

An Approach to Automatic Road Vectorization of Raster Maps

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1 Introduction

Raster maps are widely available for many areas around the globe. The road network that commonly exists in raster maps is an important source of road vector data for the areas for which road vectors are not readily available. To extract the road vector data from raster maps, the first step is to extract the pixels that represent roads from the raster maps (i.e., the road raster layers in the raster maps) and then extract the road vector data from the road pixels. Since the roads usually overlap with other map features and raster maps very often contain noise introduced during the processes of image compression and scanning, the extraction of road pixels from raster maps is difficult. Moreover, for extracting the road vectors from road pixels, previous work commonly uses the thinning operator [6] or line grouping and parallel-line matching techniques [1] to obtain the skeletons of the connected objects composed of road pixels. The thinning operator is robust and requires no parameter tunings; however, the thinned lines (i.e., the skeletons) are usually distorted around the line intersections and hence the extracted road vectors are not accurate, especially when the thinning operator is applied on thick lines. On the other hand, the line grouping and parallel-line matching techniques require manual settings on various parameters to identify the skeletons, such as the maximum difference between the slopes of two line segments to be merged.

In this paper, we present an approach for extracting accurate road vector data from raster maps with no parameter tunings. We first utilize our previous techniques to extract the road pixels from raster maps [4] and generate a road raster layer that contains one-pixel width road lines representing the skeletons of the connected objects composed of the extracted road pixels [5]. Next, we employ the road-intersection template extraction technique [3] to identify road intersections and extract accurate road-intersection templates from the road raster layer. Finally, we trace the pixels of the road raster layer for extracting the road vectors and use the accurate road-intersection templates to avoid the distortions caused by the thinning operator around each intersection.

2 Road Pixel and Road Raster Layer Extraction

To extract the road pixels from raster maps, we utilize our technique in [4], which requires very little user input and is capable of handling various types of raster maps, especially scanned maps. Since raster maps often contain thousands of colors, our technique [4] first employs the Mean-shift and K-means segmentation methods to reduce the number of colors in the input raster map and then identifies the road colors from road areas labeled by the users. With the identified road colors, we can generate a color filter to extract the road pixels. Figure 1(a) shows a sample zoning map where the roads are not explicitly drawn but are shown as white areas between the parcels, and Figure 1(b) shows the extracted road pixels (black).

After we extract the road pixels, we identify the road format (i.e., single-line or parallel double-line roads) and the road width using the parallel-pattern tracing technique and then use the morphological operations (e.g., the erosion and dilation operators) to remove solid areas and reconnect lines [2, 5]. The number of iterations for applying the morphological operations is selected using the automatically identified format and road width. Figure 1(c) shows the results after we apply the morphological operations. To generate the road raster layer, we first erode the thick lines shown in Figure 1(c) using a binary erosion operator, which minimizes the distortions caused by the thinning operator that will be applied next. Then, the thinning operator is used to generate the road raster layer that contains one-pixel width road lines. Figure 1(d) shows the extracted road raster layer.

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Judd E. Hollander



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