P-117

HYDROGRAPHIC SELECTION / ELIMINATION IN AUTOMATED GENERALIZATION BY USING ARTIFICIAL NEURAL NETWORKS

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The central task of National Mapping Agencies has been to establish digital geographic databases from which to produce maps. The different representations are stored at different levels of detail. Its flexibility lies in its ability to derive different types of maps from the representation levels of a multiple representation database, using generalization methods in order to maintain and update the spatial database (Sarjakoski, 2007).

Technology and research have advanced our capacity for cartographic and geospatial database generalization through systems and tools that automate processes using modern database designs, knowledge bases, and artificially intelligent algorithms (Stanislawski, 2008).

Generalization is a process used for reducing the volume of data of a spatial data set while preserving important structures (Sester, 2008). Map generalization operations concerned with the abstraction of the database come under the heading of "model generalization", whilst the set of operations concerned with the optimal visualization of the selected data are grouped under "cartographic generalization". (Mackaness, 2007).

As the main feature in GIS and traditional map representation, the hydrographic network generalization has attracted interests over years and hydrographic data at different resolutions or scales are needed in various spatial studies (Ai et al., 2006).

The National Hydrography Dataset (NHD) is a vector geospatial data layer of the National Map, being developed by the United States Geological Survey (USGS) and created from many data sources and Web Map Services, representing the surface water hydrography of the United States. It is available nationwide as medium resolution at 1:100,000-scale, and as high resolution at 1:24,000-scale or better.

This paper presents an automated generalization process of a hydrographic network using 1:24,000-scale NHD. It is generalized to 1: 100, 000-scale by using an unsupervised learning method of artificial neural networks (ANN), self-organizing maps (SOM). This algorithm is used for selection / elimination of hydrographic objects such as branches of a river in GIS. The study area is the subbasin (10290107 in the 1:24,000 NHD), forms the watershed for the Pomme de Terre River, in the Midwest United States, in Missouri.

SOM is part of a large group of techniques known as ANN. One quickly realizes that, apart from seeing the SOM only in the context of other ANN methods, depending on its purpose and training parameters one could also interpret it primarily as a clustering or dimensionality reduction technique. In SOM, the input vectors do not correspond to classes known a priori. Output nodes compete for the input vectors on the basis of certain similarity functions and the weights of winning nodes are adjusted according to the weights of respective input nodes. The basic idea behind clustering is the attempt to organize objects into groupings based on certain shared characteristics (Skupin and Agarwal, 2008).

In this paper, it is considered a model-based generalization of a river network and proposed an approach that considers river attributes involving topological, geometric and semantic properties as input to a SOM. From a more practical perspective, the rivers and their corresponding attributes are used to create input vectors. The SOM training algorithm groups all rivers into different categories according to similarities of various attributes, and then selects rivers at reduced map scale based on these categories. Selection is based on the two basic categories (selected and eliminated) identified by the SOM.

Results are compared to a benchmark, 1:100,000-scale NHD. The number of the selected / eliminated objects evaluated by this approach is also compared to the number evaluated by "Radical Law", formulated by Töpfer, links the scale of the map to the amount of details it should contain. The case study applied to the network illustrates that the SOM-based approach can be used as an effective method for the selection of rivers via data visualization and exploration for multi dimensional geospatial data and shows stable behavior in noisy domains.

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