

# Advances and Recent Challenges in Cartographic Pattern Recognition

Hendrik Herold\*

\* Leibniz Institute of Ecological Urban and Regional Development Germany

\* Technical University of Dresden, Department of Geosciences, Germany

**Abstract.** This paper reviews the state-of-the-art in cartographic pattern recognition for automatic map digitization and interpretation in order to identify recent challenges to this research field arising from an increasing spatial and historical coverage of applications. Numerous previous studies have demonstrated contemporary and historical topographic maps as important sources of geospatial information for both landscape and urban research. In the same way as remotely sensed imagery, topographic maps contain and preserve snapshots of landscape and human settlement patterns at a certain point in time. Thus, maps have become, regardless of inherent uncertainties, abstraction and generalization, an extraordinarily valuable data source for many facets of land change research and quantitative historical geography. For spatial explicit land cover and land use information of former times, historic topographic paper documents have in many studies appeared to be the only source of information. However, in order to make the implicit information contained in the scanned paper maps explicitly available and spatially analyzable within (Historical) Geographic Information Systems (GIS/HGIS), techniques of automated image analysis such as image processing and pattern recognition have to be applied. Thus, cartographic pattern recognition for automated map interpretation has evolved as a vivid research field over the past few decades. Early developments have been triggered by the mere need for digital geospatial data. The information acquisition was focused on the most recent maps. Later on, as soon as digital and web cartography emerged, methods of cartographic pattern recognition have also been used to derive generalization rules that are implicitly contained in different scales of one map series. Nowadays, large amounts of scanned map documents are being made digitally available through public libraries, private collections as well as the national mapping agencies. On the other hand, vast amounts of up-to-date digital geospatial information are recently available. Thus, the focus of the research field has been started to change.

In the first part of the paper, an overview of advances in this active field of research is given. Recently proposed approaches are categorized and evaluated concerning various criteria such as complete and sectional interpretation techniques. The second part of the paper identifies recent challenges to these techniques emerging from a changing focus in the fields of application. Spatially and temporal extensive studies as well as the integration of vast amounts of digitally available, yet heterogeneous map data give rise to new research needs. Algorithms have to not only cope with changing but also coalesced and blurred graphical representations of the sought geospatial information.

In conclusion, a summary of research needs and an outlook on methodical concepts in order to overcome some of the stated issues are given.

**Keywords:** Automatic Map Interpretation, Cartographic Pattern Recognition, Historical GIS, Review