COMBINED UNCERTAINTY MODELING OF GIS ROAD DATA AND EXTRACTED OBJECTS

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ABSTRACT:

This paper describes the framework for the automatic quality assessment of existing geo-spatial data in sub-urban areas. The necessary reference information is derived from up-to-date digital aerial images via automatic image analysis. We focus on roads as these are amongst the most frequently changing objects in the landscape. In contrast to existing approaches for quality control of road data, we will carry out a common and consistent modeling and processing of the road data to be assessed and the road objects extracted from the images. For this task we will set up a geometric-topologic relationship model for the roads and their surroundings. These surrounding objects (context objects, such as rows of trees, or rows of buildings) support the quality assessment of road vector data as they may explain gaps in road extraction.
The statistical processing is based on the so called Hint-Theory, being an approach to the Dempster-Shafer Theory of Evidence. We have chosen this approach because it is possible to formulate ignorance explicitly. This property is important as normally one extracted object cannot give full evidence regarding the quality of a single GIS road object. In our approach the correspondence between the GIS road object and the extracted objects with respect to the modeled relations is investigated, resulting in a quality indication for the GIS object.
In this paper we focus on the question how to model the uncertainties inherent in existing geo-spatial data on the one side and in extracted objects on the other side. We investigate the sources of uncertainty especially for extracted objects and set up a statistical model for the given task. The adequate consideration of the statistical properties of these objects is of vital importance, because only by this means it is possible to judge the amount of evidence the extracted objects can give regarding the quality of existing vector data.
Several aspects to the uncertainty of extracted objects are identified. When the object is captured it is abstracted which can be understood as a generalization, and thus a notion of uncertainty is introduced. The measurement, i.e. capturing, taking place on these abstracted objects propagate this uncertainty. The subsequent processing of the object, for instance the conversion to another geometric representation, leads to a further propagation of this measures and thus must be modeled.
Based on the investigations we show results of the quality assessment of GIS road data. In order to show the effects of different statistical models we use simulated data, but also give results obtained by using automatic object extraction. The experimental results confirm the given statement regarding the importance of correct statistical models, especially in built-up areas where context objects hamper the extraction of road features.

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