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Deep Learning for Hyperspectral Image Analysis and Classification

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Preface

With the rapid development in the field of science and technology, the Hyperspectral Image (HSI) analysis, being extensively broader and advanced technology, has acquired the wide as well as significant advancement in the conceptual, theoretical, and application level and has become an established discipline. It takes into account hundreds of contiguous spectral channels to discover earth resources that typical traditional vision sensors are unable to identify.

This book is an outcome of research efforts in machine learning based HSI processing over a decade, which is a new methodology from the HSI perspective. The title of the book "Deep Learning for Hyperspectral Image Understanding" represents that the main purpose of the book is to explore and define novel machine learning methods and techniques for the analysis and classification of the hyperspectral remote sensing scenes by incorporating spectral and spatial characteristics of the image. In particular, the prime target is on investigation and optimization of deep learning based deep feature extraction strategies. Furthermore, in the last chapter, we present the unsupervised traditional technique of sparse coding to effectively extract spatial features and design a framework to detect the redundancy and noise in the high-dimensional data. We hope the readers can experience both the merits and demerits of supervised deep learning versus the unsupervised sparse scheme in HSI area.

An important factor that makes this book different from other HSI books is that this book exploits theory, application, and analysis of HSI, starting from noise detection removal, deep learning based feature extraction and finally classification. The book is structured according to the deep learning methods in a sequentially associated chapters that are logically related to each other and can be studied backward and forward for additional details. More specifically, most of the experiments, simulated results, graphs, and experimental analysis comparisons have been organized to have a consistent and logical organization of both the HSI content and learning methods. Techniques are combined in such an integrated structure that readers can easily understand how the concepts were established and evolved.

This book can be considered as a complete recipe that covers techniques for HSI analysis. Some of these techniques such as unsupervised HSI noise detection removal, segmentation, and feature extraction are established and matured for practical implementation. They are evaluated and analyzed with extreme detail. Various deep learning techniques established in the book will also become really useful for the coming years. For this reason, we have made the book self-sufficient so that readers can effortlessly understand and implement the algorithms without much struggle. In doing so, we have incorporated comprehensive mathematical sources and experiments for explanation.

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This book comprises HSI work that has been researched and completed over a decade in the Department of Computer Science and Technology, Tsinghua University; BNRist; and Key Laboratory of Pervasive Computing, Ministry of Education; Beijing, China.

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