Hyperspectral Image Processing And Analysis System Hipas

Based on the integration of computer vision and spectrscopy techniques, hyperspectral imaging is a novel technology for obtaining both spatial and spectral information on a product. Used for nearly 20 years in the aerospace and military industries, more recently hyperspectral imaging has emerged and matured into one of the most powerful and rapidly growing methods of non-destructive food quality analysis and control. Hyperspectral Imaging for Food Quality Analysis and Control provides the core information about how this proven science can be practically applied for food quality assessment, including information on the equipment available and selection of the most appropriate of those instruments. Additionally, real-world food-industry-based examples are included, giving the reader important insights into the actual application of the science in evaluating food products. Presentation of principles and instruments provides core understanding of how this science performs, as well as guideline on selecting the most appropriate equipment for implementation Includes real-world, practical application to demonstrate the viability and challenges of working with this technology Provides necessary information for making correct

determination on use of hyperspectral imaging
This book presents a collection of high-quality research by leading experts in computer vision and its applications. Each of the 16 chapters can be read independently and discusses the principles of a specific topic, reviews up-to-date techniques, presents outcomes, and highlights the challenges and future directions. As such the book explores the latest trends in fashion creative processes, facial features detection, visual odometry, transfer learning, face recognition, feature description, plankton and scene classification, video face alignment, video searching, and object segmentation. It is intended for postgraduate students, researchers, scholars and developers who are interested in computer vision and connected research disciplines, and is also suitable for senior undergraduate students who are taking advanced courses in related topics. However, it is also provides a valuable reference resource for practitioners from industry who want to keep abreast of recent developments in this dynamic, exciting and profitable research field.
With the widespread availability of satellite and aircraft remote sensing image data in digital form, and the ready access most remote sensing practitioners have to computing systems for image interpretation, there is a need to draw together the range of digital image processing procedures and

methodologies commonly used in this field into a single treatment. It is the intention of this book to provide such a function, at a level meaningful to the non-specialist digital image analyst, but in sufficient detail that algorithm limitations, alternative procedures and current trends can be appreciated. Often the applications specialist in remote sensing wishing to make use of digital processing procedures has had to depend upon either the mathematically detailed treatments of image processing found in the electrical engineering and computer science literature, or the sometimes necessarily superficial treatments given in general texts on remote sensing. This book seeks to redress that situation. Both image enhancement and classification techniques are covered making the material relevant in those applications in which photointerpretation is used for information extraction and in those wherein information is obtained by classification.

The book covers the most crucial parts of real-time hyperspectral image processing: causality and real-time capability. Recently, two new concepts of real time hyperspectral image processing, Progressive HyperSpectral Imaging (PHSI) and Recursive HyperSpectral Imaging (RHSI). Both of these can be used to design algorithms and also form an integral part of real time hyperpsectral image processing. This book focuses on progressive nature in algorithms on their real-time and causal processing

implementation in two major applications, endmember finding and anomaly detection, both of which are fundamental tasks in hyperspectral imaging but generally not encountered in multispectral imaging. This book is written to particularly address PHSI in real time processing, while a book, Recursive Hyperspectral Sample and Band Processing: Algorithm Architecture and Implementation (Springer 2016) can be considered as its companion book.

Hyperspectral Imaging Analysis and Applications for Food Quality

Physics, Sensors, and Algorithms

Remote Sensing Image Analysis: Including the Spatial Domain

Algorithm Design and Analysis

Hyperspectral Imaging for Food Quality Analysis and Control

Models and Methods for Image Processing

Hyperspectral Remote Sensing: Theory and Applications offers the latest information on the techniques, advances and wide-ranging applications of hyperspectral remote sensing, such as forestry, agriculture, water resources, soil and geology, among others. The book also presents hyperspectral data integration with other sources, such as LiDAR, Multi-spectral data, and other remote sensing techniques. Researchers who use this resource will be able to understand and

implement the technology and data in their respective fields. As such, it is a valuable reference for researchers and data analysts in remote sensing and Earth Observation fields and those in ecology, agriculture, hydrology and geology. Includes the theory of hyperspectral remote sensing, along with techniques and applications across a variety of disciplines Presents the processing, methods and techniques utilized for hyperspectral remote sensing and in-situ data collection Provides an overview of the state-of-the-art, including algorithms, techniques and case studies

A practical and self-contained guide to the principles, techniques, models and tools of imaging spectroscopy. Bringing together material from essential physics and digital signal processing, it covers key topics such as sensor design and calibration, atmospheric inversion and model techniques, and processing and exploitation algorithms. Readers will learn how to apply the main algorithms to practical problems, how to choose the best algorithm for a particular application, and how to process and interpret hyperspectral imaging data. A wealth of additional materials accompany the book online, including example projects and data for students, and problem solutions and viewgraphs for instructors. This is an essential text for senior undergraduate and graduate students looking to learn the fundamentals of imaging spectroscopy, and an

invaluable reference for scientists and engineers working in the field.
This book focuses on deep learning-based methods for hyperspectral image (HSI) analysis. Unsupervised spectral-spatial adaptive band-noise factor-based formulation is devised for HSI noise detection and band categorization. The method to characterize the bands along with the noise estimation of HSIs will benefit subsequent remote sensing techniques significantly. This book develops on two fronts: On the one hand, it is aimed at domain professionals who want to have an updated overview of how hyperspectral acquisition techniques can combine with deep learning architectures to solve specific tasks in different application fields. On the other hand, the authors want to target the machine learning and computer vision experts by giving them a picture of how deep learning technologies are applied to hyperspectral data from a multidisciplinary perspective. The presence of these two viewpoints and the inclusion of application fields of remote sensing by deep learning are the original contributions of this review, which also highlights some potentialities and critical issues related to the observed development trends.
Hyperspectral remote sensing is an emerging, multidisciplinary field with diverse applications that builds on the principles of material spectroscopy, radiative transfer, imaging spectrometry, and hyperspectral data

processing. While there are many resources that suitably cover these areas individually and focus on specific aspects of the hyperspectral remote sensing field, this book provides a holistic treatment that thoroughly captures its multidisciplinary nature. The content is oriented toward the physical principles of hyperspectral remote sensing as opposed to applications of hyperspectral technology. Readers can expect to finish the book armed with the required knowledge to understand the immense literature available in this technology area and apply their knowledge to the understanding of material spectral properties, the design of hyperspectral systems, the analysis of hyperspectral imagery, and the application of the technology to specific problems.

An Introduction

Processing and Analysis of Hyperspectral Data

Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data

Techniques for Spectral Detection and Classification

High Performance Computing in Remote Sensing

Understanding Hyperspectral Image and Signal Processing

Graph spectral image processing is the study of imaging data from a graph frequency perspective. Modern image sensors capture a wide range of visual data including high spatial resolution/high bit-depth 2D images and

videos, hyperspectral images, light field images and 3D point clouds. The field of graph signal processing – extending traditional Fourier analysis tools such as transforms and wavelets to handle data on irregular graph kernels – provides new flexible computational tools to analyze and process these varied types of imaging data. Recent methods combine graph signal processing ideas with deep neural network architectures for enhanced performances, with robustness and smaller memory requirements. The book is divided into two parts. The first is centered on the fundamentals of graph signal processing theories, including graph filtering, graph learning and graph neural networks. The second part details several imaging applications using graph signal processing tools, including image and video compression, 3D image compression, image restoration, point cloud processing, image segmentation and image classification, as well as the use of graph neural networks for image processing.

Hyperspectral imaging is utilised in

many applications, where measured data are processed, interpreted and converted into physical, chemical and/or biological properties of the target objects and/or processes being studied. In this thesis, various methods were proposed and applied to crop reflectance data (acquired by hand-held spectrometers) to detect, characterise and quantify disease severity and plant density. Furthermore, various surface water quality parameters of inland waters have been monitored using hyperspectral images acquired by airborne systems. However, the large size of these images raises the need for efficient data reduction. A new type of self-organising weighted neural networks was proposed and used for efficient reduction, mapping and clustering of large high-dimensional data sets, such as hyperspectral images. Finally, the analysis can be reversed to generate high resolution spectra from simpler measurements using multiple colour-filter mosaics, as suggested in the thesis. The acquired instantaneous image is demosaicked to generate a

multi-band image that can finally be transformed into a hyperspectral image. This book is about the novel aspects and future trends of the hyperspectral imaging in agriculture, food, and environment. The topics covered by this book are hyperspectral imaging and their applications in the nondestructive quality assessment of fruits and vegetables, hyperspectral imaging for assessing quality and safety of meat, multimode hyperspectral imaging for food quality and safety, models fitting to pattern recognition in hyperspectral images, sequential classification of hyperspectral images, graph construction for hyperspectral data unmixing, target visualization method to process hyperspectral image, and soil contamination mapping with hyperspectral imagery. This book is a general reference work for students, professional engineers, and readers with interest in the subject.

Earth observation is the field of science concerned with the problem of monitoring and modeling the processes on the Earth surface and their interaction with the atmosphere. The

Earth is continuously monitored with advanced optical and radar sensors. The images are analyzed and processed to deliver useful products to individual users, agencies and public administrations. To deal with these problems, remote sensing image processing is nowadays a mature research area, and the techniques developed in the field allow many real-life applications with great societal value. For instance, urban monitoring, fire detection or flood prediction can have a great impact on economical and environmental issues. To attain such objectives, the remote sensing community has turned into a multidisciplinary field of science that embraces physics, signal theory, computer science, electronics and communications. From a machine learning and signal/image processing point of view, all the applications are tackled under specific formalisms, such as classification and clustering, regression and function approximation, data coding, restoration and enhancement, source unmixing, data fusion or feature selection and

extraction. This book covers some of the fields in a comprehensive way. Table of Contents: Remote Sensing from Earth Observation Satellites / The Statistics of Remote Sensing Images / Remote Sensing Feature Selection and Extraction / {Classification / Spectral Mixture Analysis / Estimation of Physical Parameters

20th Scandinavian Conference, SCIA 2017, Tromsø, Norway, June 12–14, 2017, Proceedings, Part I

Fundamentals and Practices

Recent Advances in Computer Vision

Handbook Of Pattern Recognition And Computer Vision (2nd Edition)

2019 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT)

Theory and Applications

Hyperspectral Imaging, Volume 32, presents a comprehensive exploration of the different analytical methodologies applied on hyperspectral imaging and a state-of-the-art analysis of applications in different scientific and industrial areas. This book presents, for the first time, a comprehensive collection of the main

multivariate algorithms used for hyperspectral image analysis in different fields of application. The benefits, drawbacks and suitability of each are fully discussed, along with examples of their application. Users will find state-of-the art information on the machinery for hyperspectral image acquisition, along with a critical assessment of the usage of hyperspectral imaging in diverse scientific fields. Provides a comprehensive roadmap of hyperspectral image analysis, with benefits and considerations for each method discussed Covers state-of-the-art applications in different scientific fields Discusses the implementation of hyperspectral devices in different environments

This book includes some very recent applications and the newest emerging trends of hyper-spectral imaging (HSI). HSI is a very recent and strange beast, a sort of a melting pot of previous techniques and scientific interests, merging and concentrating the efforts of physicists, chemists, botanists, biologists, and physicians, to mention

just a few, as well as experts in data crunching and statistical elaboration. For almost a century, scientific observation, from looking to planets and stars down to our own cells and below, could be divided into two main categories: analyzing objects on the basis of their physical dimension (recording size, position, weight, etc. and their variations) or on how the object emits, reflects, or absorbs part of the electromagnetic spectrum, i.e., spectroscopy. While the two aspects have been obviously entangled, instruments and skills have always been clearly distinct from each other. With HSI now available, this is no longer the case. This instrument can return specimen dimensionalities and spectroscopic properties to any single pixel of your specimen, in a single set of data. HSI modality is ubiquitous and scale-invariant enough to be used to mark terrestrial resources on the basis of a land map obtained from satellite observation (actually, the oldest application of this type) or to understand if the cell you are looking at is cancerous or perfectly healthy.

For all these reasons, HSI represents one of the most exciting methodologies of the new millennium.

Based on the authors' research, this book introduces the main processing techniques in hyperspectral imaging. In this context, SVM-based classification, distance comparison-based endmember extraction, SVM-based spectral unmixing, spatial attraction model-based sub-pixel mapping and MAP/POCS-based super-resolution reconstruction are discussed in depth. Readers will gain a comprehensive understanding of these cutting-edge hyperspectral imaging techniques. Researchers and graduate students in fields such as remote sensing, surveying and mapping, geosciences and information systems will benefit from this valuable resource.

Chemical Imaging Analysis covers the advancements made over the last 50 years in chemical imaging analysis, including different analytical techniques and the ways they were developed and refined to link the composition and structure of manmade and natural materials at the nano/micro

scale to the functional behavior at the macroscopic scale. In a development process that started in the early 1960s, a variety of specialized analytical techniques was developed - or adapted from existing techniques - and these techniques have matured into versatile and powerful tools for visualizing structural and compositional heterogeneity. This text explores that journey, providing a general overview of imaging techniques in diverse fields, including mass spectrometry, optical spectrometry including X-rays, electron microscopy, and beam techniques. Provides comprehensive coverage of analytical techniques used in chemical imaging analysis Explores a variety of specialized techniques Provides a general overview of imaging techniques in diverse fields

Image Analysis

Resolving Spectral Mixtures

Remote Sensing Digital Image Analysis

Hyperspectral Data Processing

Remote Sensing Image Processing

Real-Time Progressive Hyperspectral Image Processing

Hyperspectral Imaging: Techniques for Spectral Detection and Classification is an outgrowth of the research conducted over the years in the Remote Sensing Signal and Image Processing Laboratory (RSSIPL) at the University of Maryland, Baltimore County. It explores applications of statistical signal processing to hyperspectral imaging and further develops non-literal (spectral) techniques for subpixel detection and mixed pixel classification. This text is the first of its kind on the topic and can be considered a recipe book offering various techniques for hyperspectral data exploitation. In particular, some known techniques, such as OSP (Orthogonal Subspace Projection) and CEM (Constrained Energy Minimization) that were previously developed in the RSSIPL, are discussed in great detail. This book is self-contained and can serve as a valuable and useful reference for researchers in academia and practitioners in government and industry.

This book explores recursive architectures in designing progressive hyperspectral imaging algorithms. In particular, it makes progressive imaging algorithms recursive by introducing the concept of Kalman filtering in algorithm design so that hyperspectral imagery can be processed not only progressively sample by sample or band by band but also recursively via recursive equations. This book can be considered a companion book of author's books, Real-Time Progressive Hyperspectral Image Processing, published by Springer in 2016. Explores recursive structures in algorithm architecture Implements algorithmic recursive architecture in conjunction with progressive sample and band processing Derives Recursive Hyperspectral Sample Processing (RHSP) techniques according to Band-Interleaved Sample/Pixel (BIS/BIP) acquisition format Develops Recursive

Hyperspectral Band Processing (RHBP) techniques according to Band SeQuential (BSQ) acquisition format for hyperspectral data

Written by leaders in the field of remote sensing information processing, this book covers the frontiers of remote sensors, especially with effective algorithms for signal/image processing and pattern recognition with remote sensing data. Sensor and data fusion issues, SAR images, hyperspectral images, and related special topics are also examined. Techniques making use of neural networks, wavelet transforms, and knowledge-based systems are emphasized. A special set of three chapters is devoted to seismic analysis and discrimination. In summary, the book provides an authoritative treatment of major topics in remote sensing information processing and defines new frontiers for these areas. Contents: Data Mining; SAR Image Processing; Wavelet Analysis and Applications; Military Applications of Remote Sensing; Microwave Remote Sensing; Statistical Pattern Recognition; Automatic Target Segmentation; Neural Networks; Change Detection; Seismic Signal Processing; Time Series Prediction; Image Compression; Emerging Topics. Readership: Engineers and scientists dealing with remote sensing data in particular, and signals and images in general; computer scientists involved in software development on geophysical data analysis.

Authored by a panel of experts in the field, this book focuses on hyperspectral image analysis, systems, and applications. With discussion of application-based projects and case studies, this professional reference will bring you up-to-date on this pervasive technology, wether you are working in the military and defense fields, or in remote sensing technology,

geoscience, or agriculture.

Hyperspectral Imaging Technology in Food and Agriculture

Algorithm Architecture and Implementation

With Applications from Ultrafast Time-Resolved Spectroscopy to Super-Resolution Imaging

Hyperspectral Imaging

With Algorithms for Python, Fourth Edition

Advances in Machine Learning and Signal Processing

Image Analysis, Classification and Change Detection in Remote Sensing: With Algorithms for Python, Fourth Edition, is focused on the development and implementation of statistically motivated, data-driven techniques for digital image analysis of remotely sensed imagery and it features a tight interweaving of statistical and machine learning theory of algorithms with computer codes. It develops statistical methods for the analysis of optical/infrared and synthetic aperture radar (SAR) imagery, including wavelet transformations, kernel methods for nonlinear classification, as well as an introduction to deep learning in the context of feed forward neural networks. New in the Fourth Edition: An in-depth treatment of a recent sequential change detection algorithm for polarimetric SAR image time series. The accompanying software consists of Python (open source) versions of all of the main image analysis algorithms. Presents easy, platform-independent software installation methods (Docker containerization). Utilizes freely accessible imagery via the Google Earth Engine and provides many examples of cloud programming (Google Earth Engine API). Examines deep learning

examples including TensorFlow and a sound introduction to neural networks, Based on the success and the reputation of the previous editions and compared to other textbooks in the market, Professor Canty's fourth edition differs in the depth and sophistication of the material treated as well as in its consistent use of computer codes to illustrate the methods and algorithms discussed. It is self-contained and illustrated with many programming examples, all of which can be conveniently run in a web browser. Each chapter concludes with exercises complementing or extending the material in the text.

Hyperspectral imagery has received considerable attention in the last decade as it provides rich spectral information and allows the analysis of objects that are unidentifiable by traditional imaging techniques. It has a wide range of applications, including remote sensing, industry sorting, food analysis, biomedical imaging, etc. However, in contrast to RGB images from which information can be intuitively extracted, hyperspectral data is only useful with proper processing and analysis. This book covers theoretical advances of hyperspectral image processing and applications of hyperspectral processing, including unmixing, classification, super-resolution, and quality estimation with classical and deep learning methods.

The first of its kind, this book reviews image processing tools and techniques including Independent Component Analysis, Mutual Information, Markov Random Field Models and Support Vector Machines. The book also explores a number of experimental examples based on

a variety of remote sensors. The book will be useful to people involved in hyperspectral imaging research, as well as by remote-sensing data like geologists, hydrologists, environmental scientists, civil engineers and computer scientists.

The very significant advances in computer vision and pattern recognition and their applications in the last few years reflect the strong and growing interest in the field as well as the many opportunities and challenges it offers. The second edition of this handbook represents both the latest progress and updated knowledge in this dynamic field. The applications and technological issues are particularly emphasized in this edition to reflect the wide applicability of the field in many practical problems. To keep the book in a single volume, it is not possible to retain all chapters of the first edition. However, the chapters of both editions are well written for permanent reference. This indispensable handbook will continue to serve as an authoritative and comprehensive guide in the field.

Deep Learning for Hyperspectral Image Analysis and Classification

Handbook of Blind Source Separation

The Future of Hyperspectral Imaging

Real-Time Recursive Hyperspectral Sample and Band Processing

Hyperspectral Image Generation, Processing and Analysis

Hyperspectral Remote Sensing

Hyperspectral Data Processing: Algorithm Design andAnalysis is a culmination of the research

conducted in theRemote Sensing Signal and Image Processing Laboratory (RSSIPL) atthe University of Maryland, Baltimore County. Specifically, ittreats hyperspectral image processing and hyperspectral signalprocessing as separate subjects in two different categories. Mostmaterials covered in this book can be used in conjunction with theauthor's first book, Hyperspectral Imaging: Techniques forSpectral Detection and Classification, without muchoverlap. Many results in this book are either new or have not beenexplored, presented, or published in the public domain. Theseinclude various aspects of endmember extraction, unsupervisedlinear spectral mixture analysis, hyperspectral informationcompression, hyperspectral signal coding and characterization, aswell as applications to conceal target detection, multispectralimaging, and magnetic resonance imaging. Hyperspectral DataProcessing contains eight major sections: Part I: provides fundamentals of hyperspectral dataprocessing Part II: offers various algorithm designs for endmemberextraction Part III: derives theory for supervised linear spectral mixtureanalysis Part IV: designs unsupervised methods for hyperspectral imageanalysis Part V: explores new concepts on hyperspectral informationcompression Parts VI & VII: develops techniques for hyperspectralsignal coding and characterization Part VIII: presents applications in multispectral imaging andmagnetic resonance

imaging Hyperspectral Data Processing compiles an algorithmcompendium with MATLAB codes in an appendix to help readersimplement many important algorithms developed in this book andwrite their own program codes without relying on softwarepackages. Hyperspectral Data Processing is a valuable reference forthose who have been involved with hyperspectral imaging and itstechniques, as well those who are new to the subject.

Hyperspectral imaging or imaging spectroscopy is a novel technology for acquiring and analysing an image of a real scene by computers and other devices in order to obtain quantitative information for quality evaluation and process control. Image processing and analysis is the core technique in computer vision. With the continuous development in hardware and software for image processing and analysis, the application of hyperspectral imaging has been extended to the safety and quality evaluation of meat and produce. Especially in recent years, hyperspectral imaging has attracted much research and development attention, as a result rapid scientific and technological advances have increasingly taken place in food and agriculture, especially on safety and quality inspection, classification and evaluation of a wide range of food products, illustrating the great advantages of using the technology for objective, rapid, non-destructive and automated safety inspection as well as quality control. Therefore, as the first reference book in the area,

Hyperspectral Imaging Technology in Food and Agriculture focuses on these recent advances. The book is divided into three parts, which begins with an outline of the fundamentals of the technology, followed by full covering of the application in the most researched areas of meats, fruits, vegetables, grains and other foods, which mostly covers food safety and quality as well as remote sensing applicable for crop production. Hyperspectral Imaging Technology in Food and Agriculture is written by international peers who have both academic and professional credentials, with each chapter addressing in detail one aspect of the relevant technology, thus highlighting the truly international nature of the work. Therefore the book should provide the engineer and technologist working in research, development, and operations in the food and agricultural industry with critical, comprehensive and readily accessible information on the art and science of hyperspectral imaging technology. It should also serve as an essential reference source to undergraduate and postgraduate students and researchers in universities and research institutions. Explores the application of statistical signal processing to hyperspectral imaging and further develops non-literal (spectral) techniques for subpixel detection and mixed pixel classification. This text is the first of its kind on the topic anc can be considered a recipe book offering various techniques for hyperspectral data exploitation.

Solutions for Time-Critical Remote Sensing Applications The recent use of latest-generation sensors in airborne and satellite platforms is producing a nearly continual stream of high-dimensional data, which, in turn, is creating new processing challenges. To address the computational requirements of time-critical applications, researchers have begun incorporating high performance computing (HPC) models in remote sensing missions. High Performance Computing in Remote Sensing is one of the first volumes to explore state-of-the-art HPC techniques in the context of remote sensing problems. It focuses on the computational complexity of algorithms that are designed for parallel computing and processing. A Diverse Collection of Parallel Computing Techniques and Architectures The book first addresses key computing concepts and developments in remote sensing. It also covers application areas not necessarily related to remote sensing, such as multimedia and video processing. Each subsequent chapter illustrates a specific parallel computing paradigm, including multiprocessor (cluster-based) systems, large-scale and heterogeneous networks of computers, grid computing platforms, and specialized hardware architectures for remotely sensed data analysis and interpretation. An Interdisciplinary Forum to Encourage Novel Ideas The extensive reviews of current and future developments combined with thoughtful perspectives on the potential

challenges of adapting HPC paradigms to remote sensing problems will undoubtedly foster collaboration and development among many fields.

Independent Component Analysis and Applications
Graph Spectral Image Processing
Frontiers of Remote Sensing Information Processing
Endmember Finding and Anomaly Detection
Hyperspectral Data Exploitation

The 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT) aims to provide a forum that brings together International researchers from academia and practitioners in the industry to meet and exchange ideas and recent research work on all aspects of Information and Communication Technologies including Computing, communication, IOT, LiDAR, Image Analysis, wireless communication and other new technologies

The two-volume set LNCS 10269 and 10270 constitutes the refereed proceedings of the 20th Scandinavian Conference on Image Analysis, SCIA 2017, held in Tromsø, Norway, in June 2017. The 87 revised papers presented were carefully reviewed and selected from 133 submissions. The contributions are structured in topical sections on history of SCIA; motion analysis and 3D vision; pattern detection and

recognition; machine learning; image processing and applications; feature extraction and segmentation; remote sensing; medical and biomedical image analysis; faces, gestures and multispectral analysis.

This book is a completely updated, greatly expanded version of the previously successful volume by the author. The Second Edition includes new results and data, and discusses a unified framework and rationale for designing and evaluating image processing algorithms. Written from the viewpoint that image processing supports remote sensing science, this book describes physical models for remote sensing phenomenology and sensors and how they contribute to models for remote-sensing data. The text then presents image processing techniques and interprets them in terms of these models. Spectral, spatial, and geometric models are used to introduce advanced image processing techniques such as hyperspectral image analysis, fusion of multisensor images, and digital elevationmodel extraction from stereo imagery. The material is suited for graduate level engineering, physical and natural science courses, or practicing remote sensing scientists. Each chapter is enhanced by student exercises designed to stimulate an understanding of the material. Over 300 figuresare produced

specifically for this book, and numerous tables provide a rich bibliography of the research literature.

This book reviews the state of the art in algorithmic approaches addressing the practical challenges that arise with hyperspectral image analysis tasks, with a focus on emerging trends in machine learning and image processing/understanding. It presents advances in deep learning, multiple instance learning, sparse representation based learning, low-dimensional manifold models, anomalous change detection, target recognition, sensor fusion and super-resolution for robust multispectral and hyperspectral image understanding. It presents research from leading international experts who have made foundational contributions in these areas. The book covers a diverse array of applications of multispectral/hyperspectral imagery in the context of these algorithms, including remote sensing, face recognition and biomedicine. This book would be particularly beneficial to graduate students and researchers who are taking advanced courses in (or are working in) the areas of image analysis, machine learning and remote sensing with multi-channel optical imagery. Researchers and professionals in academia and industry working in areas such as

electrical engineering, civil and environmental engineering, geosciences and biomedical image processing, who work with multi-channel optical data will find this book useful.

Remote Sensing

Hyperspectral Imaging Remote Sensing

Imaging Spectroscopy for Scene Analysis

Image Analysis, Classification and Change Detection in Remote Sensing

Theories and Applications

Hyperspectral Image Analysis

Resolving Spectral Mixtures: With Applications from Ultrafast Time-Resolved Spectroscopy to Superresolution Imaging offers a comprehensive look into the most important models and frameworks essential to resolving the spectral unmixing problem—from multivariate curve resolution and multi-way analysis to Bayesian positive source separation and nonlinear unmixing. Unravelling total spectral data into the contributions from individual unknown components with limited prior information is a complex problem that has attracted continuous interest for almost four decades. Spectral unmixing is a topic of interest in statistics, chemometrics, signal processing, and image analysis. For decades, researchers from these fields were often unaware of the work in other disciplines due to their different scientific and technical backgrounds and interest in different objects or samples. This led to the development of quite different approaches to solving the same problem. This multi-authored book will bridge the gap between disciplines with

contributions from a number of well-known and strongly active chemometric and signal processing research groups. Among chemists, multivariate curve resolution methods are preferred to extract information about the nature, amount, and location in time (process) and space (imaging and microscopy) of chemical constituents in complex samples. In signal processing, assumptions are usually around statistical independence of the extracted components. However, the chapters include the complexity of the spectral data to be unmixed as well as dimensionality and size of the data sets. Advanced spectroscopy is the key thread linking the different chapters. Applications cover a large part of the electromagnetic spectrum. Time-resolution ranges from femtosecond to second in process spectroscopy and spatial resolution covers the submicronic to macroscopic scale in hyperspectral imaging. Demonstrates how and why data analysis, signal processing, and chemometrics are essential to the spectral unmixing problem Guides the reader through the fundamentals and details of the different methods Presents extensive plots, graphical representations, and illustrations to help readers understand the features of different techniques and to interpret results Bridges the gap between disciplines with contributions from a number of well-known and highly active chemometric and signal processing research groups

In processing food, hyperspectral imaging, combined with intelligent software, enables digital sorters (or optical sorters) to identify and remove defects and foreign material that are invisible to traditional camera and laser sorters. Hyperspectral Imaging

Analysis and Applications for Food Quality explores the theoretical and practical issues associated with the development, analysis, and application of essential image processing algorithms in order to exploit hyperspectral imaging for food quality evaluations. It outlines strategies and essential image processing routines that are necessary for making the appropriate decision during detection, classification, identification, quantification, and/or prediction processes. Features Covers practical issues associated with the development, analysis, and application of essential image processing for food quality applications Surveys the breadth of different image processing approaches adopted over the years in attempting to implement hyperspectral imaging for food quality monitoring Explains the working principles of hyperspectral systems as well as the basic concept and structure of hyperspectral data Describes the different approaches used during image acquisition, data collection, and visualization The book is divided into three sections. Section I discusses the fundamentals of Imaging Systems: How can hyperspectral image cube acquisition be optimized? Also, two chapters deal with image segmentation, data extraction, and treatment. Seven chapters comprise Section II, which deals with Chemometrics. One explains the fundamentals of multivariate analysis and techniques while in six other chapters the reader will find information on and applications of a number of chemometric techniques: principal component analysis, partial least squares analysis, linear discriminant model, support vector machines, decision trees, and artificial neural networks. In the last section,

Applications, numerous examples are given of applications of hyperspectral imaging systems in fish, meat, fruits, vegetables, medicinal herbs, dairy products, beverages, and food additives.

This book presents a detailed analysis of spectral imaging, describing how it can be used for the purposes of material identification, object recognition and scene understanding. The opportunities and challenges of combining spatial and spectral information are explored in depth, as are a wide range of applications. Features: discusses spectral image acquisition by hyperspectral cameras, and the process of spectral image formation; examines models of surface reflectance, the recovery of photometric invariants, and the estimation of the illuminant power spectrum from spectral imagery; describes spectrum representations for the interpolation of reflectance and radiance values, and the classification of spectra; reviews the use of imaging spectroscopy for material identification; explores the recovery of reflection geometry from image reflectance; investigates spectro-polarimetric imagery, and the recovery of object shape and material properties using polarimetric images captured from a single view.

Hyperspectral Image AnalysisAdvances in Machine Learning and Signal ProcessingSpringer Nature

Hyperspectral Image Processing

Chemical Imaging Analysis

Hyperspectral Imaging in Agriculture, Food and Environment

Edited by the people who were forerunners in creating the field, together with contributions from 34 leading

international experts, this handbook provides the definitive reference on Blind Source Separation, giving a broad and comprehensive description of all the core principles and methods, numerical algorithms and major applications in the fields of telecommunications, biomedical engineering and audio, acoustic and speech processing. Going beyond a machine learning perspective, the book reflects recent results in signal processing and numerical analysis, and includes topics such as optimization criteria, mathematical tools, the design of numerical algorithms, convolutive mixtures, and time frequency approaches. This Handbook is an ideal reference for university researchers, R&D engineers and graduates wishing to learn the core principles, methods, algorithms, and applications of Blind Source Separation. Covers the principles and major techniques and methods in one book Edited by the pioneers in the field with contributions from 34 of the world ' s experts Describes the main existing numerical algorithms and gives practical advice on their design Covers the latest cutting edge topics: second order methods; algebraic identification of under-determined mixtures, time-frequency methods, Bayesian approaches, blind identification under non negativity approaches, semi-blind methods for communications Shows the applications of the methods to key application areas such as telecommunications, biomedical engineering, speech, acoustic, audio and music processing, while also giving a general method for developing applications

One of the first texts to focus on investigating, designing and implementing algorithms and computer programs as an introduction to the rapidly evolving field of hyperspectral image and signal processing Covering a range of applications, the authors provide a tutorial on hyperspectral image analysis, focusing on the mathematical, physical, and algorithmic models necessary to devise programs that can extract the useful information that is present in measured hyperspectral data. The amount of data produced by a hyperspectral imaging device can be enormous so care and advanced processing steps must be taken to efficiently and effectively extract information. The reader will learn about these processing steps. The authors take the readers through the topic step-by-step; from the physics foundations of the acquisition process, to the particular algorithms and families of processing tools for classification, feature selection/extraction, visualization, unmixing and classification. Homework problems are provided whereby some problems are mathematical in nature whereas others involve writing brief computer programs. Describes the science and hardware technology underlying hyperspectral image analysis. Focuses on the mathematical and algorithmic concepts for processing hyperspectral data. Teaches readers the conceptual basis of how the hundreds of bands in spectral pixels can be used to gather information about the materials and objects that are present in the field of view (or scene) of a hyperspectral camera. Outlines how to write programs

that can find things that are smaller than a single pixel, and in turn details how to write programs that can describe and classify components of a scene. Shows how programs can use spatial information together with spectral information to produce more accurate automated analyses of images. Illustrates methods with a number of examples from across several applications areas, such as estimating the extent of an oil spill, detecting toxic gases around industrial plants or for homeland security, imaging human tissue to aid medical diagnosis. Includes companion website hosted by the authors offering publicly available hyperspectral images and sample programs for processing, as well as Matlab code.

Advanced imaging spectral technology and hyperspectral analysis techniques for multiple applications are the key features of the book. This book will present in one volume complete solutions from concepts, fundamentals, and methods of acquisition of hyperspectral data to analyses and applications of the data in a very coherent manner. It will help readers to fully understand basic theories of HRS, how to utilize various field spectrometers and bioinstruments, the importance of radiometric correction and atmospheric correction, the use of analysis, tools and software, and determine what to do with HRS technology and data.

Remote Sensing image analysis is mostly done using only spectral information on a pixel by pixel basis. Information captured in neighbouring cells, or information about patterns surrounding the pixel of interest often provides

useful supplementary information. This book presents a wide range of innovative and advanced image processing methods for including spatial information, captured by neighbouring pixels in remotely sensed images, to improve image interpretation or image classification. Presented methods include different types of variogram analysis, various methods for texture quantification, smart kernel operators, pattern recognition techniques, image segmentation methods, sub-pixel methods, wavelets and advanced spectral mixture analysis techniques. Apart from explaining the working methods in detail a wide range of applications is presented covering land cover and land use mapping, environmental applications such as heavy metal pollution, urban mapping and geological applications to detect hydrocarbon seeps. The book is meant for professionals, PhD students and graduates who use remote sensing image analysis, image interpretation and image classification in their work related to disciplines such as geography, geology, botany, ecology, forestry, cartography, soil science, engineering and urban and regional planning.