

Adaptive Octrees, Algorithms and Implementations

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Abstract

Octrees find a wide variety of applications across computational science as they allow for the spatial decomposition of a three dimensional domain. The adaptivity of an octree refers to the potential to have neighbouring tree nodes of non-uniform size at a given level of the octree. This allows for a better description of non-uniformly distributed data, allowing the octree to ‘adapt’ to the data. In this document we describe the main theoretical underpinnings of adaptive octrees, with special reference to their application in Fast Multipole Methods. We move on to a description of major sequential and parallel implementations of adaptive octrees, and describe the strategy being undertaken by the new Python/SYCL implementation being developed as a part of the Excalibur exascale software collaboration [1], [AdaptOctree](#). [2]

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Motivation

Algorithms

AdaptOctree Software

References

- [1] *Exascale Computing for System-Level Engineering*. URL: <https://excalibur-sle.github.io/>.
- [2] Hari Sundar, Rahul S Sampath, and George Biros. “Bottom-up construction and 2: 1 balance refinement of linear octrees in parallel”. In: *SIAM Journal on Scientific Computing* 30.5 (2008), pp. 2675–2708.