Computing Delaunay Triangulations in Parallel

Title: *Computing Delaunay Triangulations in Parallel*

Lab, institution and University: INRIA Sophia Antipolis

City and country: Sophia Antipolis, France

Team or project in the lab: Projet GEOMETRICA

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General presentation of the topic (roughly 5 to 10 lines):

Parallel computing is getting more and more ubiquitous in the day-to-day scientific computing landscape: from the emergence of multiple-core and multiple-processors machines, even on common laptops, to large "grid" clusters.

The Delaunay triangulation is a fundamental geometric data structure which is used in many applications such as meshing or surface reconstruction. There are numerous algorithms to compute such a triangulation, but in all cases its running time usually still takes a non-negligible part of the total running time of the whole application.

Objective of the internship (roughly 10 to 20 lines):

We would like to investigate new parallel algorithms to speed up the computation of 2D and 3D Delaunay triangulations, especially targetting the common case of multiple cores and multiple processors machines (shared memory, low number of processors). Some algorithms already exist in the litterature, which will need to be studied and compared as a first step. For example, one could start a few steps of a divide and conquer algorithm, then distribute the computations, and then merge them back.

An implementation will be realized based on the CGAL library, which already provides efficient sequential algorithms to compute Delaunay triangulations. Special care will have to be taken to preserve other highly desirable properties like memory locality, as well as fast point location properties in the resulting triangulation.

As time permits, we also would like to start investigating the case of distributed memory on clusters, for very large triangulations.

Special material used (if any):

The CGAL library (www.cgal.org), multiple processors machines, eventually the local cluster.

Expected ability of the student:

Computational geometry, C++ programming.