

Real-Time Texture Remapping in Progressive Meshes

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Stakeholder: Configura AB in Linköping (problem has been adapted from the original request).

Problem Description

Rendering of large polygonal meshes in real-time consumes valuable computation time that could otherwise be used for other problems. If the amount of polygons can be reduced without affecting the visual quality of the final render significantly, then we can save computation time and memory. Algorithms that reduce the polygon count of a mesh based on some metric are called *mesh simplification algorithms*. An issue that has been found in industry and research is that the quality of the texture coordinates used for *texture mapping* are degraded when this simplification algorithm is applied. There are two primary problems that need to be solved to keep the quality of the texture mapping: we want to *minimize texture stretch* and also *minimize texture deviation*. The alternative problem is thus called *progressive meshing*, which means we optimize the mesh simplification based on the property of the texture/bump/normal/gloss maps.

Proposed Approach

We first plan to research the field for state-of-the-art methods for doing progressive remeshing, and integrate that algorithm, or an improved derivative of it, into Configura's graphics pipeline. After this, we plan to measure the relative time speedup gained and memory reduced by doing mesh simplification. Finally, we compare the visual improvements of textures when using this technique against an ordinary mesh simplification algorithm (according to some suitable metric)

Literature Base

- Sander, Pedro V., et al. "Texture mapping progressive meshes." *Proceedings of the 28th annual conference on Computer graphics and interactive techniques*. ACM, 2001.
- Hoppe, Hugues. "Progressive meshes." *Proceedings of the 23rd annual conference on Computer graphics and interactive techniques*. ACM, 1996.
- Garland, Michael, and Paul S. Heckbert. "Surface simplification using quadric error metrics." *Proceedings of the 24th annual conference on Computer graphics and interactive techniques*. ACM Press/Addison-Wesley Publishing Co., 1997.
- Luebke, David P. *Level of detail for 3D graphics*. Morgan Kaufmann, 2003.

Relevant Courses

- **TNM061 3-D Computer Graphics:** gave an overview of the *computer graphics* field.
- **TNM079 Modeling and Animation Theory:** introduced *mesh simplification* and other mesh data structures like the *half-edge data structure* for traversing any triangle mesh.
- **TAIU05 Linear Algebra:** since the area of computer graphics uses vectors/matrices.
- **TAOP07 Optimization, Introduction Course:** our problem can be described as such.
- **TDDD20 Construction and Analysis of Algorithms:** to evaluate our given solution.