GEOGRAM: A Library of Geometric Algorithms

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We present a set of geometric algorithms for grid generation. The implementation of the algorithms is available in the public GEOGRAM [1] library (BSD Open-Source License). The set of algorithms comprises :

- Robust geometric predicates, using adaptive precision floating point arithmetics [2] simulation of simplicity [3] to handle the corner cases, and arithmetic filters [4] to early detect and quicly handle the easy cases;
- Geometric search data structures, including Kd-Trees (for nearest neighbors queries) and Axis-Aligned BBox Trees (for mesh intersection);
- Delaunay triangulation and power diagrams in 3d;
- Restricted Voronoi Diagram in arbitrary dimension.

The design of the library follows a minimalistic principle, combined with the algorithmic state of the art, inspired by [5]. Compared with CGAL, our implementation is significantly more memory efficient, sometimes faster, much easier to understand (no generic programming), at the cost of being less generic/dynamic. All the algorithms are parallelized using an abstract model that supports pthreads, OpenMP and Windows threads. In addition, the library has no dependancy and is easy to compile on any platform that has IEEE754 floating point arithmetics (Linux, Mac, Windows, Android, ...). The library was used to implement a solver for Optimal Transport [6]

References

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