Interactive Generalization of Digital Terrain Models

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In the past, various efforts have been made to automate the process of hillshading for topographic and thematic maps. Methods for analytical hillshading are based on the calculation of shading values from a digital terrain model (DTM). However, the results of analytical hillshading have often been criticized because of their poor graphical quality compared to those from manual practice. The reasons for this shortcoming are mainly due to inappropriate shading models, inaccurate DTMs, and insufficient generalization. Existing methods for automated relief generalization have resulted in an improvement of the appearance of the shaded relief, but still do not satisfy in all respects. In particular, there are relatively few capabilities for local control and adaptation of generalization operators, and for the support of complex intuitive operators such as the exaggeration of relief forms.

This paper focuses on the role that the interactive manipulation of DTMs can play for further improvements of analytical hillshading. Manipulation of shapes and structures (e. g., the DTM) offers several advantages over image manipulation (e. g., manipulation of shading values). Firstly, modifications are not restricted to a fixed illumination environment, secondly, consistently manipulated surfaces enable a physically based shading, and finally, shading can be performed more efficiently with shape manipulations than with paint tools.

Concepts and methods for interactive manipulation of surfaces have been evaluated. Subsequently, a system has been developed that enables the shading of the surfaces. Direct modelling of surface features is achieved by a set of tools, whose actions are immediately reflected by the shading. Emphasis is on tools which enable precise shape-specific operations. For relief generalization, two basic types of tools are important, one for local smoothing operations (e. g., filling holes and ditches, or cutting peaks and ridges), and one for the construction of arbitrary shapes along a path (e. g., breaklines, ridges, and valleys). Furthermore, a selection mechanism has been implemented which restricts the application of common filter procedures and generalization methods to a specified subarea. A number of existing DTMs have been used to demonstrate the power of these interactive tools for relief generalization. Additionally, methods for an interactive editing of light sources have been studied.

Interactive manipulations of surfaces need not necessarily be restricted to relief generalization. The use of interactive DTM tools for the planning process, landscape architecture, or the simulation of phenomenon related to natural surfaces will be discussed.