

Cloud-based generation, storage and processing of triangular and tetrahedral meshes

Post-doctoral position

*FP7 project IQmulus
IGN – MATIS laboratory
Saint Mandé, France*



Context

One of the main research topics of the MATIS lab of the French Mapping Agency (IGN) is focused on the acquisition, management and processing of lidar point clouds acquired using aerial surveys and mobile mapping systems.

This position is funded by the european FP7 project IQmulus (www.iqmulus.eu), subtitled « A High-volume Fusion and Analysis Platform for Geospatial Point Clouds, Coverages and Volumetric Data Sets », which goal is to develop a platform that provides the needed functionalities to integrate latest research results in data processing and visualization to tackle important real-life challenges in geospatial applications. Given the wide choice of different available sensors and the massive amounts of data thus obtained, combined with the intent to provide useful knowledge in an appropriate period of time, the platform thus has to be scalable in processing and storage, and capable of handling the four aspects of variety, volume, velocity and analytics that are commonly associated with the term Big Data. New emerging data acquisition techniques provide fast and efficient means for multidimensional spatial data collection using a combination of ground, airborne and space-borne sensor platforms. All these systems provide point clouds, often enriched with other sensor data, yielding high volumes of raw data.

These point clouds are typically transformed into triangular meshes to represent the ground surface and all the objects of the remotely-sensed scene to enable further processing (analysis, simplification...) and visualization. Likewise, tetrahedral meshes may be produced to represent the decomposition of space into labeled volume (“buildings”, “ground”, “vegetation”, “empty/air”...) either as an intermediate product or as a final product in applications such as flooding simulations.

Scientific contribution

There is no clearly established standards for representing triangular, tetrahedral and more generally simplicial meshes, that are tailored to enable an efficient distributed storage and processing in a cloud environment. Defining how to distribute the computation, storage and processing of these meshes is the primary topic of this post-doctoral position, in collaboration with researchers from IMATI genova, CNR, Italy.

Concerning the computation of these simplicial meshes, we will focus on Delaunay triangulations. Beyond stream processing [Isenburg 2006] that enables single node computation of 2D Delaunay meshes using a limited memory footprint, [Wu 2011] proposed a single node implementation that could be ported to a cloud environment and extended to the 3D Delaunay triangulation of tetrahedral meshes.

The contributions will be three-fold :

- Distributed storage of simplicial meshes.
- Distributed computation of 2D and 3D Delaunay triangulations of arbitrary large point clouds.
- Distributed manipulation of simplicial meshes : dual graph extraction and storage, re-partitioning

of a distributed mesh (possibly with overlapping patches)...

Profile

- The candidate should have a PhD degree in computational geometry, lidar processing and/or distributed computing
- Prior knowledge and experience in more than one of these topics will definitively be an asset.
- Programming proficiency is mandatory : either in C/C++ or scala
- Good English reading and writing skills (French skills are valued but not necessary)

Organization

- Deadline for application May 15th 2015.
- Beginning : as soon as possible
- End : October 2016.
- Location : MATIS laboratory, IGN, Saint-Mandé, Paris, France
- Salary : depends on the candidate experience.

Application

Applications must be sent to the contacts in a single PDF-format and include :

- a detailed CV with a description of realized projects + publications
- a motivation letter
- a summary of the thesis
- 2-3 recommendation letters

Contacts

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References

[Isenburg 2006] Martin Isenburg, Yuanxin Liu, Jonathan Shewchuk, and Jack Snoeyink, Streaming Computation of Delaunay Triangulations, ACM Transactions on Graphics 25(3):1049-1056, July 2006. Special issue on Proceedings of SIGGRAPH 2006

[Wu 2011] Huayi Wu, Xuefeng Guan, Jianya Gong, ParaStream: A parallel streaming Delaunay triangulation algorithm for LiDAR points on multicore architectures, Computers & Geosciences, Volume 37, Issue 9, September 2011, Pages 1355-1363