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Object Detection in Aerial and Satellite Images

To our families and friends...

Preface

Very high resolution satellite and aerial images provide valuable information to researchers. With their availability, there has been much interest to extract man-made objects from such imageries. Among these, detection of objects such as buildings, road segments, and urban area boundaries play crucial roles especially for municipalities, government agencies, rescue teams, military, and other civil agencies. For a human expert, manually extracting this valuable information is tedious and prone to errors. One possible solution to extract this information is developing automated techniques. Unfortunately, the solution is not straightforward if standard image processing and pattern recognition techniques are used.

In this book, we provide some new approaches using several local and semi-local invariant features (such as SIFT, Gabor features, gradient features, and color invariants) to automatically detect man-made objects in remotely sensed images. These invariant features are very powerful in detecting objects under various imaging conditions (like illumination, viewing angle, etc). However, extraction of invariant features is not sufficient for detecting objects. Therefore, we further formalize the problem by developing graph theoretical, probabilistic, and region based methods, to extract structural information to verify object appearance.

The book consists of five parts. In the first part, we give a brief information about aerial and satellite images. We also introduce object detection problems in these images. Using mathematical techniques, in the second part we first develop methods to detect urban area boundaries. We also formulate some measures to estimate the degree of urbanization in detected urban areas. Having detected urban area boundaries, we develop our algorithms to detect separate buildings and road segments in urban area. We present these approaches in the third and fourth part respectively. We tested the robustness of the proposed algorithms using a diverse data set including very high resolution panchromatic Ikonos satellite and aerial images. Experimental results indicate the high performance and usefulness of our object detection approaches on

such a diverse image dataset. Finally, in the fifth part we summarize and discuss all object detection methods presented in this book.

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Contents

Part I INTRODUCTION

Part II DETECTING AND GRADING THE URBAN REGION

1	PREVIOUS STUDIES	3
2	URBAN REGION DETECTION USING SIFT DESCRIPTORS AND GRAPH THEORY	5
2.1	Bilateral Filtering for Preprocessing	6
2.2	Scale Invariant Feature Transform (SIFT)	7
2.2.1	Scale Space Analysis	8
2.2.2	Feature Localization	8
2.2.3	Orientation Assignment	9
2.2.4	Feature Descriptor	9
2.3	Detecting the Urban Region	10
2.3.1	Graph Representation	10
2.3.2	Multiple Subgraph Matching to Detect the Urban Region ...	11
3	URBAN REGION DETECTION USING GABOR FEATURES	15
3.1	Local Feature Point Extraction	15
3.1.1	Gabor Filtering	16
3.1.2	Local Feature Points	16
3.2	Detecting the Urban Region	18
3.2.1	Voting Matrix Formation	18
3.2.2	Optimum Decision Making	19
4	GRADING THE URBAN REGION USING LOCAL FEATURES ...	21
4.1	Local Feature Extraction and Representation	21
4.2	Measuring Land Development	21
4.2.1	Number of Voting Local Features	22

4.2.2	Normalized Sum of Votes	22
4.2.3	Maximum Vote	22
4.2.4	Normalized Urban Area.....	22
4.2.5	Normalized Sum of Votes in the Urban Region	23
4.2.6	Fusion of Features	23
4.3	Sample Results	24
5	EXPERIMENTAL RESULTS	25
5.1	Urban Region Detection Using SIFT Descriptors and Graph Theory	25
5.1.1	Tests on Different Modules	28
5.1.2	Computation Times	28
5.2	Urban Region Detection Using Gabor Features	29
5.2.1	Tests on Parameter Values	30
5.2.2	The Overall Performance on Satellite Images	31
5.2.3	The Overall Performance on Aerial Images	32
5.2.4	Computation Time	33
5.3	Comparison of the Proposed Urban Region Detection Systems.....	35
5.4	Grading the Urban Region Using Local Features	36
5.4.1	Overall Performance	36
5.5	Comparison of the Proposed Land Development Measures	37
6	SUMMARY OF THE CHAPTER	39

Part III BUILDING DETECTION

7	PREVIOUS STUDIES ON BUILDING DETECTION	3
8	BUILDING DETECTION USING SIFT DESCRIPTORS AND GRAPH THEORY	7
8.1	Graph Cut Method to Detect Separate Buildings.....	7
9	BUILDING DETECTION USING DIFFERENT LOCAL FEATURES	11
9.1	Local Feature Vector Extraction	11
9.1.1	Harris Corner based Local Feature Vectors	11
9.1.2	GMSR based Local Feature Vectors.....	13
9.1.3	Gabor Filtering based Local Feature Vectors	14
9.2	Building Detection	15
9.2.1	Kernel based Density Estimation	15
9.2.2	Detecting Buildings using Variable Kernel based Density Estimation	17
9.2.3	Data and Decision Fusion for Building Detection	19
10	BUILDING DETECTION USING STEERABLE FILTERS	21
10.1	Edge Detection with Steerable Filters	21
10.2	Building Detection	23

11 BUILDING DETECTION USING COLOR INDICES	25
11.1 Detecting Buildings	25
11.1.1 Detecting Rooftop and Shadow Pixels	25
11.1.2 Estimating the Illumination Direction	26
11.1.3 Verifying the Building Appearance	27
11.2 Determining the Building Shape with a Novel Approach	27
11.3 Validity of Results	29
12 DAMAGED BUILDING DETECTION USING SHADOW INFORMATION	33
12.1 Detecting Buildings and their Shadows	33
12.2 Measuring the Degree of Damage	35
13 EXPERIMENTAL RESULTS	37
13.1 Building Detection Using SIFT Descriptors and Graph Theory	37
13.1.1 Tests on Different Modules	40
13.1.2 Tests on Parameter Values	40
13.1.3 Comparison with Derivative of Morphological Profiles	41
13.1.4 Computation Times	42
13.2 Building Detection Using Harris, GMSR and Gabor based Local Features	43
13.2.1 Building Detection Results on Satellite Images	43
13.2.2 Building Detection Results on Aerial Images	45
13.3 Building Detection by Fusing Different Local Features	47
13.3.1 Building Detection Results on Satellite Images	47
13.3.2 Building Detection Results on Aerial Images	47
13.3.3 Computation Times	50
13.4 Building Detection Using Steerable Filters	50
13.4.1 Building Detection on Satellite Images	51
13.4.2 Building Detection on Aerial Images	52
13.5 Building Detection Using Color Indices	53
13.6 Damaged Building Detection Using Shadow Information	53
13.7 Comparison of the Proposed Building Detection Methods	56
14 SUMMARY OF THE CHAPTER	59

Part IV ROAD DETECTION

15 PREVIOUS STUDIES ON ROAD DETECTION	3
16 ROAD DETECTION USING STEERABLE FILTERS	5
16.1 Preprocessing	5
16.2 Extracting Road Features using Steerable Filtering	5
16.3 Grouping Extracted Features to Detect Road Centers	7
16.4 Road Tracking	8

17 ROAD DETECTION USING COLOR INFORMATION	11
17.1 Training the Classifier with Invariant Color Features	11
17.2 Detecting Asphalt Roads Using One Class Classifier	11
18 EXPERIMENTAL RESULTS	15
18.1 Road Detection Using Steerable Filters	15
18.2 Road Detection Using Color Information	18
18.3 Comparison of the Proposed Road Detection Methods	22
19 SUMMARY OF THE CHAPTER	23

Part V CONCLUSIONS

References	5
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