

Book review

Digital Analysis of Remotely Sensed Imagery
J. Gao, McGraw-Hill, New York, 2009, 645 pp

Reviewed by

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This book by Jay Gao provides students and practitioners with a suitable textbook to comprehend information derivation from airborne and spaceborne remote sensing materials. The reader can follow, throughout the chapters, the various steps involved in the exploitation of remote sensing imagery, from the selection of the relevant remotely sensed images to the integration of the derived information in GIS. It covers not only the concepts and principles of remote sensing images analysis. A comprehensive coverage of image formats, storage, and processing systems is also including in the book that will be of great interest for those engaged in analysis and management of geospatial images.

This book requires a low working knowledge of remote sensing fundamentals and no specific mathematical background. The basic concepts related to geomatics sciences (ex. projections and coordinate systems, GIS, GPS) are provided when these topics step in the image analysis approaches. The image algorithms are not extensively described. Instead, the main principles governing the processing are comprehensively explained. Therefore, the reader can have a solid understanding of the methods characteristics, their use in the various image processing systems and their relevance according to a specific application without being overwhelmed by mathematic formulas. The level of details provided for the methods description may not be sufficient for remote sensing researchers exploring image analysis solutions for specific research topics. However, it may provide them with a good overview of the various possible approaches, from the classical ones to the more advanced and recent ones. Compared to a number of books dealing with digital analysis of remotes sensing images, the book by Jay Gao proposes recent developments and trends in image analysis. New techniques for images geometric rectification as well as recent innovative image classifications are comprehensively described. Having more simple or practical examples of the methods application would be a good addition to the book especially if it is used as textbook for remote sensing courses.

The book presents in almost all the chapters a review of the strengths and limits of the image analysis methods. Comparative tables and case studies are also provided which are very useful to underline the methods differences and performances. Accuracy assessment is especially well addressed in the book. A full chapter is dedicated to classification accuracy assessment. And the factors influencing the results accuracy, reliability are generally described as well as their

impact. Such focus on accuracy assessment is one of the strengths of this book since quality control is a prominent concern in the geospatial field.

The book consists of fourteen chapters. It starts with two overview chapters, the first dedicated to the bases of remote sensing (ex. image components, features, properties) the second dedicated to the various remote sensing data currently available.

Chapters 3 and 4 address two topics that are seldom presented in remote sensing books: the image data format and the image processing systems. The description of the image formats, especially those involving data compression, is of particular interest in the current context where an ever increasing volume of storage is required for the images.

The book covers comprehensively the image geometric rectification in chapter 5. Techniques used to generate geometrically reliable images are provided. The chapter describes the general procedure and fundamentals of image rectification. The various rectification models are provided but only the polynomial model is detailed due to its flexibility and versatility. It would have been worth describing the RPC model in more length since it is very suited to rectification of images at a high resolution level like IKONOS and Quickbird. The availability of such hyperspatial imagery tends to increase in the current context. The sources, number and impact of the Ground Control Points (GCP) is one of the elements of interest of this chapter. Several comparative examples are included which provide good illustrations of the GCP selection importance when dealing with images rectification.

Chapter 6 reviews the main image processing generally applied when manipulating remote sensing imagery. Even if the chapter is entitled “image enhancement”, it covers not only the contrast enhancement and filtering topics, but the edge detection, multiple image manipulation, and image transformation as well. This chapter is well illustrated, several practical examples being provided to easily understand the processing principles. The computation of indices is shortly presented in the chapter. Only the vegetation indices are addressed, especially the NDVI index. Given the extensive use of indices in the remote sensing field, a larger attention may have been dedicated to this topic.

Chapter 7 is another good feature of the book. It covers comprehensively spectral image classification and all the basic knowledge one must have when engaging in remote sensing imagery classification. The main methods of, respectively, the supervised and unsupervised classification approaches are described. In addition to the traditional algorithms, fuzzy image classification is addressed in this chapter. Enough details are provided to grasp the relevance and principles of this approach without overwhelming the reader with too many theoretical concepts from the fuzzy logic theory. Subpixel image classification is also discussed in this chapter. However this part could benefit from practical examples and illustrations. Relying on the provided equations and explanations, it may not be straightforward for students or practitioners not familiar with remote sensing to understand how such an approach can be used.

Chapter 8 and 9 cover topics that are generally addressed in machine learning or artificial intelligence books namely neural network and decision tree classification. The fundamentals, the main architectures and construction methods are provided as well as the most common networks

and trees in use. The two chapters provided a good overview of these two domains without excessive details. They would be a good starting point for someone who wants to get more familiar with these techniques.

Chapter 10 addresses the spatial analysis of the image. The information is extracted from the image no more from a pixel basis but from an object perspective. The chapter covers first the main segmentation methods (pixel-based, region-based, edge-based, knowledge-based, texture-based). The fundamentals of object-oriented classification are then provided. This section is a specific contribution of th Jay Gao's book compared to the topics generally addressed in remote sensing books. With the emergence of hyperspatial resolution satellite images, this advanced image processing become very relevant. The comparison of per-pixel and object-oriented classifications conducted in the chapter is very interesting and instructive.

Chapter 11 addresses the use of knowledge when engaging in image classification. It provided the fundamentals about knowledge description and integration in the image analysis process. Such systems as expert systems or blackboards are shortly described. The topic of knowledge integration and representation is a research field in itself. It is a difficult task to synthesize in a single book chapter the relevant aspects and capabilities of such a domain. The relevance of this chapter in the book may be questioned. It would require more detailed explanations to be able to take advantage of the information provided.

Chapter 12 covers an important topic in remote sensing namely classification accuracy assessment. This is another good feature of the book. The inaccuracy of classification results, the procedure of accuracy assessment and the report of accuracy will be found of great interest by practitioners and students.

Chapter 13 deals with multitemporal image analysis. It focuses especially on change detection. Visual and quantitative methods generally used to underline changes in the images are presented. The reader will find the essential information required when tackling change detection problems.

Chapter14 provides a short introduction to GIS and GPS in the perspective of image and geospatial data integration. Only the basic principles are covered.

In general, the structure of the book is good and a sufficient number of references are provided to the reader at the end of each chapter if he wants to dig deeper into a topic. On the whole, regardless of the minor shortcomings discussed previously, this book will be welcomed by its target audience with pleasure and great appreciation. Its content is well explained, very readable, and there are reasonable details to understand the method principles, strengths and limitations.