Geophysical Research Abstracts
Vol. 16, EGU2014-8402-1, 2014
EGU General Assembly 2014

Digital terrain model generalization incorporating scale, semantic and cognitive constraints

Panagiotis Partsinevelos (1) and Maria Papadogiorgaki (2)

(1) School of Mineral Resources Engineering, Technical University of Crete, Chania, Greece (ppartsi@mred.tuc.gr), (2) School of Electronics & Computer Engineering, Technical University of Crete, Chania, Greece

Cartographic generalization is a well-known process accommodating spatial data compression, visualization and comprehension under various scales. In the last few years, there are several international attempts to construct tangible GIS systems, forming real 3D surfaces using a vast number of mechanical parts along a matrix formation (i.e. bars, pistons, vacuums). Usually, moving bars upon a structured grid push a stretching membrane resulting in a smooth visualization for a given surface. Most of these attempts suffer either in their cost, accuracy, resolution and/or speed.

Under this perspective, the present study proposes a surface generalization process that incorporates intrinsic constrains of tangible GIS systems including robotic-motor movement and surface stretching limitations. The main objective is to provide optimized visualizations of 3D digital terrain models with minimum loss of information. That is, to minimize the number of pixels in a raster dataset used to define a DTM, while reserving the surface information. This neighborhood type of pixel relations adheres to the basics of Self Organizing Map (SOM) artificial neural networks, which are often used for information abstraction since they are indicative of intrinsic statistical features contained in the input patterns and provide concise and characteristic representations. Nevertheless, SOM remains more like a black box procedure not capable to cope with possible particularities and semantics of the application at hand. E.g. for coastal monitoring applications, the near - coast areas, surrounding mountains and lakes are more important than other features and generalization should be "biased"-stratified to fulfill this requirement. Moreover, according to the application objectives, we extend the SOM algorithm to incorporate special types of information generalization by differentiating the underlying strategy based on topologic information of the objects included in the application.

The final research scheme comprises of the combination of SOM with the variations of other widely used generalization algorithms. For instance, an adaptation of the Douglas-Peucker line simplification method in 3D data is used in order to reduce the initial nodes, while maintaining their actual coordinates. Furthermore, additional methods are deployed, aiming to corroborate and verify the significance of each node, such as mathematical algorithms exploiting the pixel's nearest neighbors. Finally, besides the quantitative evaluation of error vs information preservation in a DTM, cognitive inputs from geoscience experts are incorporated in order to test, fine-tune and advance our algorithm.

Under the described strategy that incorporates mechanical, topology, semantic and cognitive restrains, results demonstrate the necessity to integrate these characteristics in describing raster DTM surfaces.

Acknowledgements: This work is partially supported under the framework of the "Cooperation 2011" project ATLANTAS (11_SYN_6_1937) funded from the Operational Program "Competitiveness and Entrepreneurship" (co-funded by the European Regional Development Fund (ERDF)) and managed by the Greek General Secretariat for Research and Technology.