Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
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Quantifying Visibility in Volumetric Rendering with Compute Shaders

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Introduction

In Volumetric Rendering applications, understanding what aspects of the data are visible to the user is an important step in optimizing the expressiveness of the image, leading to a better final render.

The aim of this thesis is to design an algorithmic process by which visibility aspects of a Volumetrically Rendered object can be computed in real time. The two taken into consideration within this thesis are the saliency of the data set, and the relative visibility of the individual data points within the final rendered image.

Implementation

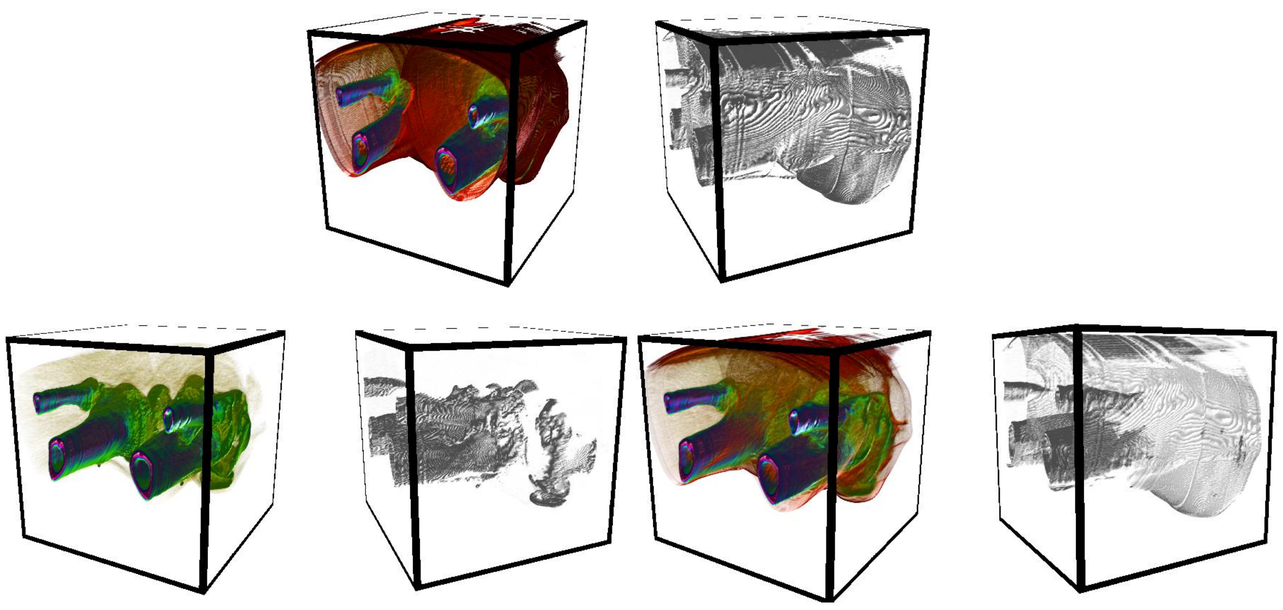
Main Loop

Each volume is rendered to a framebuffer with separate cameras, and each framebuffer is converted to a texture and mapped to a quad, allowing for independent movement.

GLSL

The **Relative Visibility** of a point is calculated by casting a ray from the point to the camera position, and sampling along it at the same interval as during the Volumetric Rendering, subtracting the alpha value of the sample from the current value for the point being computed.

The **Saliency** of a point is calculated by applying a Laplacian filter to the data, revealing gradients of colour intensity.



Each image set depicts the same transfer function but with lower opacity values tied to each material, along with the visibility field associated with the view shown. A darker colour indicates a higher visibility.

Volumetric Rendering

In opposed to rendering a triangle mesh with a constant texture, volumetric rendering samples a 3D point cloud to create a surface representation for texturing. This allows for semi-transparent volumes to be rendered in real time.

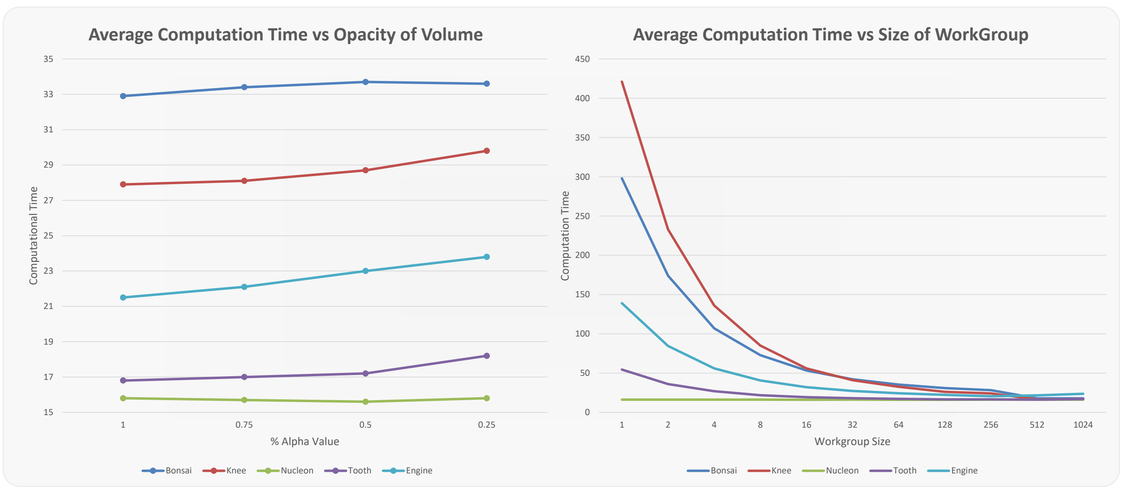
Compute Shaders

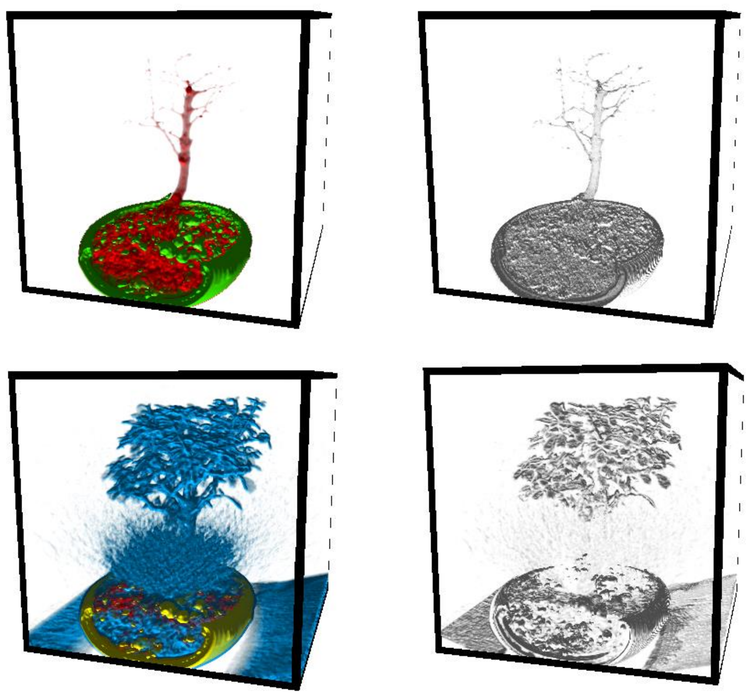
Running separately to the rendering pipeline, Compute Shaders are a General Purpose shader solution native to OpenGL, allowing for computation work on the GPU through GLSL.

Saliency

Saliency refers to how noticeable or important an object is in its surroundings. In the field of Volume Rendering, a material can be given a higher saliency through the opacity and colour values assigned to it.

Evaluation





The image sets show the change in the Saliency Field for the same data set but with different transfer functions. A darker colour indicates a more salient area.

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