

How the Implementation of a Bounding Volume Hierarchy Affects the Time Taken to Render a Ray-Traced 3D Scene

Introduction

In computer graphics, ray-tracing is when a series of light rays are cast from an image plane into a scene, with the colour of each pixel determined by how its corresponding ray interacts with the objects.[1] As ray-tracing is often a costly process, acceleration structures are often implemented in the scene to reduce the time taken to render an image.

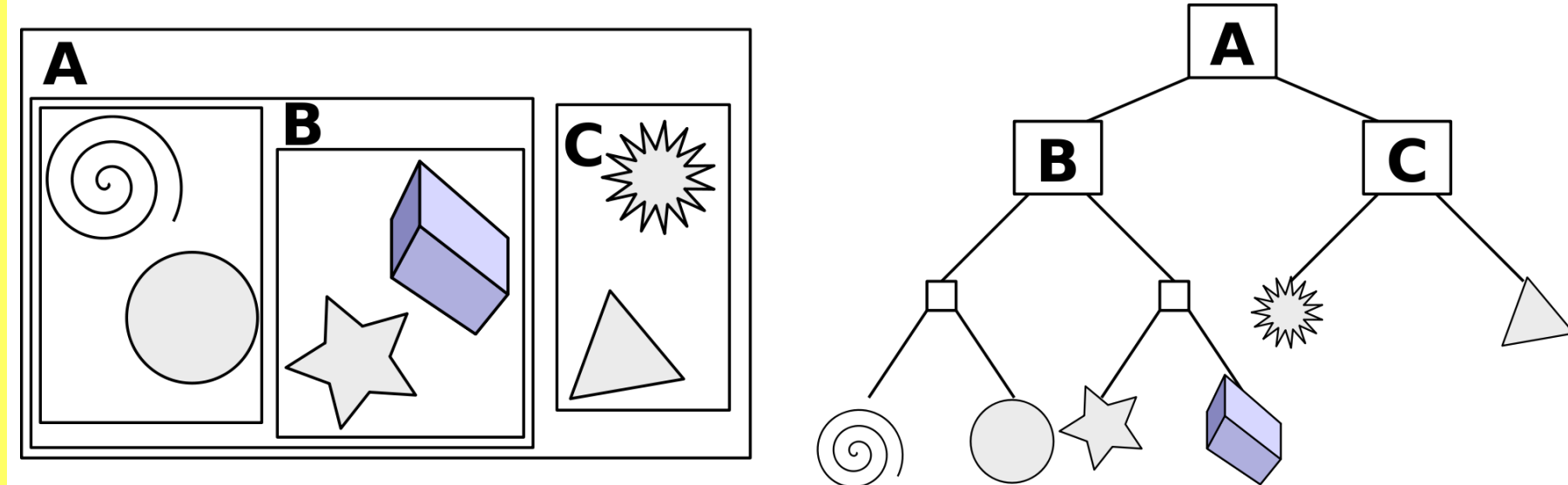


Figure 1: Bounding volume hierarchy[2]

Background Research

There are three primary types of acceleration structure that are commonly implemented in ray-tracing. Spatial subdivision algorithms divide each section of the scene into a number of smaller, non-overlapping regions.[3] The uniform grid splits the scene up into a number of equally-sized voxels.[4] The bounding volume hierarchy, which splits a larger bounding volume containing every object in the scene into smaller volumes.[5]

Aims and Objectives

The aim of this project is to design, develop and test a ray-tracing program that incorporates a bounding volume hierarchy. The rendering times of the scenes with and without the hierarchy are compared alongside the number of ray-object intersection tests performed. The bounding volume hierarchy has been chosen because it is the simplest structure to implement.

Conclusions

The first iteration records the time taken to produce scenes without the bounding volume hierarchy. The scenes containing a larger number of implicit objects took more time to render, as well as scenes with larger objects.

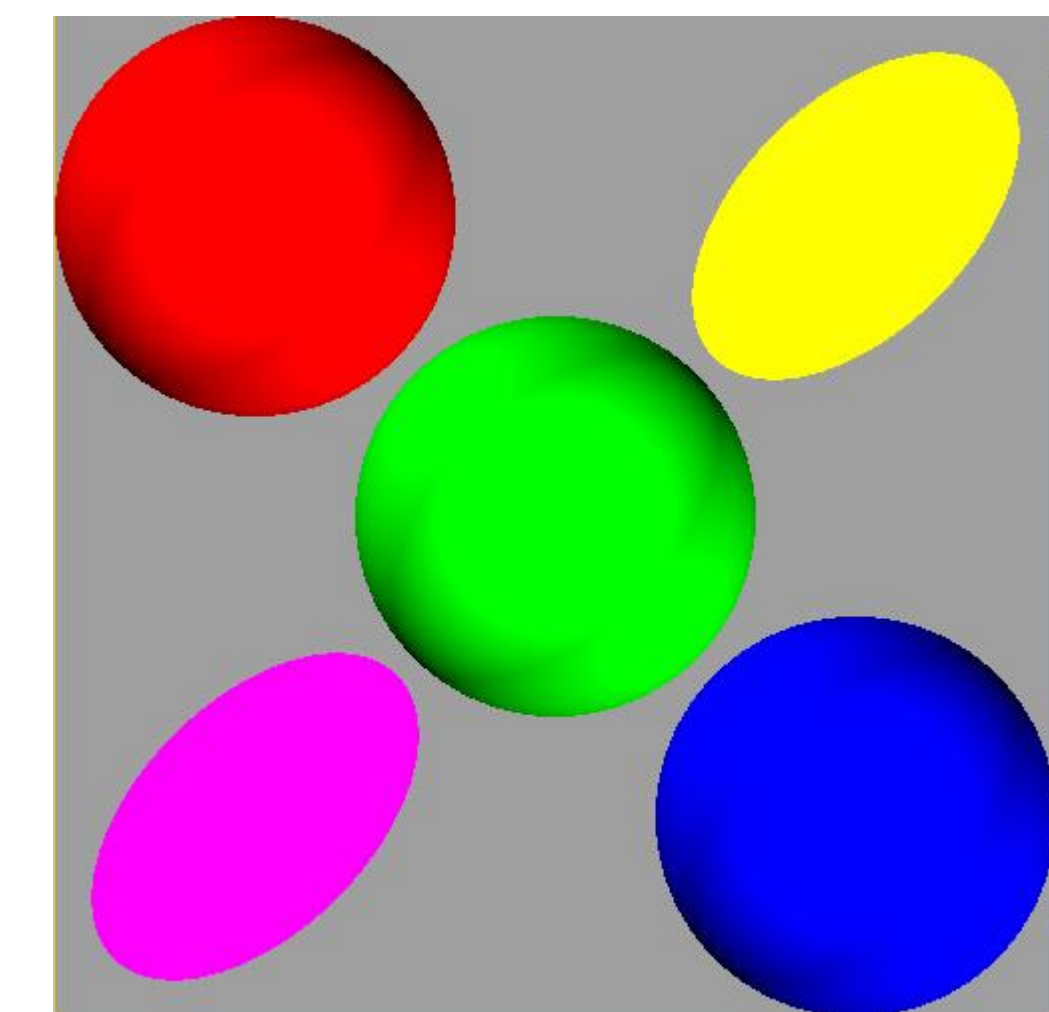


Figure 2: Test render using implicit objects

The second iteration incorporates the bounding volume hierarchy into the scene. This results in a reduction in collision tests and rendering time compared with the first iteration.

The third iteration loads polygonal models into the scene from an .obj file. Increasing the number of polygons loaded caused the hierarchy building time to increase, whereas increasing the scale value increased the image rendering time.

Work cited

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