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# Remote Sensing Digital Image Analysis An Introduction

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### INTRODUCTION

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### Remote Sensing Digital Image Analysis

#### An Introduction *Springer Science & Business Media*

Now in an updated edition that adds new and revised material, this book offers a comprehensive introduction to quantitative evaluation of satellite and aircraft derived remotely retrieved data. Each chapter includes practice problems.

### Remote Sensing Digital Image Analysis

#### An Introduction *Springer Science & Business Media*

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.

### Remote Sensing Digital Image Analysis

#### An Introduction *Springer Science & Business Media*

Possibly the greatest change confronting the practitioner and student of remote sensing in the period since the first edition of this text appeared in 1986 has been the enormous improvement in accessibility to image processing technology. Falling hardware and software costs, combined with an increase in functionality through the development of extremely versatile user interfaces, has meant that even the user unskilled in computing now has immediate and ready access to powerful and

flexible means for digital image analysis and enhancement. An understanding, at algorithmic level, of the various methods for image processing has become therefore even more important in the past few years to ensure the full capability of digital image processing is utilised. This period has also been a busy one in relation to digital data supply. Several nations have become satellite data gatherers and providers, using both optical and microwave technology. Practitioners and researchers are now faced, therefore, with the need to be able to process imagery from several sensors, together with other forms of spatial data. This has been driven, to an extent, by developments in Geographic Information Systems (GIS) which, in tum, have led to the appearance of newer image processing procedures as adjuncts to more traditional approaches.

**Remote Sensing Digital Image Analysis** *Springer*

Remote Sensing Digital Image Analysis provides a comprehensive treatment of the methods used for the processing and interpretation of remotely sensed image data. Over the past decade there have been continuing and significant developments in the algorithms used for the analysis of remote sensing imagery, even though many of the fundamentals have substantially remained the same. As with its predecessors this new edition again presents material that has retained value but also includes newer techniques, covered from the perspective of operational remote sensing. The book is designed as a teaching text for the senior undergraduate and postgraduate student, and as a fundamental treatment for those engaged in research using digital image analysis in remote sensing. The presentation level is for the mathematical non-specialist. Since the very great number of operational users of remote sensing come from the earth sciences communities, the text is pitched at a level commensurate with their background. The chapters progress logically through means for the acquisition of remote sensing images, techniques by which they can be corrected, and methods for their interpretation. The prime focus is on applications of the methods, so that worked examples are included and a set of problems conclude each chapter.

**Remote Sensing Digital Image Analysis** *Springer Nature*

**Remote Sensing Digital Image Analysis**

**An Introduction** *Springer Science & Business Media*

Revised and enlarged to reflect new developments in the field, the fourth edition of this well-established text provides an introduction to quantitative evaluation of satellite- and aircraft-derived remotely retrieved data. Each chapter covers the pros and cons of digital remotely sensed data, without detailed mathematical treatment of computer based algorithms, but in a manner conducive to an understanding of their capabilities and limitations.

**Remote Sensing Image Analysis: Including the Spatial Domain** *Springer Science & Business Media*

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.

**Artificial Intelligence Techniques for Satellite Image Analysis** *Springer Nature*

The main objective of this book is to provide a common platform for diverse concepts in satellite image processing. In particular it presents the state-of-the-art in Artificial Intelligence (AI) methodologies and shares findings that can be translated into real-time applications to benefit humankind. Interdisciplinary in its scope, the book will be of interest to both newcomers and experienced scientists working in the fields of satellite image processing, geo-engineering, remote sensing and Artificial Intelligence. It can be also used as a supplementary textbook for graduate students in various engineering branches related to image processing.

**Remote Sensing Time Series Image Processing** *CRC Press*

Today, remote sensing technology is an essential tool for understanding the Earth and managing human-Earth interactions. There is a rapidly growing need for remote sensing and Earth observation technology that enables monitoring of world’s natural resources and environments, managing exposure to natural and man-made risks and more frequently occurring disasters, and helping the sustainability and productivity of natural and human ecosystems. The improvement in temporal resolution/revisit allows for the large accumulation of images for a specific location, creating a possibility for time series image analysis and eventual real-time assessments of scene dynamics. As an authoritative text, Remote Sensing Time Series Image Processing brings together active and recognized authors in the field of time series image analysis and presents to the readers the current state of knowledge and its future directions. Divided into three parts, the first addresses methods and techniques for generating time series image datasets. In particular, it provides guidance on the selection of cloud and cloud shadow detection algorithms for various applications. Part II examines feature development and information extraction methods for time series imagery. It presents some key remote sensing-based metrics, and their major applications in ecosystems and climate change studies. Part III illustrates various applications of time series image processing in land cover change, disturbance attribution, vegetation dynamics, and urbanization. This book is intended for researchers, practitioners, and students in both remote sensing and imaging science. It can be used as a textbook by undergraduate and graduate students majoring in remote sensing, imaging science, civil and electrical engineering, geography, geosciences, planning, environmental science, land use, energy, and GIS, and as a reference book by practitioners and professionals in the government, commercial, and industrial sectors.

**Image Processing and GIS for Remote Sensing**

**Techniques and Applications** *John Wiley & Sons*

Following the successful publication of the 1st edition in 2009, the 2nd edition maintains its aim to provide an application-driven package of essential techniques in image processing and GIS, together

with case studies for demonstration and guidance in remote sensing applications. The book therefore has a “3 in 1” structure which pinpoints the intersection between these three individual disciplines and successfully draws them together in a balanced and comprehensive manner. The book conveys in-depth knowledge of image processing and GIS techniques in an accessible and comprehensive manner, with clear explanations and conceptual illustrations used throughout to enhance student learning. The understanding of key concepts is always emphasised with minimal assumption of prior mathematical experience. The book is heavily based on the authors’ own research. Many of the author-designed image processing techniques are popular around the world. For instance, the SFIM technique has long been adopted by ASTRIUM for mass-production of their standard “Pan-sharpen” imagery data. The new edition also includes a completely new chapter on subpixel technology and new case studies, based on their recent research.

**Object-Based Image Analysis**

**Spatial Concepts for Knowledge-Driven Remote Sensing Applications** *Springer Science & Business Media*

This book brings together a collection of invited interdisciplinary perspectives on the recent topic of Object-based Image Analysis (OBIA). Its content is based on select papers from the 1 OBIA International Conference held in Salzburg in July 2006, and is enriched by several invited chapters. All submissions have passed through a blind peer-review process resulting in what we believe is a timely volume of the highest scientific, theoretical and technical standards. The concept of OBIA first gained widespread interest within the GIScience (Geographic Information Science) community circa 2000, with the advent of the first commercial software for what was then termed ‘object-oriented image analysis’. However, it is widely agreed that OBIA builds on older segmentation, edge-detection and classification concepts that have been used in remote sensing image analysis for several decades. Nevertheless, its emergence has provided a new critical bridge to spatial concepts applied in multiscale landscape analysis, Geographic Information Systems (GIS) and the synergy between image-objects and their radiometric characteristics and analyses in Earth Observation data (EO).

**Image Analysis, Classification and Change Detection in Remote Sensing**

**With Algorithms for Python, Fourth Edition** *CRC Press*

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.

**Remote Sensing**

**Models and Methods for Image Processing** *Elsevier*

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.

**Radar Interferometry**

**Data Interpretation and Error Analysis** *Springer Science & Business Media*

This book is the product of five and a half years of research dedicated to the understanding of radar interferometry, a relatively new space-geodetic technique for measuring the earth’s topography and its deformation. The main reason for undertaking this work, early 1995, was the fact that this technique proved to be extremely useful for wide-scale, fine-resolution deformation measurements. Especially the interferometric products from the ERS-1 satellite provided beautiful first results—several interferometric images appeared as highlights on the cover of journals such as Nature and Science. Accuracies of a few millimeters in the radar line of sight were claimed in semi-continuous image data acquired globally, irrespective of cloud cover or solar illumination. Unfortunately, because of the relative lack of supportive observations at these resolutions and accuracies, validation of the precision and reliability of the results remained an issue of concern. From a geodetic point of view, several survey techniques are commonly available to measure a specific geophysical phenomenon. To make an optimal choice between these techniques it is important to have a uniform and quantitative approach for describing the errors and how these errors propagate to the estimated parameters. In this context, the research described in this book was initiated. It describes issues involved with different types of errors, induced by the sensor, the data processing, satellite positioning accuracy, atmospheric propagation, and scattering characteristics. Nevertheless, as the first item in the subtitle “Data Interpretation and Error Analysis” suggests, data interpretation is not always straightforward.

## GNSS Remote Sensing

### Theory, Methods and Applications *Springer Science & Business Media*

The versatile and available GNSS signals can detect the Earth's surface environments as a new, highly precise, continuous, all-weather and near-real-time remote sensing tool. This book presents the theory and methods of GNSS remote sensing as well as its applications in the atmosphere, oceans, land and hydrology. Ground-based atmospheric sensing, space-borne atmospheric sensing, reflectometry, ocean remote sensing, hydrology sensing as well as cryosphere sensing with the GNSS will be discussed per chapter in the book.

### Remote Sensing Image Classification in R *Springer*

This book offers an introduction to remotely sensed image processing and classification in R using machine learning algorithms. It also provides a concise and practical reference tutorial, which equips readers to immediately start using the software platform and R packages for image processing and classification. This book is divided into five chapters. Chapter 1 introduces remote sensing digital image processing in R, while chapter 2 covers pre-processing. Chapter 3 focuses on image transformation, and chapter 4 addresses image classification. Lastly, chapter 5 deals with improving image classification. R is advantageous in that it is open source software, available free of charge and includes several useful features that are not available in commercial software packages. This book benefits all undergraduate and graduate students, researchers, university teachers and other remote- sensing practitioners interested in the practical implementation of remote sensing in R.

### Spatial Statistics for Remote Sensing *Springer Science & Business Media*

This book is a collection of papers on spatial statistics for remote sensing. The book emerges from a study day that was organized in 1996 at the International Institute for Aerospace Survey and Earth Sciences, ITC, in Enschede, The Netherlands. It was by several means a memorable event. The beautiful new building, according to a design by the famous modern Dutch architect Max van Huet was just opened, and this workshop was the first to take place there. Of course, much went wrong during the workshop, in particular as the newest electronic equipment regularly failed. But the workshop attracted more than hundred attendants, and was generally well received. The results of the workshop have been published in Stein et al. (1998). The aim of the workshop was to address issues of spatial statistics for remote sensing. The ITC has a long history on collecting and analyzing satellite and other remote sensing data, but its involvement into spatial statistics is of a more recent date. Uncertainties in remote sensing images and the large amounts of data in many spectral bands are now considered to be of such an impact that it requires a separate approach from a statistical point of view. To quote from the justification of the study day, we read: Modern communication means such as remote sensing require an advanced use of collected data. Satellites collect data with different resolution on different spectral bands.

### Techniques for Image Processing and Classifications in Remote Sensing *Academic Press*

Techniques for Image Processing and Classifications in Remote Sensing provides an introduction to the fundamentals of computer image processing and classification (commonly called ""pattern recognition"" in other applications). The book begins with a discussion of digital scanners and imagery, and two key mathematical concepts for image processing and classification—spatial filtering and statistical pattern recognition. This is followed by separate chapters on image processing and classification techniques that are widely used in the remote sensing community. The emphasis throughout is on techniques that assist in the analysis of images, not particular applications of these techniques. The book also has four appendixes, featuring a bibliography; an introduction to computer binary data representation and image data formats; a discussion of interactive image processing; and a selection of exam questions from the Image Processing Laboratory course at the University of Arizona. This book is intended for use as either a primary source in an introductory image processing course or as a supplementary text in an intermediate-level remote sensing course. The academic level addressed is upper-division undergraduate or beginning graduate, and familiarity with calculus and basic vector and matrix concepts is assumed.

## Thermal Infrared Remote Sensing

### Sensors, Methods, Applications *Springer Science & Business Media*

This book provides a comprehensive overview of the state of the art in the field of thermal infrared remote sensing. Temperature is one of the most important physical environmental variables monitored by earth observing remote sensing systems. Temperature ranges define the boundaries of habitats on our planet. Thermal hazards endanger our resources and well-being. In this book renowned international experts have contributed chapters on currently available thermal sensors as well as innovative plans for future missions. Further chapters discuss the underlying physics and image processing techniques for analyzing thermal data. Ground-breaking chapters on applications present a wide variety of case studies leading to a deepened understanding of land and sea surface temperature dynamics, urban heat island effects, forest fires, volcanic eruption precursors, underground coal fires, geothermal systems, soil moisture variability, and temperature-based mineral discrimination. 'Thermal Infrared Remote Sensing: Sensors, Methods, Applications' is unique because of the large field it spans, the potentials it reveals, and the detail it provides. This book is an indispensable volume for scientists, lecturers, and decision makers interested in thermal infrared technology, methods, and applications.

### Essential Image Processing and GIS for Remote Sensing *John Wiley & Sons*

Essential Image Processing and GIS for Remote Sensing is an accessible overview of the subject and successfully draws together these three key areas in a balanced and comprehensive manner. The book provides an overview of essential techniques and a selection of key case studies in a variety of application areas. Key concepts and ideas are introduced in a clear and logical manner and described through the provision of numerous relevant conceptual illustrations. Mathematical detail is kept to a minimum and only referred to where necessary for ease of understanding. Such concepts are explained through common sense terms rather than in rigorous mathematical detail when explaining image processing and GIS techniques, to enable students to grasp the essentials of a notoriously challenging subject area. The book is clearly divided into three parts, with the first part introducing essential image processing techniques for remote sensing. The second part looks at GIS and begins with an overview of the concepts, structures and mechanisms by which GIS operates. Finally the third part introduces Remote Sensing Applications. Throughout the book the relationships between GIS, Image Processing and Remote Sensing are clearly identified to ensure that students are able to apply the various techniques that have been covered appropriately. The latter chapters use numerous relevant case studies to illustrate various remote sensing, image processing and GIS applications in practice.

## Image Analysis, Classification and Change Detection in Remote Sensing

### With Algorithms for ENVI/IDL and Python, Third Edition *CRC Press*

Image Analysis, Classification and Change Detection in Remote Sensing: With Algorithms for ENVI/IDL and Python, Third Edition introduces techniques used in the processing of remote sensing digital imagery. It emphasizes the development and implementation of statistically motivated, data-driven techniques. The author achieves this by tightly interweaving theory, algorithms, and computer codes. See What's New in the Third Edition: Inclusion of extensive code in Python, with a cloud computing example New material on synthetic aperture radar (SAR) data analysis New illustrations in all chapters Extended theoretical development The material is self-contained and illustrated with many programming examples in IDL. The illustrations and applications in the text can be plugged in to the ENVI system in a completely transparent fashion and used immediately both for study and for processing of real imagery. The inclusion of Python-coded versions of the main image analysis algorithms discussed make it accessible to students and teachers without expensive ENVI/IDL licenses. Furthermore, Python platforms can take advantage of new cloud services that essentially provide unlimited computational power. The book covers both multispectral and polarimetric radar image analysis techniques in a way that makes both the differences and parallels clear and emphasizes the importance of choosing appropriate statistical methods. Each chapter concludes with exercises, some of which are small programming projects, intended to illustrate or justify the foregoing development, making this self-contained text ideal for self-study or classroom use.

### Image Processing for Remote Sensing *CRC Press*

Edited by leaders in the field, with contributions by a panel of experts, Image Processing for Remote Sensing explores new and unconventional mathematics methods. The coverage includes the physics and mathematical algorithms of SAR images, a comprehensive treatment of MRF-based remote sensing image classification, statistical approaches for

### Signal Processing for Remote Sensing *CRC Press*

Written by leaders in the field, Signal Processing for Remote Sensing explores the data acquisitions segment of remote sensing. Each chapter presents a major research result or the most up to date development of a topic. The book includes a chapter by Dr. Norden Huang, inventor of the Huang-Hilbert transform who, along with and Dr. Steven Long discusses the application of the transform to remote sensing problems. It also contains a chapter by Dr. Enders A. Robinson, who has made major contributions to seismic signal processing for over half a century, on the basic problem of constructing seismic images by ray tracing. With rapid technological advances in both sensor and processing technologies, a book can only capture the current process and result. However, the numerous mathematical techniques provided in this book have lasting value, giving it a useful role for many years to come. While the majority of remote sensing titles cover only image processing, this book focuses on the data acquisitions segment of remote sensing. Its uniquely specific and practical approach allows you to directly apply the knowledge in this book to your field of remote sensing applications.

## Introductory Digital Image Processing

### A Remote Sensing Perspective *Pearson College Division*

For junior/graduate-level courses in Remote Sensing in Geography, Geology, Forestry, and Biology. This revision of Introductory Digital Image Processing: A Remote Sensing Perspective continues to focus on digital image processing of aircraft- and satellite-derived, remotely sensed data for Earth resource management applications. Extensively illustrated, it explains how to extract biophysical information from remote sensor data for almost all multidisciplinary land-based environmental projects. Part of the Prentice Hall Series Geographic Information Science.

## Remote Sensing Time Series

### Revealing Land Surface Dynamics *Springer*

This volume comprises an outstanding variety of chapters on Earth Observation based time series analyses, undertaken to reveal past and current land surface dynamics for large areas. What exactly are time series of Earth Observation data? Which sensors are available to generate real time series? How can they be processed to reveal their valuable hidden information? Which challenges are encountered on the way and which pre-processing is needed? And last but not least: which processes can be observed? How are large regions of our planet changing over time and which dynamics and trends are visible? These and many other questions are answered within this book "Remote Sensing Time Series Analyses - Revealing Land Surface Dynamics". Internationally renowned experts from Europe, the USA and China present their exciting findings based on the exploitation of satellite data archives from well-known sensors such as AVHRR, MODIS, Landsat, ENVISAT, ERS and METOP amongst others. Selected review and methods chapters provide a good overview over time series processing and the recent advances in the optical and radar domain. A fine selection of application chapters addresses multi-class land cover and land use change at national to continental scale, the derivation of patterns of vegetation phenology, biomass assessments, investigations on snow cover duration and recent dynamics, as well as urban sprawl observed over time.

### Image Registration for Remote Sensing *Cambridge University Press*

Image registration employs digital image processing in order to bring two or more digital images into precise alignment for analysis and comparison. Accurate registration algorithms are essential for creating mosaics of satellite images and tracking changes on the planet's surface over time. Bringing together invited contributions from 36 distinguished researchers, the book presents a detailed overview of current research and practice in the application of image registration to remote sensing imagery. Chapters cover the problem definition, theoretical issues in accuracy and efficiency, fundamental algorithms, and real-world case studies of image registration software applied to imagery from operational satellite systems. This book provides a comprehensive and practical overview for Earth and space scientists, presents image processing researchers with a summary of current research, and can be used for specialised graduate courses.

## Satellite Remote Sensing

### A New Tool for Archaeology *Springer Science & Business Media*

This book provides a state-of-the art overview of satellite archaeology and it is an invaluable volume for archaeologists, scientists, and managers interested in using satellite Earth Observation (EO) to improve the traditional approach for archaeological investigation, protection and management of Cultural Heritage. The recent increasing development of EO techniques and the tremendous advances in Information and Communication Technologies (ICT) have resulted primarily in Cultural Heritage applications. The book focuses on new challenging prospects for the use of EO in

archaeology not only for probing the subsurface to unveil sites and artifacts, but also for the management and valorization as well as for the monitoring and preservation of cultural resources. The book provides a first-class understanding of this revolutionary scenario which was unthinkable several years ago. The book offers: (i) an excellent collection of outstanding articles focusing on satellite data processing, analysis and interpretation for archaeological applications, (ii) impressive case studies, (iii) striking examples of the high potential of the integration of multi-temporal, multi-scale, multi-sensors techniques. Each chapter is composed as an authoritative contribution to help the reader grasp the value of its content. The authors are renowned experts from the international scientific community. Audience: This book will be of interest to scientists in remote sensing applied to archeology, geoarcheology, paleo-environment, paleo-climate and cultural heritage.

**Remote Sensing Image Processing** *Morgan & Claypool Publishers*

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

**Remote Sensing and Image Interpretation** *Wiley*

From recent developments in digital image processing to the next generation of satellite systems, this book provides a comprehensive introduction to the field of remote sensing and image interpretation. This book is discipline neutral, so readers in any field of study can gain a clear understanding of these systems and their virtually unlimited applications. \* The authors underscore close interactions among the related areas of remote sensing, GIS, GPS, digital image processing, and environmental modeling. \* Appendices include material on sources of remote sensing data and information, remote sensing periodicals, online glossaries, and online tutorials.

**Radar Remote Sensing of Urban Areas** *Springer Science & Business Media*

One of the key milestones of radar remote sensing for civil applications was the launch of the European Remote Sensing Satellite 1 (ERS 1) in 1991. The platform carried a variety of sensors; the Synthetic Aperture Radar (SAR) is widely considered to be the most important. This active sensing technique provides all-day and all-weather mapping capability of considerably ?ne spatial resolution. ERS 1 and its sister system ERS 2 (launch 1995) were primarily designed for ocean applications, but soon the focus of attention turned to onshore mapping. Examples for typical applications are land cover classification also in tropical zones and monitoring of glaciers or urban growth. In parallel, international Space Shuttle Missions dedicated to radar remote sensing were conducted starting already in the 1980s. The most prominent were the SIR-C/X-SAR mission focussing on the investigation of multi-frequency and multi-polarization SAR data and the famous Shuttle Radar Topography Mission (SRTM). Data acquired during the latter enabled to derive a DEM of almost global coverage by means of SAR Interferometry. It is indisputable today and for many regions the best elevation model available. Differential SAR Interferometry based on time series of imagery of the ERS satellites and their successor Envisat became an important and unique technique for surface deformation monitoring. The spatial resolution of those devices is in the order of some tens of meters.

**Big Data Analytics for Satellite Image Processing and Remote Sensing** *IGI Global*

The scope of image processing and recognition has broadened due to the gap in scientific visualization. Thus, new imaging techniques have developed, and it is imperative to study this progression for optimal utilization. Big Data Analytics for Satellite Image Processing and Remote Sensing is a critical scholarly resource that examines the challenges and difficulties of implementing big data in image processing for remote sensing and related areas. Featuring coverage on a broad range of topics, such as distributed computing, parallel processing, and spatial data, this book is geared towards scientists, professionals, researchers, and academicians seeking current research on the use of big data analytics in satellite image processing and remote sensing.

**Remote Sensing of Urban and Suburban Areas** *Springer Science & Business Media*

"Remote Sensing of Urban and Suburban Areas" provides instructors with a text reference that has a logical and easy-to-follow flow of topics around which they can structure the syllabi of their urban remote sensing courses. Topics have been chosen to bridge the gap between remote sensing and urban studies through a better understanding of the science that underlies both fields. In so doing, the book includes 17 chapters written by leading international experts in respected fields to provide a balanced coverage of fundamental issues in both remote sensing and urban studies. Emphasis is placed on: theoretical and practical issues in contemporary urban studies and remote sensing; the spectral, spatial and temporal requirements of remotely sensed data in relation to various urban phenomena; methods and techniques for analyzing and integrating remotely sensed data and image processing with geographic information systems to address urban problems; and examples of applications in which applying remote sensing to tackle urban problems is deemed useful and important.

**Multitemporal Remote Sensing**

**Methods and Applications** *Springer*

Written by world renowned scientists, this book provides an excellent overview of a wide array of methods and techniques for the processing and analysis of multitemporal remotely sensed images. These methods and techniques include change detection, multitemporal data fusion, coarse-resolution time series processing, and interferometric SAR multitemporal processing, among others. A broad range of multitemporal datasets are used in their methodology demonstrations and application examples, including multispectral, hyperspectral, SAR and passive microwave data. This book features a variety of application examples covering both land and aquatic environments. Land applications include urban, agriculture, habitat disturbance, vegetation dynamics, soil moisture, land surface albedo, land surface temperature, glacier and disaster recovery. Aquatic applications include

monitoring water quality, water surface areas and water fluctuation in wetland areas, spatial distribution patterns and temporal fluctuation trends of global land surface water, as well as evaluation of water quality in several coastal and marine environments. This book will help scientists, practitioners, students gain a greater understanding of how multitemporal remote sensing could be effectively used to monitor our changing planet at local, regional, and global scales.

**Remote Sensing Image Fusion** *CRC Press*

A synthesis of more than ten years of experience, Remote Sensing Image Fusion covers methods specifically designed for remote sensing imagery. The authors supply a comprehensive classification system and rigorous mathematical description of advanced and state-of-the-art methods for pansharpening of multispectral images, fusion of hyperspectral and

**Remote Sensing for Geologists**

**A Guide to Image Interpretation** *CRC Press*

A guide to image interpretation, this book contains detailed color plates and tables that compare satellite imaging systems, list remote sensing web sites, and detail photointerpretation equipment. It includes case histories of the search for petroleum and mineral deposits and examines engineering uses of remote sensing. The volume comprises four sections: project initiation; exploration techniques; exploitation and engineering remote sensing; and environmental concerns. They combine to provide readers with a solid foundation of what image interpretation is and enables them to recognize features of interest and effectively use imagery in projects for the petroleum, mining, or groundwater industries.

**Remote Sensing Data Analysis in R** *CRC Press*

Remote Sensing Data Analysis in R is a guide book containing codes for most of the operations which are being performed for analysing any satellite data for deriving meaningful information. The goal of this book is to provide hands on experience in performing all the activities from the loading of raster and vector data, mapping or visualisation of data, pre-processing, calculation of indices, classification and advanced machine learning algorithms on remote sensing data in R. The reader will be able to acquire skills to carry out most of the operations of raster data analysis - more flexibly - in open-source freely available software i.e. R which are generally available in the paid digital image processing software. Note: T&F does not sell or distribute the Hardback in India, Pakistan, Nepal, Bhutan, Bangladesh and Sri Lanka. The title is co-published with New India Publishing Agency.

**Imaging Spectrometry**

**Basic Principles and Prospective Applications** *Springer Science & Business Media*

A significant step forward in the world of earth observation was made with the development of imaging spectrometry. Imaging spectrometers measure reflected solar radiance from the earth in many narrow spectral bands. Such a spectroscopical imaging system is capable of detecting subtle absorption bands in the reflectance spectra and measure the reflectance spectra of various objects with a very high accuracy. As a result, imaging spectrometry enables a better identification of objects at the earth surface and a better quantification of the object properties than can be achieved by traditional earth observation sensors such as Landsat TM and SPOT. The various chapters in the book present the concepts of imaging spectrometry by discussing the underlying physics and the analytical image processing techniques. The second part of the book presents in detail a wide variety of applications of these new techniques ranging from mineral identification, mapping of expansive soils, land degradation, agricultural crops, natural vegetation and surface water quality. Additional information on extras.springer.com Sample hyperspectral remote sensing data sets and ENVI viewing software (Freelook) are available on <http://extras.springer.com>

**Fundamentals of Satellite Remote Sensing**

**An Environmental Approach, Third Edition** *CRC Press*

Fundamentals of Satellite Remote Sensing: An Environmental Approach, Third Edition, is a definitive guide to remote sensing systems that focuses on satellite-based remote sensing tools and methods for space-based Earth observation (EO). It presents the advantages of using remote sensing data for studying and monitoring the planet, and emphasizes concepts that make the best use of satellite data. The book begins with an introduction to the basic processes that ensure the acquisition of space-borne imagery, and provides an overview of the main satellite observation systems. It then describes visual and digital image analysis, highlights various interpretation techniques, and outlines their applications to science and management. The latter part of the book covers the integration of remote sensing with Geographic Information System (GIS) for environmental analysis. This latest edition has been written to reflect a global audience and covers the most recent advances incorporated since the publication of the previous book, relating to the acquisition and interpretation of remotely sensed data. New in the Third Edition: Includes additional illustrations in full color. Uses sample images acquired from different ecosystems at different spatial resolutions to illustrate different interpretation techniques. Includes updated EO missions, such as the third generations of geostationary meteorological satellites, the new polar orbiting platforms (Suomi), the ESA Sentinels program, and high-resolution commercial systems. Includes extended coverage of radar and LIDAR processing methods. Includes all new information on near-ground missions, including unmanned aerial vehicles (UAVs). Covers new ground sensors, as well as machine-learning approaches to classification. Adds more focus on land surface characterization, time series, change detection, and ecosystem processes. Extends the interactions of EO data and GIS that cover different environmental problems, with particular relevance to global observation. Fundamentals of Satellite Remote Sensing: An Environmental Approach, Third Edition, details the tools that provide global, recurrent, and comprehensive views of the processes affecting the Earth. As one of CRC's Essential titles, this book and stands out as one of the best in its field and is a must-have for researchers, academics, students, and professionals involved in the field of environmental science, as well as for libraries developing collections on the forefront of this industry.

**Remote Sensing Digital Image Analysis: An Introduction**

**Kernel Methods for Remote Sensing Data Analysis** *John Wiley & Sons*

Kernel methods have long been established as effective techniques in the framework of machine learning and pattern recognition, and have now become the standard approach to many remote sensing applications. With algorithms that combine statistics and geometry, kernel methods have proven successful across many different domains related to the analysis of images of the Earth acquired from airborne and satellite sensors, including natural resource control, detection and monitoring of anthropic infrastructures (e.g. urban areas), agriculture inventorying, disaster

prevention and damage assessment, and anomaly and target detection. Presenting the theoretical foundations of kernel methods (KMs) relevant to the remote sensing domain, this book serves as a practical guide to the design and implementation of these methods. Five distinct parts present state-of-the-art research related to remote sensing based on the recent advances in kernel methods, analysing the related methodological and practical challenges: Part I introduces the key concepts of machine learning for remote sensing, and the theoretical and practical foundations of kernel methods. Part II explores supervised image classification including Super Vector Machines (SVMs), kernel discriminant analysis, multi-temporal image classification, target detection with kernels, and Support Vector Data Description (SVDD) algorithms for anomaly detection. Part III looks at semi-

supervised classification with transductive SVM approaches for hyperspectral image classification and kernel mean data classification. Part IV examines regression and model inversion, including the concept of a kernel unmixing algorithm for hyperspectral imagery, the theory and methods for quantitative remote sensing inverse problems with kernel-based equations, kernel-based BRDF (Bidirectional Reflectance Distribution Function), and temperature retrieval KMs. Part V deals with kernel-based feature extraction and provides a review of the principles of several multivariate analysis methods and their kernel extensions. This book is aimed at engineers, scientists and researchers involved in remote sensing data processing, and also those working within machine learning and pattern recognition.