



DTMs: discussion of a new multi-resolution function based model

M. A. Brovelli, L. Biagi, and G. Zamboni

Politecnico di Milano, DIIAR, Geomatics Laboratory of Como Campus, Como, Italy (maria.brovelli@polimi.it)

The diffusion of new technologies based on WebGIS and virtual globes allows DTMs distribution and three dimensional representations to the Web users' community. In the Web distribution of geographical information, the database storage size represents a critical point: given a specific interest area, typically the server needs to perform some preprocessing, the data have to be sent to the client, that applies some additional processing. The efficiency of all these actions is crucial to guarantee a near real time availability of the information.

DTMs are obtained from the raw observations by some sampling or interpolation technique and typically are stored and distributed as Triangular Irregular Networks (TIN) or regular grids. A new approach to store and transmit DTMs has been studied and implemented. The basic idea is to use multi-resolution bilinear spline functions to interpolate the raw observations and to represent the terrain. More in detail, the algorithm performs the following actions.

- 1) The spatial distribution of the raw observations is investigated. In areas where few data are available, few levels of splines are activated while more levels are activated where the raw observations are denser: each new level corresponds to an halving of the spline support with respect to the previous level.
- 2) After the selection of the spline functions to be activated, the relevant coefficients are estimated by interpolating the raw observations. The interpolation is computed by batch least squares.
- 3) Finally, the estimated coefficients of the splines are stored.

The algorithm guarantees a local resolution consistent with the data density, exploiting all the available information provided by the sample. The model can be defined "function based" because the coefficients of a given function are stored instead of a set of heights: in particular, the resolution level, the position and the coefficient of each activated spline function are stored by the server and are transmitted to the clients. These data allow the complete reconstruction of the terrain at any point.

A preliminary implementation of the algorithm had been already presented: however, some optimization problems were present in the automatic choice of the activated splines. Now, all these problems have been solved and the algorithm has been completely implemented.

In the presentation, the new multi-resolution approach is discussed and compared with the traditional techniques to interpolate, store and transmit DTMs, considering accuracy and storage requirements. Moreover it is compared with other multi-resolution techniques. Different case studies of smooth and rough terrains have been analyzed: the results provided by our approach are completely satisfactory. The research has been funded by the INTERREG HELI-DEM (Helvetia Italy Digital Elevation Model) project.