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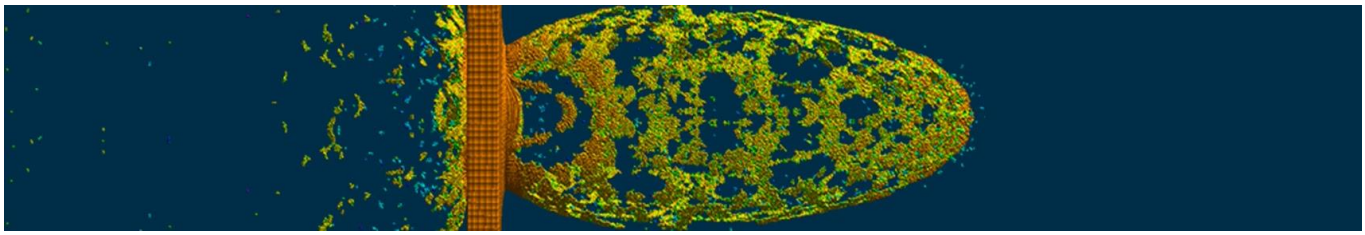

IDP Project: Accelerating Signed Distance Reconstruction from Triangular Meshes

Project Overview and Goal

In computer graphics and engineering simulations, the signed distance field (or level set field) is a powerful tool for representing the surface of volumetric objects. This approach is widely used across various applications, including rendering, collision detection, and fluid simulations. Typically, signed distances are reconstructed from objects described by triangular surface meshes.

The conventional method for calculating the unsigned distance at arbitrary points involves using a binary tree structure to store the mesh triangles and performing recursive searches to find the minimum distance. While effective, this tree-based recursion is inherently unsuited for GPU applications due to its incompatibility with parallel processing paradigms.

This project aims to **redefine and accelerate the signed distance reconstruction process by eliminating recursion**. The focus will be on exploring alternative data structures that enable efficient triangle searches using iterative methods, such as for-loops, which are GPU-friendly.

Key Highlights

- The project leverages **SPHinXsys**, an open-source, multi-physics library renowned for its particle-based simulations.
- SPHinXsys is powered by **SYCL (via Intel's DPC++)**, providing robust GPU computing capabilities while remaining versatile for non-GPU environments.
- The library already supports triangular mesh file reading and level set field construction using standard approaches, offering a solid foundation for the proposed improvements.

References: To explore SPHinXsys, check out the repository: SPHinXsys GitHub Repository.

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