BOOK RREVIEWS

PRINCIPLES AND APPLICATIONS OF IMAGING RADAR

Manual of Remote Sensing, Third Edition, Volume 2. Edited by FLOYD M. HENDERSON and ANTHONY J. LEWIS. Editor-in-Chief ROBERT A. RYERSON. Published in Co-operation with The American Society for Photogrammetry and Remote Sensing. John Wiley and Sons, Inc., 1998. ISBN 0-471-29406-3. 220 x 280 mm, xxv + 866 pp, 73 colour plates. Student price US$120, Member price US$150, Non-member price US$198.

Reviewed by Bruce Forster of the University of New South Wales in Sydney, Australia

The growth in remote sensing since the publication of the Second Edition of the Manual of Remote Sensing is highlighted by this volume on radar remote sensing. Back in 1983 when the Second Edition was published it consisted of two volumes, the first essentially theoretical and the second on applications. This Third Edition consists of a series of independent volumes covering different topic areas including: Volume 1 Earth Observing Platforms and Sensors; Volume 2 the subject of this review; and Volume 3 Remote Sensing for the Earth Sciences. In addition there are at least a further three volumes in the writing stage. The "Radar Volume" with nearly 900 pages, and large format pages, is almost as large as one volume of the Second Edition, and this in a topic area, radar, that very few practitioners or indeed remote sensing scientists had experience with in 1983. Floyd Henderson and Tony Lewis, the Joint Editors, Bob Ryerson, the Editor-in-Chief, and all the chapter editors and contributing authors are to be congratulated on a magnificent volume.

Radar remote sensing is not an easy topic. The relationships between the radar parameters, the Earth surface and the backscatter is very complex, and requires a good understanding of the basic physics to maximise understanding of the return signals and for conversion of the image data into information. The first six chapters provide the basis to enable the reader to obtain such an understanding, while the next eleven chapters convert theory to practice with chapters that cover a wide range of radar applications. As explained in the introduction the volume is intended to address four major audiences: (1) practitioners and scientists in the geosciences who have been trained in remote sensing; (2) researchers in the geosciences who do not have training in remote sensing; (3) remote sensing practitioners and scientists in the geosciences who have experience with radar; and (4) basic remote sensing researchers and investigators (with and without experience with radar) outside the geosciences. This intention has been fulfilled by the editors; the volume will be the primary reference text for many years to come.

The volume is essentially comprised of two parts, Chapters 2 to 6 (Chapter 1 being the introduction) comprising essential theory, and Chapters 7 to 16 covering applications. A final chapter, Chapter 17, addresses radar education, data sources and data collection. Chapter 2 provides a technical perspective of radar fundamentals. As befits

such a complex topic area, this chapter comprises 121 pages, and is the largest of the 17 chapters that make up the volume. This theory and the fundamentals of radar are put into a geoscience perspective in Chapter 3, while Chapter 4 provides a comprehensive coverage of radargrammetry, which essentially is the geometric or "photogrammetric" analysis of radar image data. Chapters 5 and 6 provide the theory of polarimetry and radar interferometry respectively, areas which have become increasingly important as data from multipolarised radar and InSAR systems become available.

Chapters 7 to 16 cover a wide range of applications. These chapters represent the current state of research in the particular application fields. They are essentially independent of each other and can be read separately. Because of this some topics are covered in more than one chapter. However this adds to the reader's understanding because these topics are approached from different viewpoints and application perspectives. Application areas covered in the volume are agriculture, forestry, geology, geomorphology and hydrology, oceanography, snow and ice, human settlements and population, and archaeology.

If there were to be a small criticism of the volume from this reviewer's perspective it is the lack of a specific chapter dealing with image processing. While aspects of processing are covered in many of the theory and application chapters, it is considered that radar with its particular processing problems, when compared to visible-infrared image data, should have a single chapter devoted to it. For example, practitioners familiar with maximum likelihood single pixel classification algorithms used for visible-infrared data, may not realise that because of the coherent nature of the radar return signal, such an approach can lead to significant classification errors and that classification using, for example, segmentation methods is better suited to radar data. Similar differences in approach also apply to image filtering and enhancement.

The text throughout the volume is very well illustrated and supported with tables, diagrams, and images in both black and white and colour, the latter being found in a separate section at the end of the book. References are extensive and well woven into the text. An extensive Glossary provides readers with detailed definitions of terms used in the text (and with reference to the chapter to which the term specifically applies); a very detailed Index completes the volume.

Radar remote sensing is becoming one of the most important tools for the monitoring of the Earth. This volume is the most important publication in this field and will continue to be so well into the future. It is an essential textbook for remote sensing practitioners, scientists, academics and graduate students; at a cost of US$ 150 (Member) it must represent the highest information content per dollar value of any textbook in the field of remote sensing and associated technologies.

Tracking and Kalman Filtering Made Easy

By ELI BROOKER. Wiley Interscience, 1998. ISBN 0-471-18407-1. 477 pages

Review by Paul Cross of University College London, England

With so much current interest in the geomatics community in the general field of high precision navigation and tracking, and with so many current solutions based on Kalman filtering, it is natural to view a book with the title "Tracking and Kalman filtering made easy" with considerable enthusiasm. Unfortunately, whilst not being without some relevance, the book has relatively little to offer geomatic engineers in general, or photogrammetrists in particular.

The book is in two parts. The first deals with the basics of tracking, prediction and smoothing. It begins with some fundamental concepts of tracking and swiftly moves to the Kalman filter itself. The treatment is mathematically rigorous, but nevertheless includes many useful intuitive explanations. It does not demand a detailed prior mathematical knowledge from the reader because it develops many mathematical procedures (e.g. matrix differentiation) more or less from first principles as and when they are needed. Also the general transition from one-dimensional (single variable) problems to multi-dimensions and the necessary introduction of matrices is extremely smoothly handled. Towards the end of this part of the book the filtering of various radar waveforms is treated - something unlikely to interest many readers of this review!

The second (and longest) part of the book deals with a number of more advanced aspects of filtering, including topics such as: minimum variance estimation; fixed, expanded and fading memory filtering; orthonormal transformations (Givens, Householder and Gram-Schmidt); and the general treatment of non-linear problems (the so-called extended Kalman filter). Actually there is much here of general mathematical interest to photogrammetrists as all of these techniques could have a role to play in some photogrammetric estimation problems - especially in ill-conditioned least squares as they avoid the further ill-conditioning caused by explicitly forming normal equations. The problem is that the treatment is not easily accessible because all of the examples come from the field of radar tracking and it is rather hard to relate to them. Those with a good knowledge of Kalman filtering will appreciate the elegance of the treatment but those new to the topic will probably find it hard going (unless they happen to have a good knowledge of radar).

As will be apparent from the foregoing, the book is specifically aimed at those involved in tracking targets with various kinds of radar. Of course this is not a criticism! Just a warning to the geomatics community that this book is targeted elsewhere. At a first glance itondo might seem that there ought to be a close analogy with image correlation problems in video imagery - but this reviewer did not find it easy to spot this. What are, however, likely to be of some value to this community are the pure mathematics sections - although of course there are good alternative texts from the general literature on stochastic processes.

So, in conclusion, this is not really a 'must have' or even a 'would be useful to have' book for photogrammetrists - but nevertheless it is one worth spending a little time

with in a library or bookshop if it is serendipitously discovered. It really does treat some aspects of Kalman filtering very elegantly indeed.

Note from the Editor-in-Chief

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