

Parallel intersection detection in massive sets of cubes

W. Randolph Franklin
Rensselaer Polytechnic Institute
Troy, NY, USA
mail@wrfranklin.org

Salles V. G. Magalhães
Universidade Fed. de Viçosa
Viçosa, MG, Brazil
salles@ufv.br

ABSTRACT

We present PARCUBE, which finds the pairwise intersections in a set of millions of congruent cubes. This operation is required when computing boolean combinations of meshes or polyhedra in CAD/CAM and additive manufacturing, and in determining close points in a 3D set. PARCUBE is very compact because it uses a uniform grid with a functional programming API. PARCUBE is very fast; even single threaded it usually beats CGAL's elapsed time, sometimes by a factor of 3. Also because it is FP, PARCUBE parallelizes very well. On an Nvidia GPU, processing 10M cubes to find 6M intersections, it took 0.33 elapsed seconds, beating CGAL by a factor of 131. PARCUBE is independent of the specific parallel architecture, whether shared memory multicore Intel Xeon using either OpenMP or TBB, or Nvidia GPUs with thousands of cores. We expect the principles used in PARCUBE to apply to other computational geometry problems. Efficiently finding all bipartite intersections would be an easy extension.

CCS CONCEPTS

• **Theory of computation** → **Nearest neighbor algorithms**; *MapReduce algorithms*; *Computational geometry*; • **Computing methodologies** → *MapReduce algorithms*;

KEYWORDS

Parallel Programming, Computational Geometry, Intersection, Close Points, Near Points, Uniform Grid, Functional Programming, Thrust, Map-Reduce Algorithms

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NOTE

This paper will be presented at BIGSPATIAL. As allowed by ACM, a copy is available at <https://wrf.ecse.rpi.edu/p/224-parcube-bigspatial-2017.pdf>.

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