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Implementation of volume rendering in C# for LightningChart

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SAVONIA UNIVERSITY OF APPLIED SCIENCES **THESIS Abstract**

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Abstract

Arction Oy is a Finnish software company, based in Kuopio. Their main poduect is LightningChart, the fastest C# framework for visualisation of scientific, engineering, trading and research data. The library contains banch of tools for visualisation of XY graph, 3D XYZ, smith, polar, 3D pie/donut views and 3D objects.

The company wanted to extend the LightingChart's abilities of poligonal 3D models rendering by volume rendering. It gives Arction an opportunity to attract new clients to the product. In result the framework provides an uniqe possibility to render volume and poligonal models at same visualisation.

The project started from a literature research and comparing of different volume visualisation techniques, to choose the best one for the Arction's case and implement it inside the framework. The implementation of the volume rendering engine is based on DirectX used together with C# via SharpDX API and HSLS shader language for low level optimisation of rendering calculations.

The final chapter of the report contains an evaluation of the results and suggestion for a future development of the engine.

Keywords
Visualisation, Ray Casting, 3D, C#, LightningChart, DirectX, HLSL, Image Processing, Volume Rendering, Rendering

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My special thanks go to Mr. Pasi Toummainen, CEO of the company, who expressed interest to my idea to extend the library by the volume rendering engine, gave me permission to work on the project and guided me especially at very early part of the development process.

Moreover, I would like to say thank you to my thesis supervisor, Arto Toppinen, for his mentoring and support during the report writing stage of my work.

In addition I would like to express my deepest gratitude Karlsuruhe Institute of Technology, there I got the first experience with volume rendering via ray casting. I am especially grateful to Nicolas Tan Jerome, who was my mentor during the part of my internship related to modification of TomorayCaster 2 and to Aleksandr Lizin, the creator of the WebGL volume rendering engine.

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Chapter 1

Introduction

1.1 Motivation

Volume data is very commone our day. An importance of the type of datasets will grow in nearest future, because of development if field of 3D data acquisition and possiblities to performe the visualisations on modern office workstation with an interective frame rate.

Volume rendering is a process of multi-dimentional data visualisation into two-dimensional image which gives observer an opportunity to reconise meaningful insights in the origianl information. The technology allows us to represent 3 dimensions of the data via position in a 3D space and 3 more via color of the point.

The dataset can be captured by vaiouse number of technologies like: MRI[1], CT[2], PET[3], or USCT[4]. They also can be produced by physical symulations, especially for fluid dynamics. Volumetric information plaies a big role in medicine for an advenced cancer detection, visualization of aneurisms and treatment planning. This kind of rendering is also very useful for nondesctructive material testing via computer tomography or ultrasound. Geoseismic researches produces huge three-dimensional datasets need to be visualised. They are used to an oil exploration and planning of the deposit development.

1.2 Personal backgound

I recieved my first expirince in visualisation of volumetric data during my internship at Institute of Data Processing and Electronics, which belonges to the Karlsruhe Institute of Technology (KIT). I was a part of the 3D Ultrasound Computer Tomography (USCT) team. Thier main goal is development of a new imaging methodology for early breast cancer detection. During the work placement I had to develop an algorithm to visualise five-dimensional datasets. In result the algorithm was integrated into Tomoraycaster 2[5] and

[1] Magnetic resonance imaging
[2] Computer tomograthy
[3] Positron emission tomography
[4] Ultrasound computer tomography
[5] JavaScript framework for visualisation of 3D data, developed in IPE

USCT's edition of DICOM Viewer.

On the project I made my very first steps in modern computer graphics. I got my first expirince in work with WebGL during custimisation of the Tomoraycater, learned GLSL, my first shader languag, I also gained a lot of knowledge about image processing and scintific data visualisation, which became the basis for my thesis work.

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