

1. Record Nr.	UNINA9910789208603321
Autore	Richards John A
Titolo	Remote Sensing Digital Image Analysis : An Introduction / / John A. Richards
Pubbl/distr/stampa	Berlin, Heidelberg : , : Springer Berlin Heidelberg : , : Imprint : Springer, , 1993
ISBN	3-642-88087-8
Edizione	[Second, revised and enlarged edition 1993.]
Descrizione fisica	1 online resource (xx, 340 pages) : 174 illustrations
Disciplina	621.36/78
Soggetti	Geographical information systems Refuse and refuse disposal Water pollution Air pollution Soil science Soil conservation Noise control Geographical Information Systems/Cartography Waste Management/Waste Technology Waste Water Technology / Water Pollution Control / Water Management / Aquatic Pollution Atmospheric Protection/Air Quality Control/Air Pollution Soil Science & Conservation Noise Control
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Bibliographic Level Mode of Issuance: Monograph
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	1 — Sources and Characteristics of Remote Sensing Image Data -- 1.1 Introduction to Data Sources -- 1.1.1 Characteristics of Digital Image Data -- 1.1.2 Spectral Ranges Commonly Used in Remote Sensing -- 1.1.3 Concluding Remarks -- 1.2 Weather Satellite Sensors -- 1.2.1 Polar Orbiting and Geosynchronous Satellites -- 1.2.2 The NOAA AVHRR (Advanced Very High Resolution Radiometer) -- 1.2.3 The Nimbus CZCS (Coastal Zone Colour Scanner) -- 1.2.4 GMS VISSR (Visible and Infrared Spin Scan Radiometer) -- 1.3 Earth Resource

Satellite Sensors in the Visible and Infrared Regions -- 1.3.1 The Landsat System -- 1.3.2 The Landsat Instrument Complement -- 1.3.3 The Return Beam Vidicon(RBV) -- 1.3.4 The Multispectral Scanner (MSS) -- 1.3.5 The Thematic Mapper (TM) -- 1.3.6 The SPOT High Resolution Visible (HRV) Imaging Instrument -- 1.3.7 The Skylab S 192 Multispectral Scanner -- 1.3.8 The Heat Capacity Mapping Radiometer (HCMR) -- 1.3.9 Marine Observation Satellite (MOS) -- 1.3.10 Indian Remote Sensing Satellite (IRS) -- 1.4 Aircraft Scanners in the Visible and Infrared Regions -- 1.4.1 General Considerations -- 1.4.2 The Daedalus AADS 1240/1260 Multispectral Line Scanner -- 1.4.3 The Airborne Thematic Mapper (ATM) -- 1.4.4 The Thermal Infrared Multispectral Scanner (TIMS) -- 1.4.5 The MDA MEIS-II Linear Array Aircraft Scanner -- 1.4.6 Imaging Spectrometers -- 1.5 Image Data Sources in the Microwave Region -- 1.5.1 Side Looking Airborne Radar and Synthetic Aperture Radar -- 1.5.2 The Seasat SAR -- 1.5.3 Shuttle Imaging Radar-A (SIR-A) -- 1.5.4 Shuttle Imaging Radar-B (SIR-B) -- 1.5.5 ERS-1 -- 1.5.6 JERS-1 -- 1.5.7 Radarsat -- 1.5.8 Aircraft Imaging Radar Systems -- 1.6 Spatial Data Sources in General -- 1.6.1 Types of Spatial Data -- 1.6.2 Data Formats -- 1.6.3 Geographic Information Systems (GIS) -- 1.6.4 The Challenge to Image Processing and Analysis -- 1.7 A Comparison of Scales in Digital Image Data -- References for Chapter 1 -- Problems -- 2 — Error Correction and Registration of Image Data -- 2.1 Sources of Radiometric Distortion -- 2.1.1 The Effect of the Atmosphere on Radiation -- 2.1.2 Atmospheric Effects on Remote Sensing Imagery -- 2.1.3 Instrumentation Errors -- 2.2 Correction of Radiometric Distortion -- 2.2.1 Detailed Correction of Atmospheric Effects -- 2.2.2 Bulk Correction of Atmospheric Effects -- 2.2.3 Correction of Instrumentation Errors -- 2.3 Sources of Geometric Distortion -- 2.3.1 Earth Rotation Effects -- 2.3.2 Panoramic Distortion -- 2.3.3 Earth Curvature -- 2.3.4 Scan Time Skew -- 2.3.5 Variations in Platform Altitude, Velocity and Attitude -- 2.3.6 Aspect Ratio Distortion -- 2.3.7 Sensor Scan Nonlinearities -- 2.4 Correction of Geometric Distortion -- 2.4.1 Use of Mapping Polynomials for Image Correction -- 2.4.1.1 Mapping Polynomials and Ground Control Points -- 2.4.1.2 Resampling -- 2.4.1.3 Interpolation -- 2.4.1.4 Choice of Control Points -- 2.4.1.5 Example of Registration to a Map Grid -- 2.4.2 Mathematical Modelling -- 2.4.2.1 Aspect Ratio Correction -- 2.4.2.2 Earth Rotation Skew Correction -- 2.4.2.3 Image Orientation to North-South -- 2.4.2.4 Correction of Panoramic Effects -- 2.4.2.5 Combining the Corrections -- 2.5 Image Registration -- 2.5.1 Georeferencing and Geocoding -- 2.5.2 Image to Image Registration -- 2.5.3 Sequential Similarity Detection Algorithm -- 2.5.4 Example of Image to Image Registration -- 2.6 Miscellaneous Image Geometry Operations -- 2.6.1 Image Rotation -- 2.6.2 Scale Changing and Zooming -- References for Chapter 2 -- Problems -- 3 — The Interpretation of Digital Image Data -- 3.1 Two Approaches to Interpretation -- 3.2 Forms of Imagery for Photointerpretation -- 3.3 Computer Processing for Photointerpretation -- 3.4 An Introduction to Quantitative Analysis — Classification -- 3.5 Multispectral Space and Spectral Classes -- 3.6 Quantitative Analysis by Pattern Recognition -- 3.6.1 Pixel Vectors and Labelling -- 3.6.2 Unsupervised Classification -- 3.6.3 Supervised Classification -- References for Chapter 3 -- Problems -- 4 — Radiometric Enhancement Techniques -- 4.1 Introduction -- 4.1.1 Point Operations and Look Up Tables -- 4.1.2 Scalar and Vector Images -- 4.2 The Image Histogram -- 4.3 Contrast Modification in Image Data -- 4.3.1 Histogram Modification Rule -- 4.3.2 Linear Contrast Enhancement -- 4.3.3 Saturating Linear Contrast Enhancement -- 4.3.4 Automatic Contrast Enhancement -- 4.3.5 Logarithmic and Exponential Contrast

Enhancement -- 4.3.6 Piecewise Linear Contrast Modification -- 4.4 Histogram Equalization -- 4.4.1 Use of the Cumulative Histogram -- 4.4.2 Anomalies in Histogram Equalization -- 4.5 Histogram Matching -- 4.5.1 Principle of Histogram Matching -- 4.5.2 Image to Image Contrast Matching -- 4.5.3 Matching to a Mathematical Reference -- 4.6 Density Slicing -- 4.6.1 Black and White Density Slicing -- 4.6.2 Colour Density Slicing and Pseudocolouring -- References for Chapter 4 -- Problems -- 5 — Geometric Enhancement Using Image Domain Techniques -- 5.1 Neighbourhood Operations -- 5.2 Template Operators -- 5.3 Geometric Enhancement as a Convolution Operation -- 5.4 ImageDomain Versus Fourier Transformation Approaches -- 5.5 Image Smoothing (Low Pass Filtering) -- 5.5.1 Mean Value Smoothing -- 5.5.2 Median Filtering -- 5.6 Edge Detection and Enhancement -- 5.6.1 Linear Edge Detecting Templates -- 5.6.2 Spatial Derivative Techniques -- 5.6.2.1 The Roberts Operator -- 5.6.2.2 The Sobel Operator -- 5.6.3 Thinning, Linking and Edge Responses -- 5.6.4 Edge Enhancement by Subtractive Smoothing -- 5.7 Line Detection -- 5.7.1 Linear Line Detecting Templates -- 5.7.2 Non-linear and Semi-linear Line Detecting Templates -- 5.8 General Convolution Filtering -- 5.9 Shape Detection -- References for Chapter 5 -- Problems -- 6 — Multispectral Transformations of Image Data -- 6.1 The Principal Components Transformation -- 6.1.1 The Mean Vector and Covariance Matrix -- 6.1.2 A Zero Correlation, Rotational Transform -- 6.1.3 An Example — Some Practical Considerations -- 6.1.4 The Effect of an Origin Shift -- 6.1.5 Application of Principal Components in Image Enhancement and Display -- 6.1.6 The Taylor Method of Contrast Enhancement -- 6.1.7 Other Applications of Principal Components Analysis -- 6.2 The Kauth-Thomas Tasseled Cap Transformation -- 6.3 Image Arithmetic, Band Ratios and Vegetation Indices -- References for Chapter 6 -- Problems -- 7 — Fourier Transformation of Image Data -- 7.1 Introduction -- 7.2 Special Functions -- 7.2.1 The Complex Exponential Function -- 7.2.2 The Dirac Delta Function -- 7.2.2.1 Properties of the Delta Function -- 7.2.3 The Heaviside Step Function -- 7.3 Fourier Series -- 7.4 The Fourier Transform -- 7.5 Convolution -- 7.5.1 The Convolution Integral -- 7.5.2 Convolution with an Impulse -- 7.5.3 The Convolution Theorem -- 7.6 Sampling Theory -- 7.7 The Discrete Fourier Transform -- 7.7.1 The Discrete Spectrum -- 7.7.2 Discrete Fourier Transform Formulae -- 7.7.3 Properties of the Discrete Fourier Transform -- 7.7.4 Computation of the Discrete Fourier Transform -- 7.7.5 Development of the Fast Fourier Transform Algorithm -- 7.7.6 Computational Cost of the Fast Fourier Transform -- 7.7.7 Bit Shuffling and Storage Considerations -- 7.8 The Discrete Fourier Transform of an Image -- 7.8.1 Definition -- 7.8.2 Evaluation of the Two Dimensional, Discrete Fourier Transform -- 7.8.3 The Concept of Spatial Frequency -- 7.8.4 Image Filtering for Geometric Enhancement -- 7.8.5 Convolution in Two Dimensions -- 7.9 Concluding Remarks -- References for Chapter 7 -- Problems -- Chapters 8—Supervised Classification Techniques -- I. Standard Classification Algorithms -- 8.1 Steps in Supervised Classification -- 8.2 Maximum Likelihood Classification -- 8.2.1 Bayes'Classification -- 8.2.2 The Maximum Likelihood Decision Rule -- 8.2.3 Multivariate Normal Class Models -- 8.2.4 Decision Surfaces -- 8.2.5 Thresholds -- 8.2.6 Number of Training Pixels Required for Each Class -- 8.2.7 A Simple Illustration -- 8.3 Minimum Distance Classification -- 8.3.1 The Case of Limited Training Data -- 8.3.2 The Discriminant Function -- 8.3.3 Degeneration of Maximum Likelihood to Minimum Distance Classification -- 8.3.4 Decision Surfaces -- 8.3.5 Thresholds -- 8.4 Parallelepiped Classification -- 8.5 Classification Time Comparison of

the Classifiers -- 8.6 The Mahalanobis Classifier -- 8.7 Table Look Up Classification -- II. More Advanced Considerations -- 8.8 Context Classification -- 8.8.1 The Concept of Spatial Context -- 8.8.2 Context Classification by Image Pre-Processing -- 8.8.3 Post Classification Filtering -- 8.8.4 Probabilistic Label Relaxation -- 8.8.4.1 The Basic Algorithm -- 8.8.4.2 The Neighbourhood Function -- 8.8.4.3 Determining the Compatibility Coefficients -- 8.8.4.4 The Final Step -- Stopping the Process -- 8.8.4.5 Examples -- 8.9 Classification of Mixed Image Data -- 8.9.1 The Stacked Vector Approach -- 8.9.2 Statistical Methods -- 8.9.3 The Theory of Evidence -- 8.9.3.1 The Concept of Evidential Mass -- 8.9.3.2 Combining Evidence -- the Orthogonal Sum -- 8.9.3.3 Decision Rule -- 8.10 Classification Using Neural Networks -- 8.10.1 Linear Discrimination -- 8.10.1.1 Concept of a Weight Vector -- 8.10.1.2 Testing Class Membership -- 8.10.1.3 Training -- 8.10.1.4 Setting the Correction Increment -- 8.10.1.5 Classification -- The Threshold Logic Unit -- 8.10.1.6 Multicategory Classification -- 8.10.2 Networks of Classifiers -- Solutions of Nonlinear Problems -- 8.10.3 The Neural Network Approach -- 8.10.3.1 The Processing Element -- 8.10.3.2 Training the Neural Network -- Backpropagation -- 8.10.3.3 Choosing the Network Parameters -- 8.10.3.4 Examples -- References for Chapter 8 -- Problems -- 9 -- Clustering and Unsupervised Classification -- 9.1 Delineation of Spectral Classes -- 9.2 Similarity Metrics and Clustering Criteria -- 9.3 The Iterative Optimization (Migrating Means) Clustering Algorithm -- 9.3.1 The Basic .

---

## Sommario/riassunto

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 turn, have led to the appearance of newer image processing procedures as adjuncts to more traditional approaches.

---