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Optical Remote Sensing

Advances in Signal Processing and Exploitation Techniques

Springer

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Preface

The evolution of optical remote sensing over the past few decades has enabled the availability of rich spatial, spectral and temporal information to remote sensing analysts. Although this has opened the doors to immense possibilities for analysis of optical remotely sensed imagery, it has also necessitated advancements in signal processing and exploitation algorithms to keep up with advances in the quality and quantity of available data. As an example, the transition from multispectral to hyperspectral imagery requires conventional statistical pattern classification algorithms to be modified to effectively extract useful information from the high dimensional hyperspectral feature space. Although hyperspectral imagery is expected to provide a much detailed spectral response per pixel, conventional algorithms developed and perfected for multispectral data would often be sub-optimal for hyperspectral data. At best, they would require a significant increase in the ground-truth (training) data employed for analysis—something that is often hard to come by, and is often far too costly. As a result, signal processing and pattern recognition algorithms for analysis of such data are also evolving to cope with such issues and result in practical applications.

The last decade has seen significant advances in algorithms that represent, visualize and analyze optical remotely sensed data. These advances include new algorithms to effectively compress high dimensional imagery data for efficient storage and transmission; new techniques to effectively visualize remotely sensed data; new analysis and classification techniques to analyze and classify remotely sensed imagery; and techniques to fuse remotely sensed imagery acquired simultaneously from different sensing modalities. This book brings together leading experts in these fields with the goal of bringing the cutting edge in signal processing and exploitation research closer to users and developers of remote sensing technology. This book is not intended to be a textbook for introductory remote sensing analysis. There are existing textbooks that provide a tutorial introduction to signal and image processing methods for remote sensing. This book is intended to be a valuable reference to graduate students and researchers in the academia and the industry who are interested in keeping abreast with the current state-of-the-art in signal and image processing techniques for optical remote

sensing. This book consists of 15 chapters. Chapter 1 is an introductory chapter that sets the stage for the remainder of this book. In this chapter, we identify three key broad challenges and open problems associated with the analysis of modern optical remotely sensed imagery, and provide a motivation for each of the 14 chapters that follow within the context of these broad challenges. Chapters 2 through 6 present advances in algorithms for effective representation and visualization of high dimensional remotely sensed optical data, including on-board compressive sensing, coded aperture imaging and visualization techniques. Chapters 7 through 12 cover advances in statistical pattern classification and data analysis techniques, including multi-classifier systems and information fusion, morphological profiles, kernel methods, manifold learning and spectral pixel unmixing. Chapters 13 through 15 cover advances in multi-sensor data fusion techniques.

We would like to acknowledge and sincerely thank all contributors who participated in this collection. This book represents the state-of-the-art in signal and image processing research for optical remote sensing and would not have been possible if these contributors, who are leading experts in the field had not come together to work on these chapters. Their feedback and review of all chapters in this book was instrumental in making this a coherent and complete reference.

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