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Topographical Object Recognition through Structural Mapping

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The automatic classification of geometric topographical data into object types (and/or feature codes) can partially be done through recognition of shape [Keyes & Winstanley 2000]. Performance can be improved by extending the classification mechanism with contextual information. This improves the accuracy of automatic classification because we can frequently resolve ambiguous data by examining its context to provide evidence for category membership (thus informally, for example, we can say that a square on a map is more likely to depict a house if it is near a road.).

The context of an object can be modelled in a number of ways. We describe a method of matching the *configuration* of topographical objects and their surroundings with that of relevant example prototypes through the recognition of *analogous structures* [Gentner 1983, Plate 1998]. In this way we can automatically identify further examples of each category. The reliability of our category assignments will process in this way be greatly improved by encompassing neighbourhood data in the classification.

To classify an unknown topographical object through structural mapping requires two complimentary tasks. The central activity concerns generating the largest possible mapping between the problem data the some pre-stored prototype. The second activity revolves around determining the boundaries between this problem data and "irrelevant" background information. Category prototypes play a significant role in boundary identification, with the efficiency of the matching process being partly determined by domain selection.

This paper describes an extension to the process of identifying categories of object, with the inclusion of context information as part of a categories description. This extends the classification mechanism and supports disambiguation between similar concepts not by examining a graphical object in isolation, but by treating it as part of a connected system of graphical information. This greatly increases the robustness of the identification process by acknowledging and accounting for the influence that geographical objects have on their surroundings, and by making this an explicit part of the identification process. Thus, many (candidate) geographical features may be confirmed or rejected as category members, on the basis of the context in which that feature is discovered.

To test this method, fully structured data from large scale (1:2500) maps were analysed. A corpus of building objects was compiled from these and separated into sub-categories depending on their context. Examples of categories of building identified include *Detached-in-garden*, *Semi-detached-in-garden*, *Terraced-house-fronting-road* and so on. A test set of objects of known type (half of which were buildings, half not) was categorised according to shape using three methods: fourier descriptors [Keyes and Winstanley 1999], moment invariants [Keyes and Winstanley 2000] and scalar descriptors (area, perimeter, elongation). The objects were also matched structurally with the example categories extracted from the corpus. The effectiveness of each method at distinguishing buildings from non-buildings was compared. Results from the test data indicate that no method alone can identify buildings with more than 80% confidence. Structural mapping was as effective as the best of the shape-only techniques (scalars). The next stage of the work will be to combine results from each classifier together using the sum decision rule [Kittler 1998] which should give a more reliable classification than using one method in isolation.

References

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