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A Temporal Image-Based Approach to Motion Reconstruction for Globally Illuminated Animated Environments

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Postprint version. Presented at the *7th Annual Eurographics Workshop on Rendering*, Porto Portugal, June 1996, 11 pages.

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Abstract

This paper presents an approach to motion sampling and reconstruction for globally illuminated animated environments (under fixed viewing conditions) based on sparse spatio-temporal scene sampling, a resolution-independent temporal file format, and a Delaunay triangulation pixel reconstruction method. The argument is made that motion that is usually achieved by rendering complete images of a scene at a high frame rate (i.e. flipbook style frame-based animation) can be adequately reconstructed using many less samples (often on the order of that required to generate a single, complete, high quality frame) from the sparse image data stored in bounded slices of our temporal file. The scene is rendered using a ray tracing algorithm modified to randomly sample over space - the image plane (x, y), and time (t), yielding (x, y, t) samples that are stored in our spatio-temporal images. Reconstruction of object motion, reconstructing a picture of the scene at a desired time, is performed by projecting the (x, y, t) samples onto the desired temporal plane with the appropriate weighting, constructing the 2D Delaunay triangulation of the sample points, and Gouraud (or Phong) shading the resulting triangles. Both first and higher order visual effects, illumination and visibility, are handled. Silhouette edges and other discontinuities are more difficult to track but can be addressed with a combination of triangle filtering and image postprocessing.

Comments

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A TEMPORAL IMAGE-BASED APPROACH TO MOTION RECONSTRUCTION FOR GLOBALLY ILLUMINATED ANIMATED ENVIRONMENTS

Jeffry Nimeroff

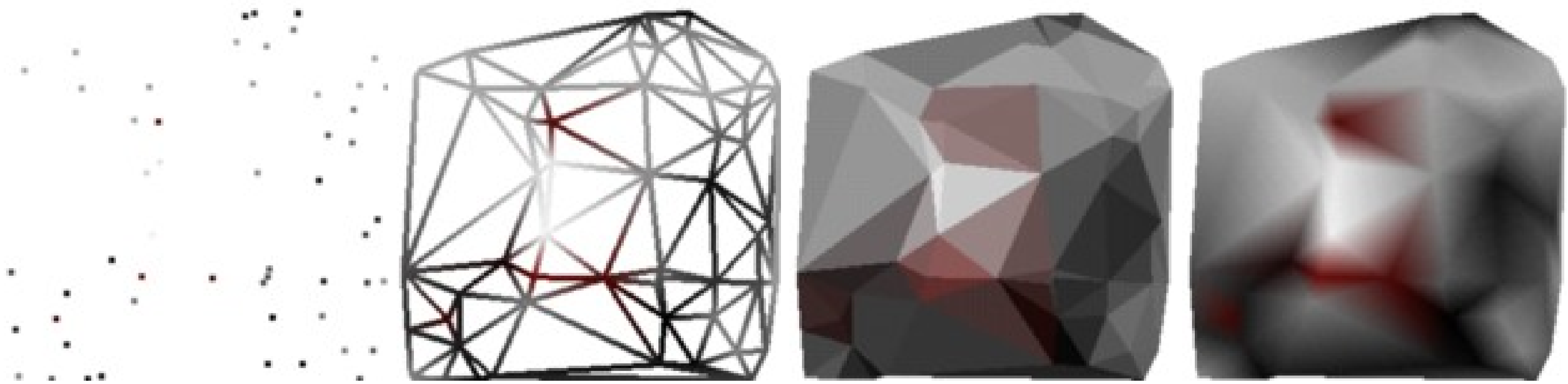
Presented at the *7th Annual Eurographics Workshop on Rendering*, Porto Portugal, June 17-19 1996

This paper presents an approach to motion sampling and reconstruction for globally illuminated animated environments (under fixed viewing conditions) based on sparse spatio-temporal scene sampling, a resolution-independent temporal file format, and a Delaunay triangulation pixel reconstruction method. The argument is made that motion that is usually achieved by rendering complete images of a scene at a high frame rate (i.e. flipbook style frame-based animation) can be adequately reconstructed using many less samples (often on the order of that required to generate a single, complete, high quality frame) from the sparse image data stored in bounded slices of our temporal file. The scene is rendered using a ray tracing algorithm modified to randomly sample over space - the image plane (x, y), and time (t), yielding (x, y, t) samples that are stored in our spatio-temporal images. Reconstruction of object motion, reconstructing a picture of the scene at a desired time, is performed by projecting the (x, y, t) samples onto the desired temporal plane with the appropriate weighting, constructing the 2D Delaunay triangulation of the sample points, and Gouraud (or Phong) shading the resulting triangles. Both first and higher order visual effects, illumination and visibility, are handled. Silhouette edges and other discontinuities are more difficult to track but can be addressed with a combination of triangle filtering and image postprocessing.

Delaunay Complex

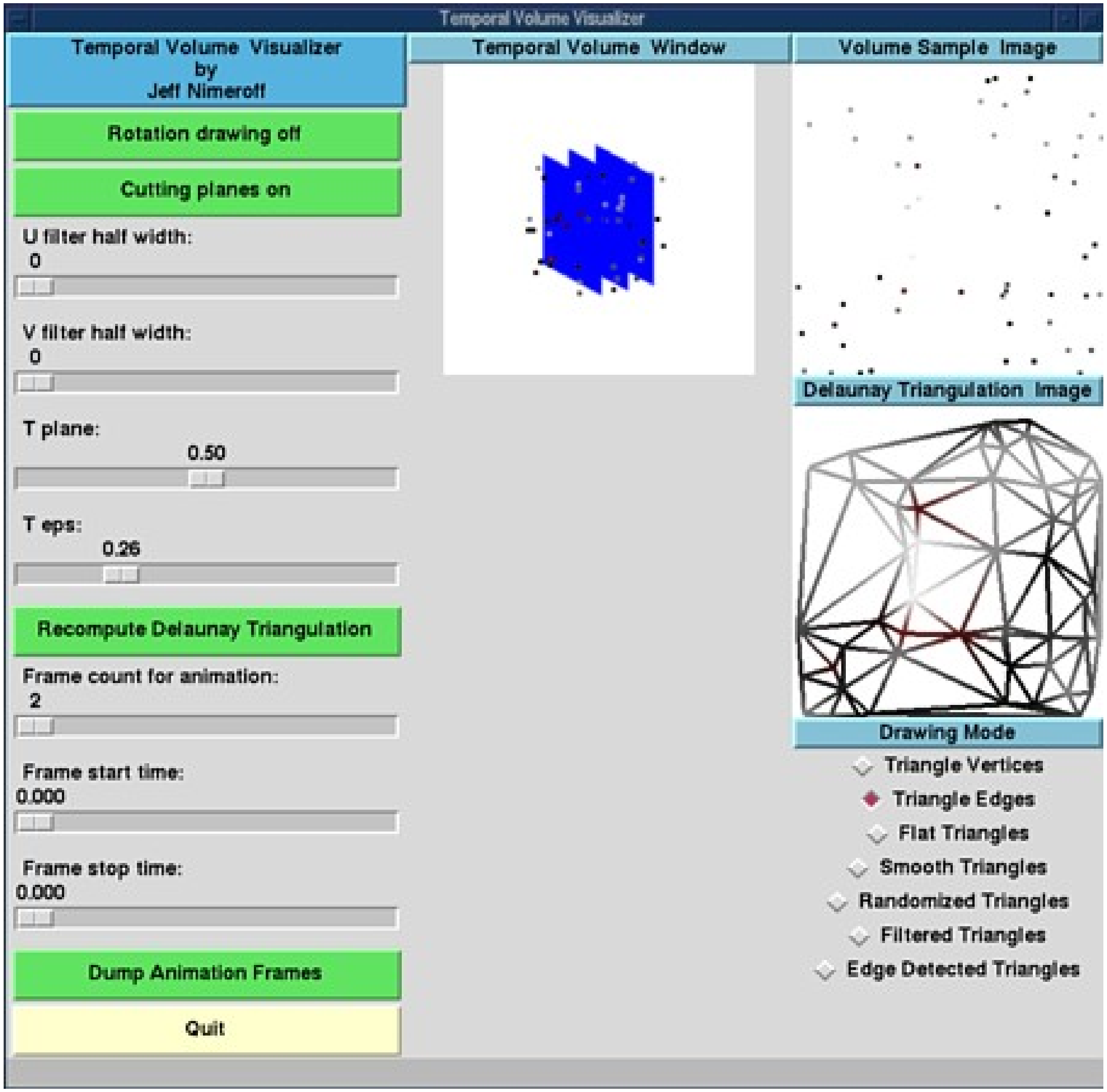
The Delaunay complex is mechanism for connecting data values in N-D (a connected mesh meeting certain proximity requirements). Once the complex is created, the connectivity information aids in reconstructing the values that between the data that exists in the mesh.

Here is an example of a 2-D Delaunay complex and various reconstruction schemes.



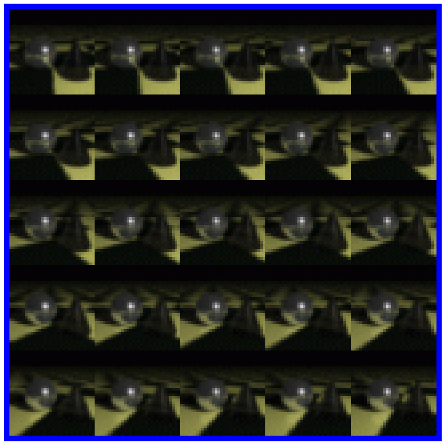
Interface

An ArcBall-based temporal volume visualizer was constructed to allow efficient reconstruction within pre-generated temporal volumes.



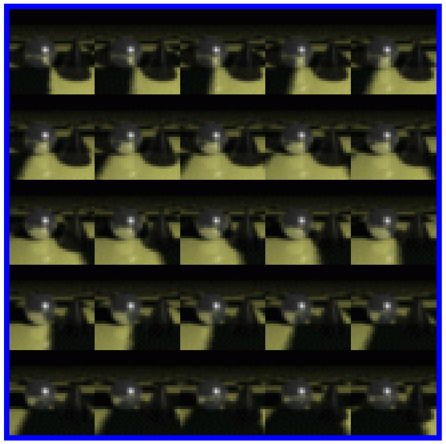
Sample Animated Sequences

These images and animated sequences illustrate the results obtained by using our new motion sampling and reconstruction method.



Rotation, Reflections, and Refractions

This sequence shows a rotating ground plane spinning under a mirrored ball and a refractive transparent cone. The higher-order reflections and refractions are reconstructed adequately from the point samples. This is not possible without a densely packed sequence of fully-rendered frames which require much more information to be stored. The 200,000 spatio-temporal rays we cast into the scene required a total sampling time of 13 minutes 24.93 seconds. Reconstruction time was approximately 30 seconds per frame on an original Indigo2 XZ.



Translation, Reflections, and Refractions

This sequence shows a translating ground plane sliding under a mirrored ball and a refractive transparent cone. As with the first example, higher-order illumination effects are tracked well. The 200,000 spatio-temporal rays we cast into the scene required a total sampling time of 13 minutes 4.87 seconds. Reconstruction time was approximately 30 seconds per frame on an original Indigo2 XZ.

Visibility, and Shadows

This sequence shows a transparent triangle sliding to the right over the top of an opaque triangle moving to the left. This example exhibits multiple object motion resolution including visibility, illumination, and shadowing changes. The 200,000 spatio-temporal rays we cast into the scene required a total sampling time of 10 minutes 23.71 seconds. Reconstruction time was approximately 30 seconds per frame.

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