BOOK REVIEW

REVIEW OF SATELLITE REMOTE SENSING: A NEW TOOL FOR ARCHAEOLOGY

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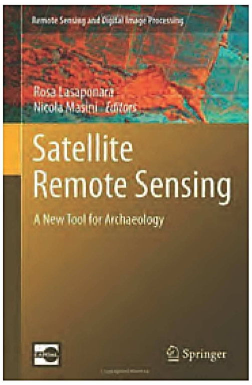

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Nicola Masini
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In the last few years, the use of remote sensing techniques in archaeology has increased in leaps and bounds. This is due mainly to the introduction of Geographic Information Systems (GIS), which provide a geographic framework for airborne and spaceborne images; new, very high resolution (VHR) satellite images; and global digital topographic data. New processing techniques have also been developed by archaeologists for specific application to their field.

Thus, the appearance of this new book: Satellite Remote Sensing: A New Tool for Archaeology, edited by Rosa Lasaponara and Nicola Masini is very timely inasmuch as it provides both a good basis for analysis as well as several test cases illustrating the use of remote sensing techniques for archaeology. The book begins with an excellent introduction to remote sensing techniques suitable for undergraduate or graduate instruction. The case studies contain more detailed information on applications of diverse data sets in several different environments which working archaeologists should find useful. One remote sensing technique noticeably missing is imaging radar. This is likely because the data are significantly different from visible to near infrared images more commonly used.

The book is well written and organized. The illustrations, important for a book on remote sensing, are of high quality and many are in color. The addition at the end of 3 indexes: for people, places, and topics is welcome and enhances the reader's ability to look up efficiently an author or a site. At times, the fact that English is not the mother tongue of most of the authors becomes apparent, but not so much to make understanding a problem.

The first 4 chapters do a good job of summarizing technology and techniques for archaeologists unfamiliar with remote sensing. Chapter 1 concentrates on basic concepts derived from subjective aerial photograph interpretation such as tone and texture and surveys the current list of VHR satellites. Chapter 2 is more quantitative and describes digital enhancement techniques along with color composites and other analysis techniques suitable for multi-spectral image data. Spatial filtering and analysis is also covered with good examples. Chapter 3 covers multi-dimensional classification and Chapter 4 finishes with a description of various data fusion techniques, in particular pan-sharpening. Throughout these initial chapters, many examples from archaeology are shown and in the following chapters the techniques are applied in other contexts.

Chapter 5, on Geomatic (or GIS) techniques in remote sensing and archeology summarizes the application of topographic and cartographic techniques in archaeology. In particular, the author stresses the value of multi-scale data ranging, for example, from topographic surveys of individual sites to airborne photogrammetric surveys of a neighborhood to satellite images of a region. Emphasis is placed on the need to place all surveys into an absolute cartographic base as this is now possible through the use of GPS receivers and produces a much more useful dataset. Several examples are given of current remote sensing systems and how they can be analyzed in a geographic context.

The following 9 chapters are essentially case studies, applying remote sensing to a particular site, but all derive principles from their studies which can be applied broadly. Chapter 6 is a case study concerning the site of Hierapolis, Turkey. Here, a multi-faceted approach was used to reconstruct the city and its environs. In particular, old declassified satellite images were combined with modern VHR satellites and all of them geometrically corrected into a GIS map base. The base served to integrate higher-resolution topography and field data such as ground-penetrating radar (GPR) as well as lower-resolution multi-spectral satellite images. Significant progress in understanding the region is summarized in the chapter.

Chapter 7 is a synopsis of the activities of NASA with regard to the application of remote sensing in archaeology. NASA supported some of the earliest uses of remote sensing starting with spaceborne photography, both black and white and color-IR. A conference in 1984 sponsored by NASA led to further advances, especially in multi-spectral and thermal infrared applications. Later, VHR and radar systems added to the tools used by archeologists. The chapter ends with a view toward the future, involving ASTER, imaging spectrometers, and the interpretation of vegetation remote sensing signatures for archaeological applications.

Chapter 8 details a successful case of detection and monitoring of site looting in Peru using time series of VHR images. The process has been automated to some extent with the hope it can be used on a routine basis.

Chapter 9 concerns the site of Angkor in Cambodia, where multi-spectral and VHR images have allowed detailed analysis of the history of water use. Both airborne and spaceborne remote sensing techniques were used to expand the site maps and as a GIS base for field data. Emphasis on remote sensing use was on mapping in a vegetated region and enhanced change detection.

Chapter 10 moves to Yemen for a study of ancient silver mines now threatened by expansion of modern mines. Multi-spectral and VHR images were the main workhorses here as the arid climate provided good exposure of the rocks and minerals of interest.

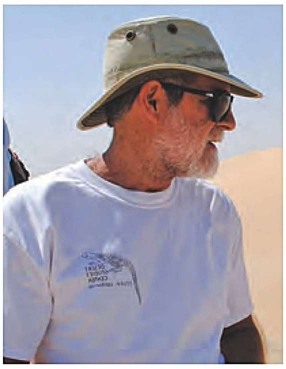
Chapter 11 shows the use of moderate-resolution multi-spectral and multi-temporal images to delineate an ancient irrigation system now obscured by modern agriculture and settlements in Burma. In this case, soil and vegetation moisture were the most important indicators of the irrigation system, so a multi-spectral index of vegetation moisture was used. Topographic data of sufficient resolution were not available, but the vegetation maps proved very useful.

Chapter 12 describes a search for underground irrigation tunnels in the extremely dry Nazca area of Peru. As water still passes through the tunnels, multi-spectral vegetation indices were used and a several-year time series developed. The multi-temporal indices showed signatures associated with different types of irrigation features.

Chapter 13 compares multi-spectral and VHR images from satellites and past air photos to show the potential for these various types of images for revealing archeological features in a Romanian test site. The general conclusion was that high resolution multi-spectral satellite data provide a new dimension for discovery.

Chapter 14 returns to the Nazca area of Peru with an extensive effort integrating ground, airborne, and spaceborne remote sensing techniques. Satellite data included topography, multi-spectral, and VHR images. The chapter describes the processing steps, including vegetation indices, pan-sharpening, spatial filtering, principal components, and others described in the initial chapters of the book. In the field, GPR, magnetic, and resistivity surveys were used to delineate buried structures. Fusion of the field data with VHR images in a GIS was a useful way to visualize the integrated data sets.

The background information combined with the range of studies presented in this book provide a well-balanced look at the various remote sensing techniques, ways of processing the data, and emphasizes the use of GIS to integrate the remote sensing data with other types of archeological data. Thus, Satellite Remote Sensing: A New Tool for Archaeology provides a blueprint for future archaeologists seeking to make the most of remote sensing.



Tom Farr received BS and MS degrees from Caltech, and a PhD from the University of Washington, all in Geology. After a short time as an engineering geologist, he joined the Radar Sciences Group at the Jet Propulsion Laboratory, where he has been since 1975. At JPL, he helped develop the first geologic applications of imaging radar using aircraft, satellites, and the Space Shuttle. He was the Deputy Project Scientist on the Shuttle Radar Topography Mission, which used interferometric radar to produce a near-global topographic map of the Earth. He has also been a science investigator on European and Japanese satellite programs and has assisted in the interpretation of radar images from Venus and recently from Saturn's moon Titan. His scientific research includes the use of remote sensing and digital topographic data for study of landscapes on Earth and other planets and how they are formed and modified by climate and tectonic or volcanic activity. He is also leading an effort to apply interferometric radar observations to groundwater monitoring.