Remote Sensing of Impervious Surfaces
Edited by Qihao Weng
CRC Press, Taylor & Francis Group, Boca Raton, Florida, xxvii and 454 pp., diagrams, tables, maps, photos, images, 12 pp. color plates, index, author biographies
ISBN: 978-1-42004-374-7
Hardcover. $129.95
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Who would have thought that there would be an entire volume dedicated to remote sensing techniques for impervious surface detection and characterization? Well, here it is. For those involved in impervious surface mapping, this book represents an excellent survey of the recent research involving remote sensing approaches. For those needing to learn more about the importance of imperviousness, its role in earth surface processes and other applications, and various methods for remote sensing of impervious surfaces, this book provides an outstanding introduction to the topic, as well as in-depth chapters that can be read entirely or scanned selectively. Remote Sensing of Impervious Surfaces offers something for all audiences.

So, just what are these impervious surfaces? The editor states that they are, “…anthropogenic features through which water cannot infiltrate into the soil, such as roads, driveways, sidewalks, parking lots, rooftops, and so on.” He goes on to describe their importance as an environmental indicator and as a measure of the degree of urbanization. Impervious surfaces have received much attention in recent years, as have methods to detect, delineate, and characterize them…hence the role of remote sensing.

Organized into five major sections, each with four chapters, Remote Sensing of Impervious Surfaces is very well structured, allowing the reader to direct his or her attention to the most relevant subject matter. Each chapter provides a review of particular approaches to remote sensing of impervious surfaces, or to the application of the derived information.

Part I, Digital Remote Sensing Methods, contains the following chapters: Estimating Percent Impervious Surfaces Using Multiple Regression; Sub-pixel Algorithms for Impervious Surface Mapping; Mapping Impervious Surfaces Using Classification and Regression Tree Algorithm; and Mapping Urban Impervious Surfaces from Medium and High Spatial Resolution Multispectral Imagery. These chapters are written by some of the foremost experts on remote sensing of impervious surfaces, and represent both new information, as well as repackaging of previously-reported work, which is not unusual for a volume such as this.

Part II, Technological Advances in Impervious Surface Mapping, consists of: A SPLIT Model for Extraction of Subpixel Impervious Surface Information; Use of Hyperspectral Imagery for Extracting Impervious Surface Data; Separation of Roads and Roofs Using Fractals; and Fusion of Radar and Optical Data For Identification of Man-Made Structures. The chapters in this section, too, are written by many of the authorities on the subject. The thematic distinction between Part I, Digital Remote Sensing Methods, and Part II, Technological Advances in Impervious Surface Mapping, is sometimes unclear. The chapters all could have been easily folded into the same part.

Part III, Transport-related Impervious Surfaces, addresses techniques dealing principally with roads and pavement: Extraction of Transportation Infrastructure from Hyperspectral Data; Road Extraction from SAR Imagery; Road Networks Derived from High Spatial Resolution Satellite Remote Sensing Data; and Spectral Characteristics of Asphalt Roads.

Part IV, Roof-related Impervious Surfaces, seems to be a mix of topical areas, addressing building extraction and roof mapping by way of: Urban 3D Building Model From LIDAR Data and Aerial Images; Building Extraction From Aerial Imagery; SAR Images of Built-Up Areas: Models and Data Elaborations; and Multi-scale Roof Mapping Using Fused Multi-Resolution Optical Satellite Images.

The final section, Part V, Impervious Surface Data Applications, attempts to provide an overview of several of the many applications of impervious surface information: Impervious Surface Area and Its Effect On Water Quality and Water Abundance; Impervious Surface Data for Hydrological Modeling of Water Flow; The Growth of Impervious Surface Coverage and Aquatic Fauna; Using Remotely Sensed Impervious Surface Data to Estimate Population.

Each chapter is preceded by a Contents listing sections and sub-sections. This is a very nice touch – providing the reader, if unable to read the entire chapter, or looking for specific details – with ready access to information of particular interest. The list of References at the end of each chapter is in itself a valuable resource.

The remote sensing-based methods for extracting impervious surface information is fairly comprehensive and mostly complete. One topic that has gained much attention recently and not addressed in the book is the use of proxy data, such as land use and land cover, for impervious surface estimation. While not remote sensing data themselves, land cover data are typically derived from visual or computer-assisted processing of aerial or satellite imagery, and models making use of land cover information in impervious surface characterization could have been justifiably included in this volume.

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The four chapters in *Transport-related Impervious Surfaces* are representative of the range of techniques for road extraction and pavement characterization. In *Roof-related Impervious Surfaces*, however, the content is a bit less unified, with two of the chapters dealing with building extraction, which is not necessarily a negative. The chapter provides an excellent blend of different platforms and sensors, including lidar, SAR, and digital optical imagery.

It is impossible to address all the application areas in a single volume such as this. The editor, however, did an excellent job of selecting representative thematic areas. There are a couple areas that might have been considered for inclusion in the applications chapter; however, such as urban heat island effects, best management practices for preserving rural character, addressing imperviousness in site plans, or inclusion of impervious surface stipulations in land use regulations, to name a few. Also, a chapter or two authored by the principals involved with some of the more prominent or successful impervious surface “programs” – such as the NLCD 2001 impervious surface product, the NOAA Coastal Services Center’s Impervious Surface Analysis Tool, or the National NEMO (Nonpoint Education for Municipal Officials) Network – would have been further illustrative of various other methods and applications.

Overall, the book is well-organized and the chapters well-written. The editor has taken measures to ensure consistency among the chapters, in the formatting of the narrative, tables, and figures. Color plates are used sparingly (12 pages), yet effectively. Though much of the content can be found elsewhere in the published literature, *Remote Sensing of Impervious Surfaces* brings a representative body of the state-of-the-art under a single cover. The book will serve as a comprehensive treatment for impervious surface remote sensing neophytes, as well as a valuable reference for veteran researchers and practitioners.