DIGITAL TERRAIN MODELLING USING TRIANGULATED IRREGULAR NETWORKS[1]

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Many marine scientists and users of the sea consider knowledge of the sea bottom as basic data, a mere context to carry out research or deploy activities. Some disciplines do need more accurate bathymetric data than others, depending on depth values being background information or crucial information for their research or activities. In bathymetry, the representation of the sea bottom surface is the main objective and hence, this discipline will try to render the sea bottom relief as accurate as possible.

The latest bathymetric sounding equipment that is available nowadays, especially the multibeam echosounder, yield a very dense bottom sampling. When compared to the common singlebeam echosounder, an enormous amount of data is produced that needs to be processed in a correct and fast way. Grid-overlay (by local linear or more sophisticated interpolation and attributing values to individual grid cells) is not an option here as this method uses an interpolation of the measured values and hence will either cause accuracy loss or generate a still larger amount of data. A triangular irregular network (TIN for short), especially the Delaunay triangulation (Dt), does respect the actual measurements and will not generate new data. In literature, a number of algorithms have been developed that determine the Dt of a set of points (vertices) given in the plane.

A performant divide-and-conquer algorithm for Delaunay triangulations was implemented to triangulate large quantities of data in minimum time. Comparison with other implemented algorithms demonstrates its excellent performance.

In some cases, it will be necessary to adapt the terrain model. Theoretical terrain models (for instance design models for marine contractors) require manual interventions, while new surveys partially overlapping old data will have to replace the latter. Therefore, the incremental algorithm has been adapted to allow insertion of individual points. When eliminating individual vertices, the hole thus created has to be retriangulated. Vertices belonging to a triangulation that is (partially) covered by a new surveyed area can be eliminated and using a very keen adaptation of the divide-and-conquer principle, the overlapping triangulations can be stitched together. This is a novel technique with the big advantage of quickly and seamlessly joining two large triangulations, without the need for retriangulation of the entire area.

Part of the immense amount of data generated by a multibeam echosounder will unavoidably be redundant. An important issue therefore will be: filtering these data, keeping those points that still assure an optimal accuracy. This accuracy can be expressed as a function of the topography or as a function of the volume. For the latter, not the height difference determines whether or not a vertex is allowed in the triangulation, the criterion is rather the change in volume caused by this one vertex. For marine contractors, it is mainly the latter that is important. A hybrid model would be most adequate.

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