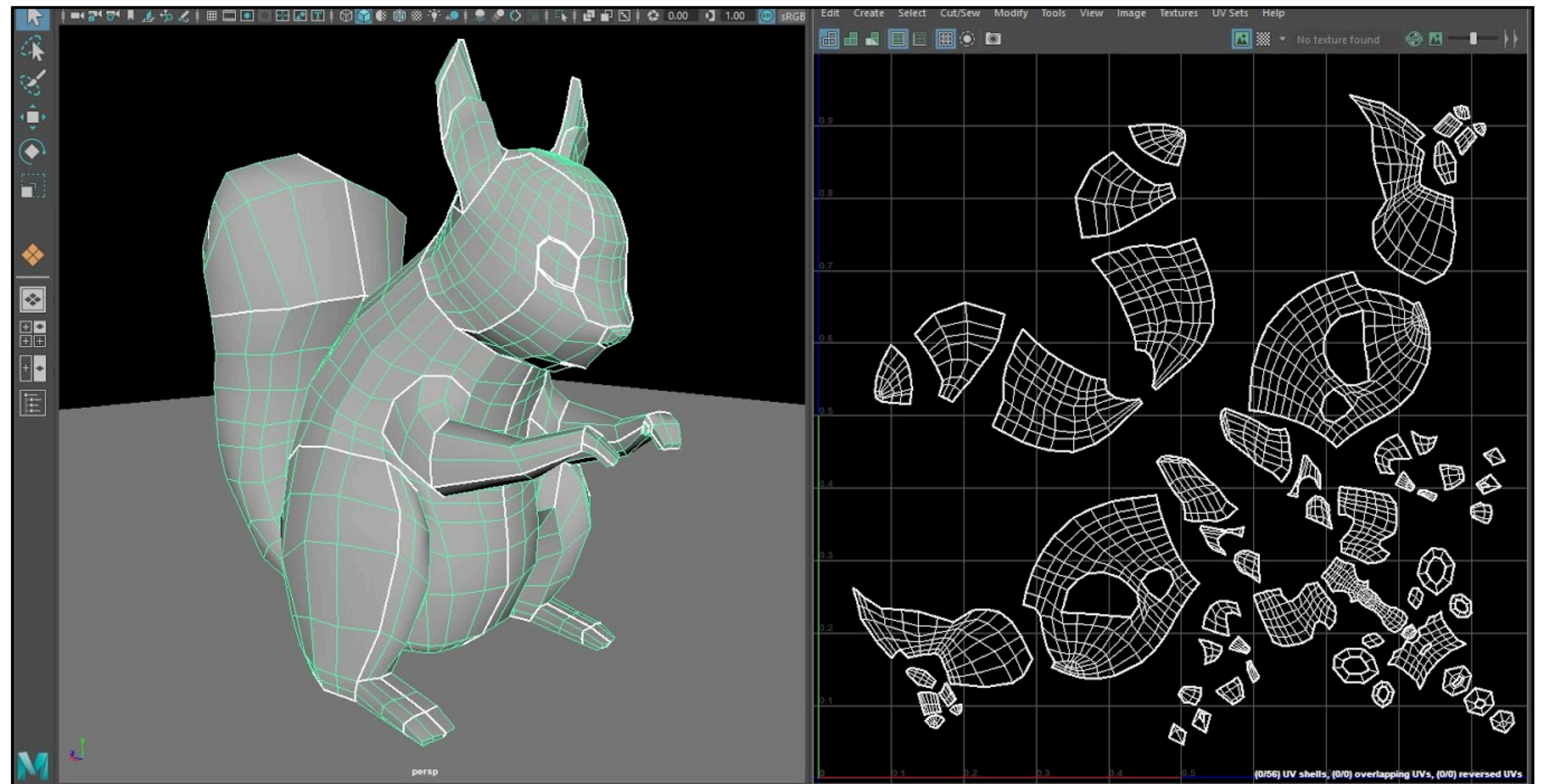


And fractional offsets, (s,t) as shown

UV Unwrapping

Some complicated meshes can't be unwrapped to one continuous area in the UV map; instead, many "UV islands" are created.

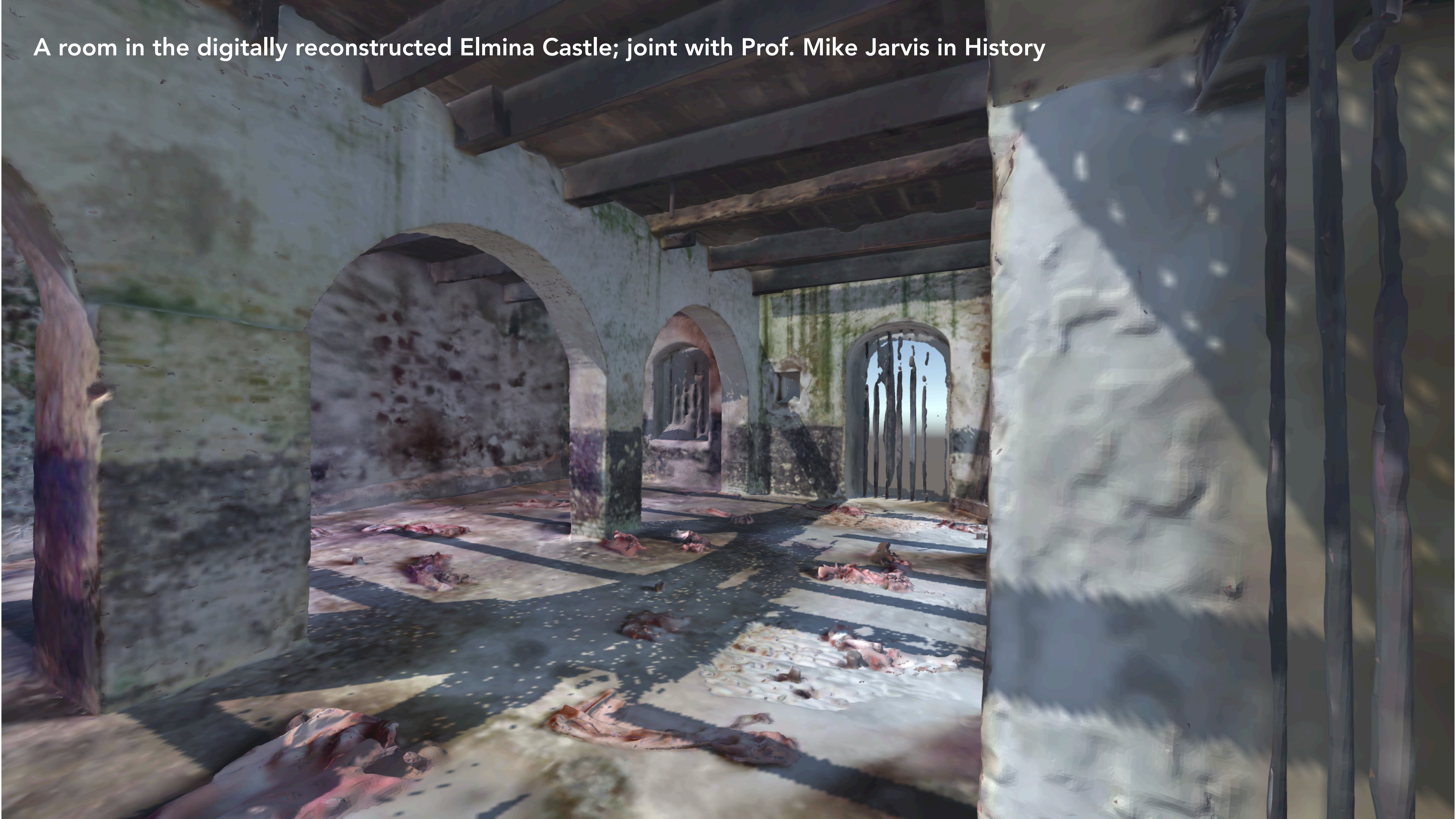
A trade-off between minimizing the total texture map area (compactness) vs. minimizing distortion within each face.



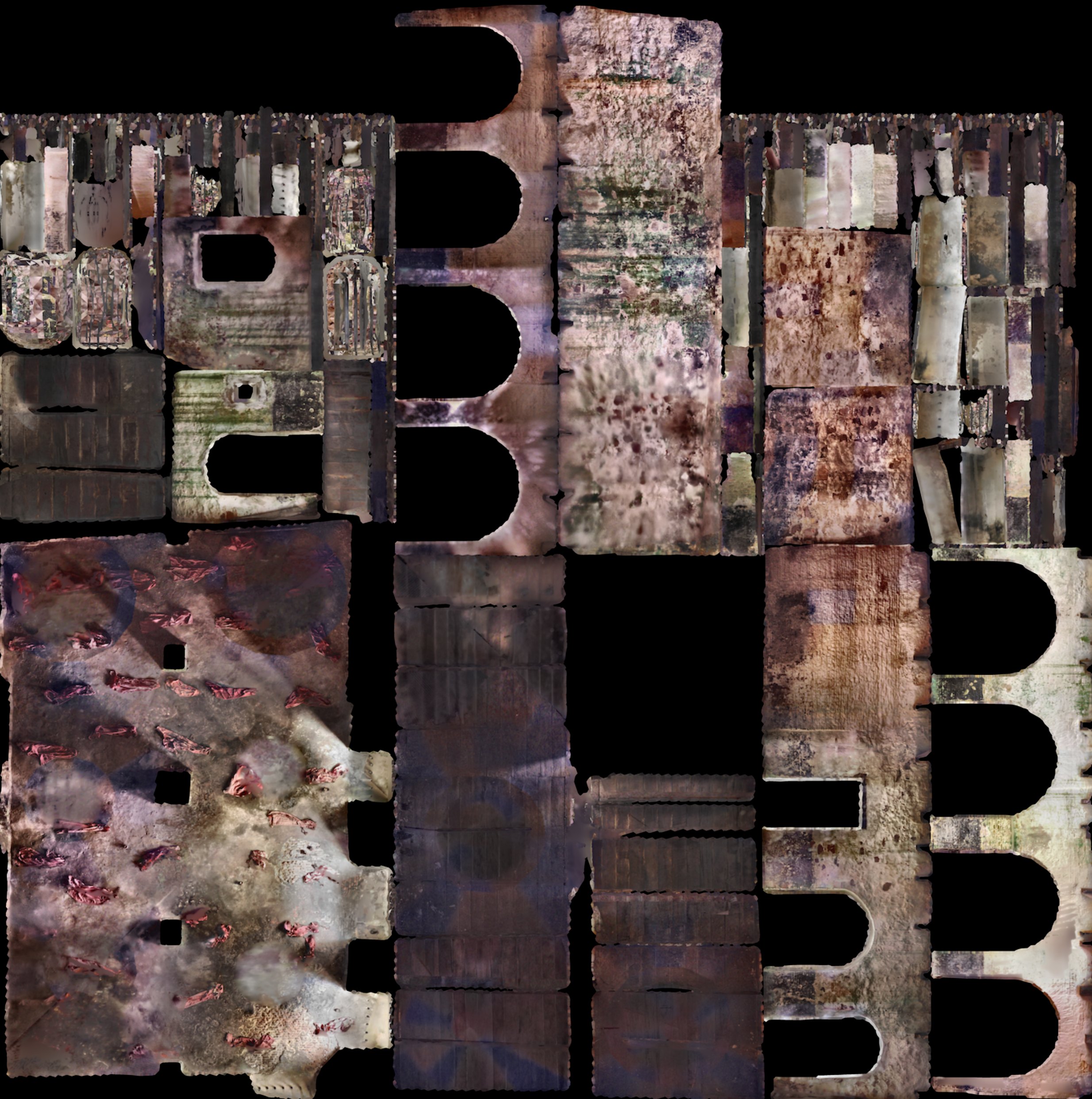




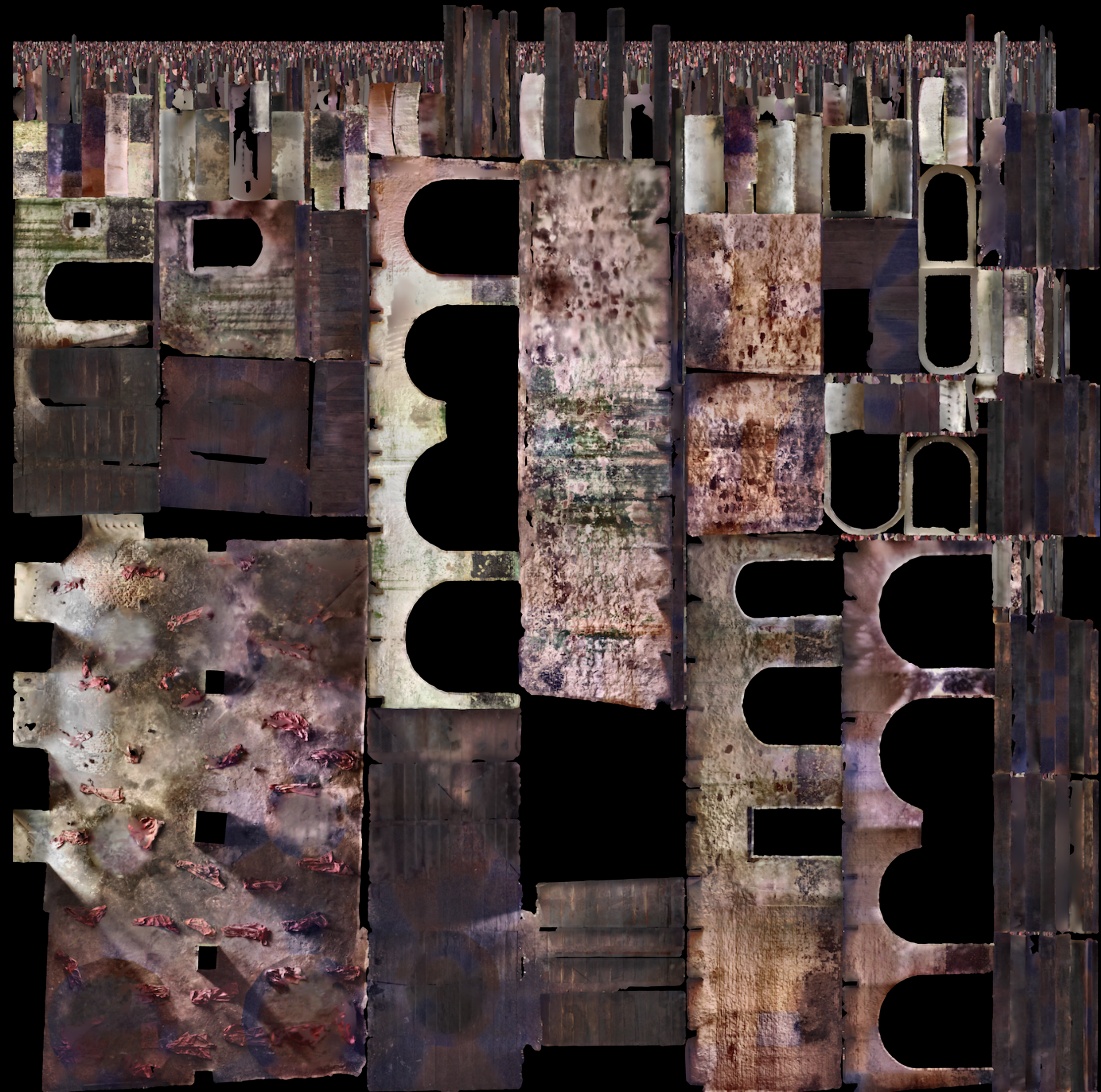
A room in the digitally reconstructed Elmina Castle; joint with Prof. Mike Jarvis in History



UV Wrapping by Meshlab



UV Wrapping by Blender



Another room in Elmina Castle

