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EXAMENSARBETE Rendering Light and Shadows for Transparent Objects
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Lights and Shadows in 3D Graphics

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A big challenge in computer graphics is calculating light and shadows. Common methods today do not produce these correctly for transparent objects. The objective of this master thesis is to solve that.

To do so we combine a newly presented light algorithm together with a new approach to an old shadow algorithm. By doing this we make it possible to correctly illuminate and create complex shadows for objects such as glass, thin fabric, smoke or fog. This enables us to create a more visually appealing picture when dealing with transparent objects. It is especially important when handling volumetric objects such as smoke as it can now cast a shadow on itself. This means that when the light shines trough the smoke it will gradually decrease in intensity the deeper it gets into the smoke.

Our method also makes it possible to color the light as it passes trough a medium. For example shining a light through a blue colored piece of glass will create a blue light. This also works for complex patterns such as those found in stained glass windows where the differently colored parts of an object will produce a different colored light. Thus it is possible to project an image in a similar fashion to how a slide projector works.

Performance is of utmost importance as the algorithms is targeted at interactive real time media such as computer games. To make this possible we utilize the powerful processing power provided by modern graphics cards.

This first algorithm we use is called ”Light Linked List” and is used to determine which parts of the visible scene are illuminated. This technique differs from the ones common in modern 3D graphics by separating data by distance from the camera. This makes it possible to differentiate between light affecting an object close to the camera from another object further away. The second algorithm, called ”Deep Shadow Mapping”, is similar to the first. The main difference is that the separation in depth is performed in relation to a light source. This enables us to have light pass through objects at different depths from the source.

In conclusion, these algorithms create a flexible system for light and shadow calculations. They make it easier to use transparent objects in computer games as they will behave more natural when interacting with light. This is important for creating a credible visual experience.

Curtains being lit from behind, casting colored shadows.

Light passing through stained glass and a column of smoke.

A transparent teapot casting a shadow which gets darker towards the edges.