An Automatic Extraction Approach of Road Information on the Basis of Recognition of Character Regions

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Abstract. The subjects about the automatic extraction of road information from maps have been recognized as effectual means to construct GIS(Geographic Information Systems) and support the services of various kinds of information, the managements of our life-lines, the planning of city projects and so on. Many researches were reported with respect to this subject. However, it is not always easy to accomplish this subject successfully because roads are, in general, overlapped and interrelated with other map components complicatedly. In this paper, we propose an experimental approach to extract road information from urban maps. The characteristic in our approach is not to extract roads directly like many traditional approaches, but to distinguish individual roads cooperatively on the basis of recognition of character regions. We do not only mention the recognition method in our approach, but also discuss the recognition results through some experiments.

1 Introduction

The issue about map recognition is one of important subjects to compose the basic resource data in constructing GIS(Geographical Information System) and various types of information systems. Until today, many approaches/methods[8,9] have been proposed, concerning this issue. For example, the skip-scan method[1], the method using negative images[2], the method based on Voronoi graphs[3] and so on were typically developed. However, since these methods were based on only the bottom-up approaches, which interpret map images directly, the processing capabilities are limited.

On the other hand, the methods based on the top-down approaches also were proposed: method based on the combination of bottom-up and top-down processings[4], method based on the cooperative paradigm among bottom-up and top-down processings[5]. In the combination method, the bottom-up processing is first applied to urban map images in order to extract the road information and then the top-down processing is used to refine the locally extracted road information globally. While, the cooperative method is developed as an enhanced version of the combination method from a viewpoint of cooperative processing.

However, it is not easy to distinguish the road information from urban map images completely even if these advanced methods were applied. This is partly because different types of data such as roads, rivers, buildings, street names,
building names, characteristic symbols and so on are overlapped or intersected on one sheet, and partly because individual data can not be well defined from a viewpoint of the formal description. In this paper, we address an experimental approach to extract road information. Our approach is based on the paradigm which first identifies character regions and then extracts the road information with help of identified character regions. Namely, though the traditional approaches focused on the direct and simple extraction problem of only the road information, our approach concentrates on the cooperative recognition method interrelated between road information and character information.

2 Approach

It is not easy, in general, to extract the road information automatically from urban map images because various kinds of map components are mutually overlapped or interconnected. Additionally, these map components are not always effectively defined by means of formal descriptions. Our objective is to recognize the road information from urban map images, and then construct the road network as a topological feature of road information. With a view to attaining to this objective, we adopt an experimental approach, which makes use of the relationships between other map components and road fragments complementarily. Fig.1 illustrates our processing flow instinctively. Our approach, which refines the extracted road fragments complementarily on the basis of recognition of character regions, is very different from many currently proposed approaches, which concentrated only on the direct extraction subject of road information.

Since the roads are interfered or overlapped by other map components such as characters and symbols, it is difficult to extract roads exactly. If we can identify the map components overlaid on roads and infer the connectivity among mutually cut-off road fragments, these separated roads are interrelated by means of the recognition of character regions. Here, we define the road as the basic recognition object, and also the road network as our target results briefly.

[Definition: Road] The road (or road fragment) is defined as a pair of two parallel line segments.

[Definition: Road network] The road network is a topological graph for expressing road information, and is composed of nodes and edges. Nodes are characteristic points in roads: intersections, connection points among neighboring roads and terminal points in road sequences. While, edges represent the connective relationships among neighboring nodes.

3 Extraction Process of Primitive Elements

3.1 Extraction of Character Regions

It is not necessarily easy to extract character regions from urban maps automatically because the map components are mutually interfered or overlaid under the complementary relationships. Our method is an enhanced version of MF (Merlin Farber Hough Transformation) method[7]. MF method[6] is useful to identify arbitrary line-drawn objects from the original images. In our method, plane-based objects must be identified since character regions are regarded as rectangular