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| MTU Kerry |
| Capturing, Editing and Merging Gaussian Splats to Create Novel 3D Environments |
| Academic Year:2023/2024  Programme Title: Computing with Games Development – MT804  Module Title: Final Year Project  Module Code: PROJ 81003  Lecturer’s Name: Claire Horgan |

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# Abstract:

Gaussian Splatting, a point cloud rendering technique originating in the 1990s, has recently seen significant advancements, making it a possible alternative to traditional photogrammetry methods. This paper explores the potential, and limitations, of Gaussian Splatting for creating novel environments in various applications, including game development. The exploration of techniques for editing and merging splats to generate unique and visually impressive 3D scenes. This paper examines the process of Gaussian Splat editing and merging, and compares it with other emerging methods, such as Neural Radiance Fields (NeRF) and traditional photogrammetry. This research demonstrates how Gaussian Splatting can contribute to the creation of highly detailed and dynamic virtual environments.

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# 1. Methodology

## 1.1 Research Question

How can Gaussian Splats be edited and merged to create novel and visually impressive 3D environments for use in game development and beyond?

## 1.2 Research Area

Computer graphics, photogrammetry, 3D rendering, and game development are the main areas of research relevant to this research project. A focus on the application of Gaussian splatting, a point-cloud based 3D rendering technique, to create novel and visually compelling 3D environments.

Techniques for editing and merging Gaussian splats are investigated, exploring their potential to alter Gaussian Splats to create unique 3D scenes for various applications, such as game development. The research aims to assess its strengths, limitations, and potential contributions to the field of 3D content creation.

# Chapter 2. Literature Review

### 2.1 **Introduction to Gaussian Splatting**

* **Historical Overview:** A brief history of Gaussian splatting, including its origins and early applications.
* **Core Concepts and Principles:** Explain the fundamental concepts of Gaussian splatting, such as point clouds, splatting, and density estimation.
* **Advantages and Limitations:** Discuss the strengths and weaknesses of Gaussian splatting compared to other 3D rendering techniques.

### **2.2 Gaussian Splatting in 3D Content Creation**

* **Applications in Game Development:** Explore the use of Gaussian splatting in creating game environments, including examples and case studies.
* **Comparison with Traditional Photogrammetry:** Analyse the differences and similarities between Gaussian splatting and traditional photogrammetry methods.
* **Emerging Techniques: NeRF and Beyond:** Discuss other recent advancements in 3D content creation, such as Neural Radiance Fields (NeRF), and compare them to Gaussian splatting.

### **2.3: Editing and Merging Gaussian Splats**

* **Editing Techniques:** Explore different methods for manipulating Gaussian splat properties, such as density, colour, and position.
* **Merging Strategies:** Discuss techniques for combining multiple Gaussian splat datasets into a single, unified representation.
* **Challenges and Considerations:** Address the potential difficulties and limitations associated with editing and merging Gaussian splats.

### **2.4: Future Directions and Potential Improvements**

* **Research Gaps and Opportunities:** Identify areas where further research is needed to advance the application of Gaussian splatting.
* **Potential Enhancements:** Suggest ways to improve Gaussian splatting techniques, such as optimizing performance or expanding its capabilities.
* **Integration with Other Technologies:** Explore the possibilities of combining Gaussian splatting with other technologies, such as machine learning or artificial intelligence.