An Approach to Automatic Road Vectorization of Raster Maps

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1 Introduction

Rater 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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documents symbol and logo recognition sketch and drawings performance evaluation and challenge processing *Graphics Recognition: Algorithms and Systems* Karl Tombre,Atul K. Chhabra,1998-04-08 This book constitutes the strictly refereed post workshop proceedings of the Second International Workshop on Graphics Recognition GREC 97 held in Nancy France in August 1997 The 34 thoroughly revised full papers presented were carefully selected for inclusion in the book on the basis of a second round of post workshop reviewing The book is divided into sections on vectorization and segmentation symbol recognition form processing map processing engineering drawings applications and systems performance evaluation and a graphics recognition contest *Graphics Recognition: Achievements, Challenges, and Evolution* Jean-Marc Ogier,Wenyin Liu,Josep Llados,2010-06-17 This book constitutes the Selected Papers of the 8th International Workshop on Graphics Recognition Achievements Challenges and Evolution held in La Rochelle France in July 2009 **A Methodology for Processing Raw LIDAR Data to Support Urban Flood Modelling Framework** Ahmad Fikri Bin Abdullah,2020-10-29 The consequences of recent floods and flash floods in many parts of the world have been devastating One way to improving flood management practice is to invest in data collection and modelling activities which enable an understanding of the functioning of a system and the selection of optimal mitigation measures A Digital Terrain Model DTM provides the most essential information for flood managers Light Detection and Ranging LiDAR surveys which enable the capture of spot heights at a spacing of 0 5m to 5m with a horizontal accuracy of 0 3m and a vertical accuracy of 0 15m can be used to develop high accuracy DTM but needs careful processing before using it for any application This book presents the augmentation of an existing Progressive Morphological filtering algorithm for processing raw LiDAR data to support a 1D 2D urban flood modelling framework The key characteristics of this improved algorithm are 1 the ability to deal with different kinds of buildings 2 the ability to detect elevated road rail lines and represent them in accordance to the reality 3 the ability to deal with bridges and riverbanks and 4 the ability to recover curbs and the use of appropriated roughness coefficient of Manning s value to represent close to earth vegetation e g grass and small bush **Open Source GIS: A GRASS GIS Approach** Markus Neteler,Helena Mitasova,2008-01-17 Since the first edition of Open Source GIS A GRASS GIS Approach was published in 2002 GRASS has undergone major improvements This second edition includes numerous updates related to the new development its text is based on the GRASS 5 3 version from December 2003 Besides changes related to GRASS 5 3 enhancements the introductory chapters have been re organized providing more extensive information on import of external data Most of the improvements in technical accuracy and clarity were based on valuable feedback from readers Open Source GIS A GRASS GIS Approach Second Edition provides updated information about the use of GRASS including geospatial modeling with raster vector and site data image processing visualization and coupling with other open source tools for geostatistical analysis and web applications A brief introduction to programming within GRASS encourages new development The sample data set used throughout the book has been updated and is available on the GRASS web site This book also

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traffic accident with little data based on the concept of transfer learning This book aims to help graduate students professionals decision makers and road planners in developing better traffic accident prediction models using advanced neural networks **IoT Sensors, ML, AI and XAI: Empowering A Smarter World** Biswajeet Pradhan,Subhas Mukhopadhyay,2024-10-24 This book uncovers and presents various real life applications in the areas of transportation smart cities manufacturing agriculture disaster management finance health care and in other areas by using cutting edge advanced Machine Learning ML techniques such as Deep Learning and Explainable AI XAI models using IoT sensor data The book provides various examples of analyzing large amounts of data detecting patterns and making predictions in real time applications and detailed case studies with practical solutions using various state of the art machine learning and IoT sensor data and all these aspects will benefit the stakeholders The book is useful for academics researchers upper undergraduate master and Ph D students engineers and practitioners in sensor IoT and AI ML technologies methods applications and related areas and it also offers valuable insights by suggesting future research directions and providing recommendations within the fields of AI and IoT **The Cross Section** ,1988 **Advances In Dynamics, Instrumentation And Control - Proceedings Of The 2004 International Conference (Cdic '04)** Chun-yi Su,En-rong Wang,Rama B Bhat,Subhash Rakheja,2004-10-18 This volume is a compilation of 50 articles representing the scientific and technical advances in various aspects of system dynamics instrumentation measurement techniques and control It serves as an important resource in the field The topics include state of the art contributions in the fields of dynamics and control of nonlinear hybrid stochastic time delayed and piecewise affine systems nonlinear control theory control of chaotic systems adaptive model predictive and real time controls with applications involving vehicular systems fault diagnostics and flexible and cellular manufacturing systems vibration suppression biomedical mobile robots etc The proceedings have been selected for coverage in Index to Scientific Technical Proceedings ISTP ISI Proceedings Index to Scientific Technical Proceedings ISTP CDROM version ISI Proceedings CC Proceedings Engineering Physical Sciences *Survey Review* ,2013 **Scientific and Technical Aerospace Reports** ,1991 Open Source GIS Markus Neteler,Helena Mitasova,2007-10-23 With this third edition of Open Source GIS A GRASS GIS Approach we enter the new era of GRASS6 the first release that includes substantial new code developed by the International GRASS Development Team The dramatic growth in open source software libraries has made the GRASS6 development more efficient and has enhanced GRASS interoperability with a wide range of open source and proprietary geospatial tools Thoroughly updated with material related to the GRASS6 the third edition includes new sections on attribute database management and SQL support vector networks analysis lidar data processing and new graphical user interfaces All chapters were updated with numerous practical examples using the first release of a comprehensive state of the art geospatial data set **Videometrics** ,1997 *MultiMedia Modeling* Laurent Amsaleg,Gylfi Þór Guðmundsson,Cathal Gurrin,Björn Þór Jónsson,Shin'ichi Satoh,2016-12-30 The two volume set LNCS 10132 and 10133 constitutes the thoroughly

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Table of Contents An Approach To Automatic Road Vectorization Of Raster Maps

1. Understanding the eBook An Approach To Automatic Road Vectorization Of Raster Maps
    - The Rise of Digital Reading An Approach To Automatic Road Vectorization Of Raster Maps
    - Advantages of eBooks Over Traditional Books
2. Identifying An Approach To Automatic Road Vectorization Of Raster Maps
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an An Approach To Automatic Road Vectorization Of Raster Maps
    - User-Friendly Interface

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