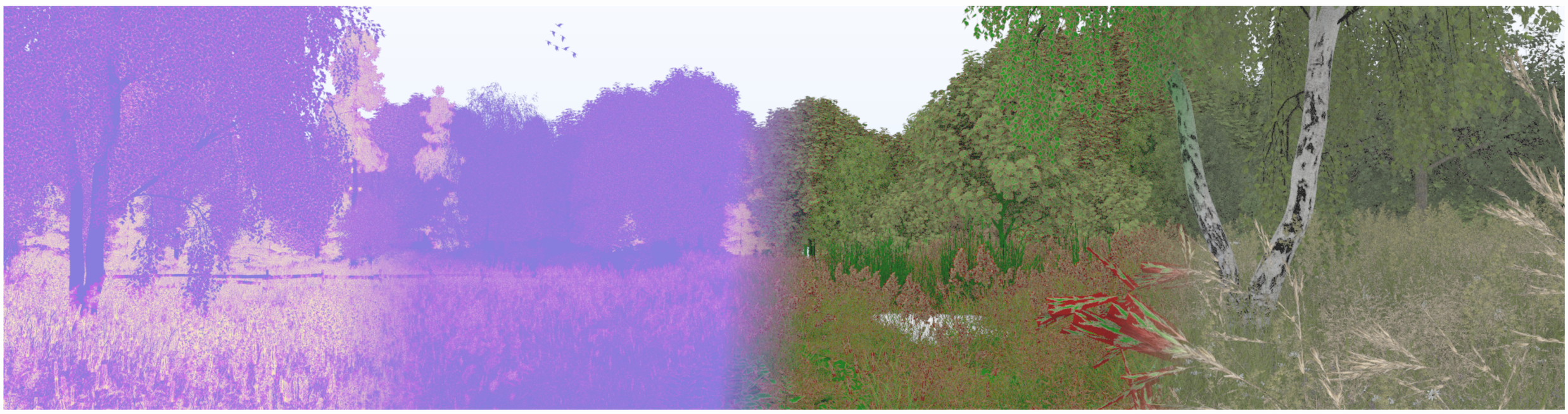
Rendering Small Things
Hardware Micromaps and Particles

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Introduction

In computer graphics, there are numerous aspects that must be considered when rendering images of virtual scenes: What physical light-generating phenomena do we care about? How do we render the scenes into images as fast and efficiently as possible? This thesis in particular covers a novel particle based rendering method, efficient construction of BVHs with `OpenMP`, micromaps compression and their possible extensions, and noteworthy extensions to the Blender plugin ecosystem for managing `PBRT` and `glTF` files.

Graphics Tooling

PBRT Scene Importing for Blender

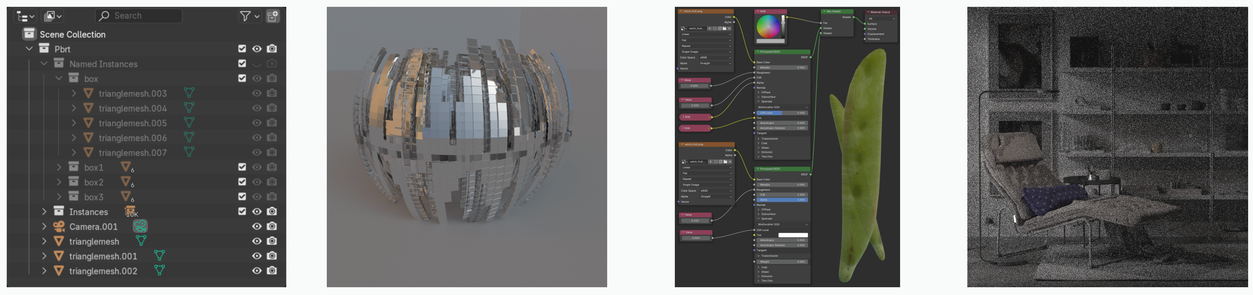


Figure 1: Blender plugin to import `PBRT` scenes into Blender, maintaining most of the layout and material graphs.

Extending glTF Scenes from Blender

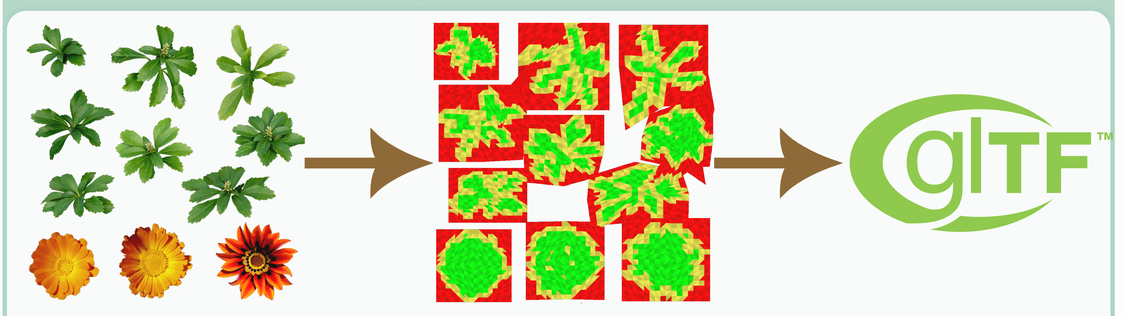


Figure 2: Blender tooling for storing custom user generated data in the `glTF` scene format.

Superluminal Photon Mapping

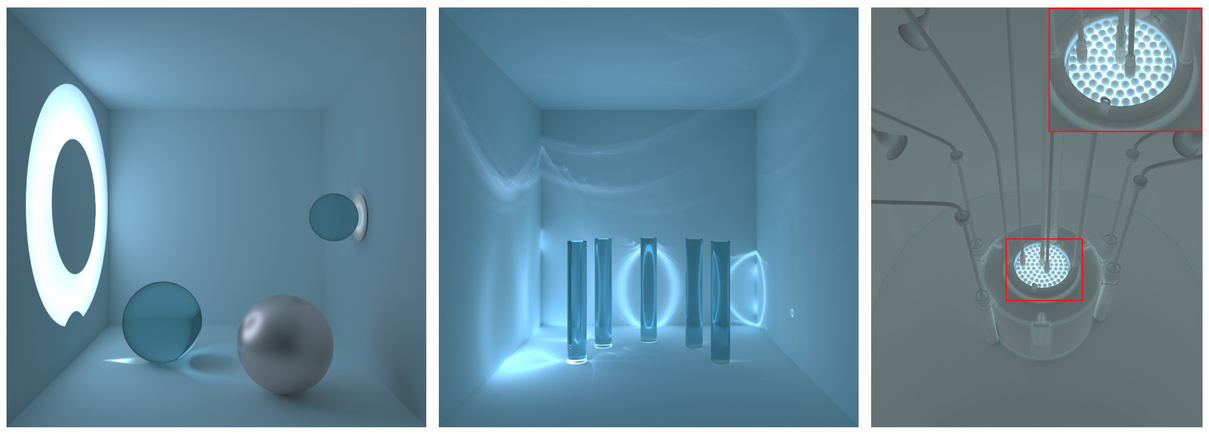


Figure 3: The first paper of this thesis cover a method for rendering images of scenes lit by virtual atomic particles traveling at superluminal speeds is presented that handles both the particle interactions and light generation in a unified ray-tracing framework.

Parallel Axis Split Tasks for BVH Construction with OpenMP

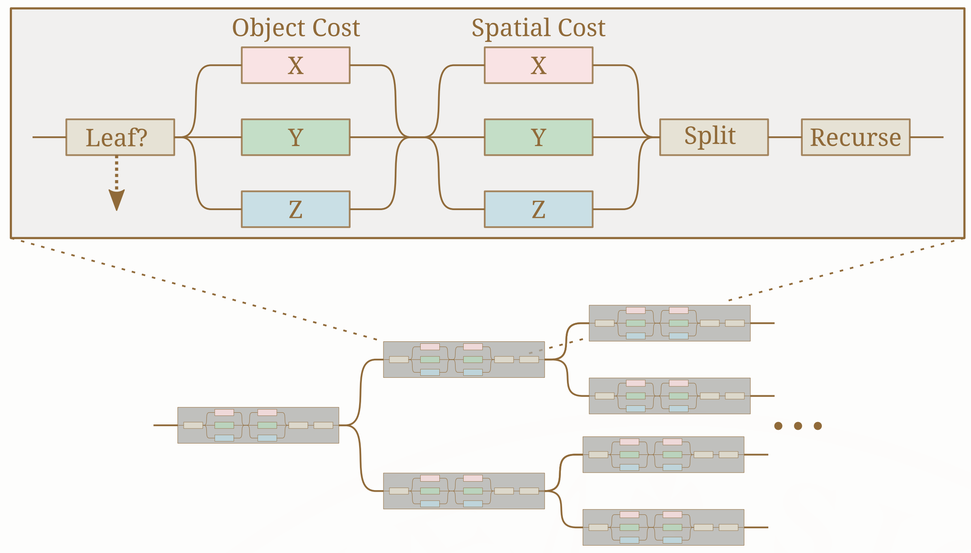


Figure 5: A small but important detail of rendering is the construction of the BVH, here, the parallelization of BVH construction is done with a simple and straightforward application of `OpenMP`.

Succinct Opacity Micromaps

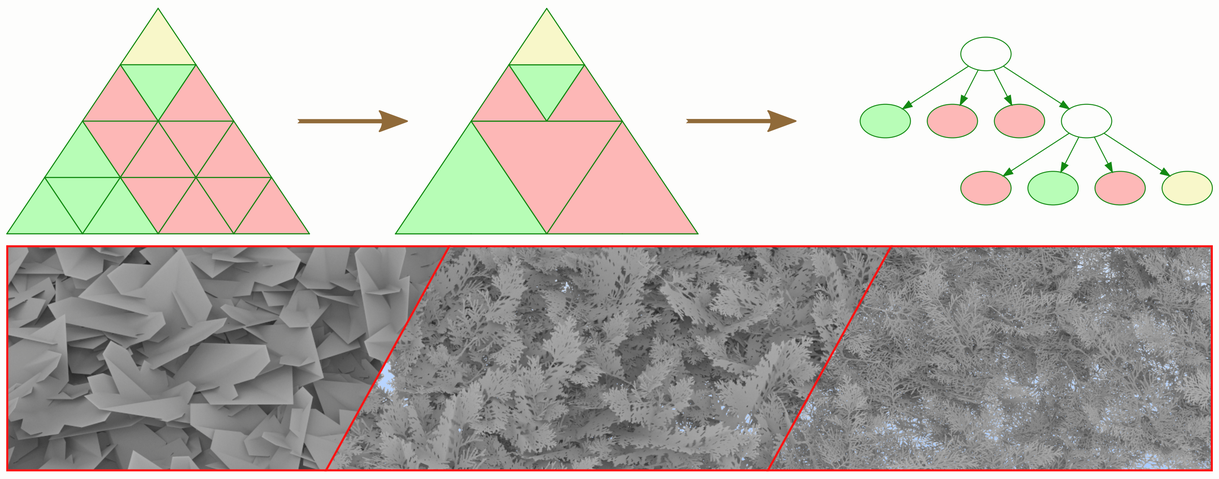


Figure 4: Hardware accelerated ray-tracing process can struggle with partially-transparent triangle meshes, but by leveraging a structure known as opacity micromaps that issue is alleviated. In this work, this construct is extended with a novel compression scheme.

Color and Attribute Micromaps

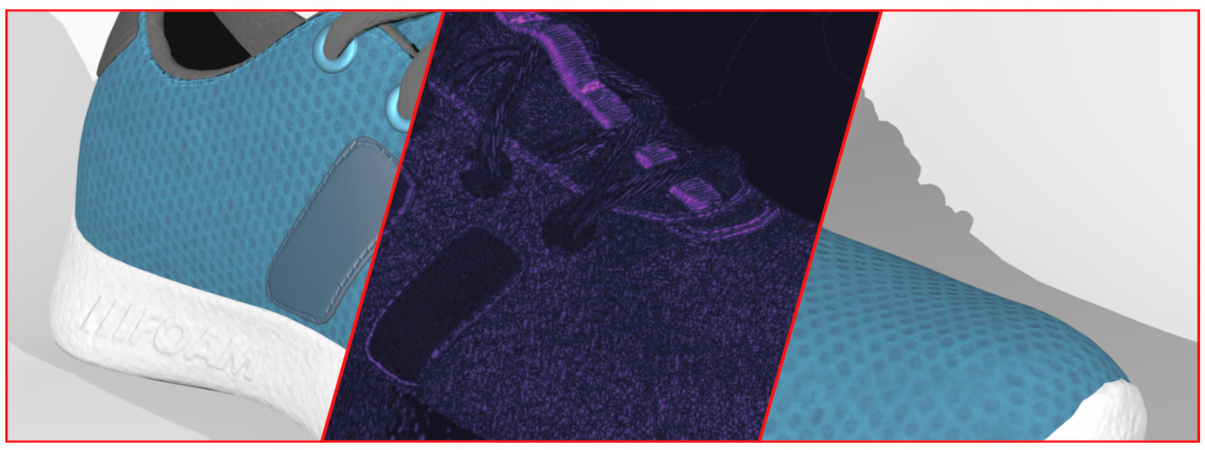


Figure 6: In this work, the micromap concept is extended to cover arbitrary surface attributes, with various potential use-cases in a future hardware accelerated real-time ray-tracing pipeline.

References

[1] Gustaf Waldemarson and Michael Doggett. "Color and Attribute Micromaps". In: *Submission*. 2026.

[2] Gustaf Waldemarson and Michael Doggett. "Parallel Axis Split Tasks for Bounding Volume Construction with OpenMP". In: *Proceedings of the 20th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications - GRAPP*. INSTICC. SciTePress, 2025, pp. 347–354. ISBN: 978-989-758-728-3. DOI: 10.5220/0013317100003912.

[3] Gustaf Waldemarson and Michael Doggett. "Photon Mapping Superluminal Particles". In: *Eurographics 2020 - Short Papers*. Ed. by Alexander Wilkie and Francesco Banterle. The Eurographics Association, 2020. ISBN: 978-3-03868-101-4. DOI: 10.2312/egs.20201004.

[4] Gustaf Waldemarson and Michael Doggett. "Succinct Opacity Micromaps". In: *Proceedings of the ACM on Computer Graphics and Interactive Techniques* 7.3 (Aug. 2024). DOI: 10.1145/3675385. URL: https://doi.org/10.1145/3675385.