

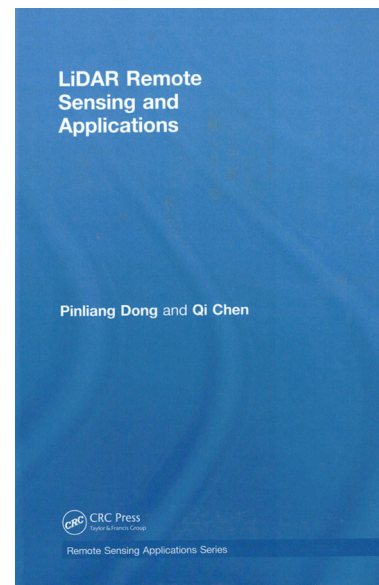
*LiDAR Remote Sensing and Applications*, by Dr. Pinliang Dong and Dr. Qi Chen, CRC Press, 2018, introduces the fundamentals of lidar remote sensing and is intended as a textbook for the undergraduate and graduate student in the fields of geography, forestry, ecology, geographic information science, remote sensing, and photogrammetric engineering.

The book consists of a total of six chapters, reference section, and index. For most of the book, the hands-on exercise projects and references follow the text in the chapters. It also includes an index map of lidar data used in the exercises and a list of abbreviations.

Commencing with the lidar Data Index Map, chapter 1, a Brief Overview of Remote Sensing, the authors discuss the history of remote sensing, basic concepts and methods or technologies of passive and active remote sensing that are introduced in separate sections. This is a short chapter with only 21 pages, but with easily understood diagrams, colorful pictures and mathematical formulas. The authors provide thoughtful explanations in straight forward language, allowing a reader to master some basic information and concepts of remote sensing.

In chapter 2, Principles of LiDAR Remote Sensing, the authors focus on lidar remote sensing by introducing the “Basic Components of LiDAR,” “Physical Principles of LiDAR,” “LiDAR Accuracy,” “LiDAR Data Formats,” “LiDAR Systems” and “LiDAR Resources.” Though a short chapter, it is probably the most important chapter in the book. The authors provide considerable information about lidar remote sensing technology. Though some more detailed information and deeper theories behind lidar technology could have been added, the chapter is definitely very helpful, especially for busy professionals working on lidar data production on a daily basis, who might lack the time to sift through a heavy, complex text. The lidar data resource and free software listed in lidar resources provides handy information for those who want to learn more about the lidar data, master or improve lidar processing skills with limited resources. At the end of the chapter, three hands-on project exercises are provided. In these exercises, the authors introduce the data used for the project, the methodology in the data processing and the purpose of the project. The step-by-step instructions should help a reader complete the project exercises with ease.

Chapter 3, Basics of LiDAR Data Processing, is another important chapter in the book. The authors introduce the basic workflow of lidar processing. In the Introduction section, two of the basic and then the most important steps of processing lidar data are introduced: classification of laser points and interpolation of discrete points into a continuous surface. The products of the classification and interpolation are also mentioned, for example, DTM (digital terrain model), DSM (digital surface model), DHM (digital height model) and TIN (triangulated irregular network). The flowchart of lidar point data



## **LiDAR Remote Sensing and Applications** Pingliang Dong and Qi Chen

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processing on page 42 helps a reader understand the major steps of lidar point data processing. The section on filtering explains the filtering algorithm used in processing, while the subsections TIN-based methods and raster-based methods explain the methods used in the processing, which provides important information for a reader to understand how these methods apply in the real lidar data production world. The section, Classification of Non-Ground Points, provides the reference information in the processing. In the section, Spatial Interpolation, the authors make extra effort to explain how the spatial interpolation works through detailed pictures, diagrams, and mathematical formulas. Following the section, two hands-on project exercises -- Creating DTM, DSM, and DHM from LiDAR Data, and -- Creating A Terrain Dataset using LiDAR Data, are provided. Readers should find the exercises interesting and helpful for understanding the discussions in the chapter.

Chapter 4 presents LiDAR for Forest Applications. The

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authors show how lidar has become a revolutionary remote sensing technology compared with the conventional optical and radar remote sensing technologies. The chapter introduces several topics in lidar applications in forest studies. Figure 4.1 lists the categories of lidar for forest applications based on sensor type, footprint size, and information extraction method, which provides very useful information in a simple manner. In the section on Canopy Surface Height Modeling and Mapping, the authors focus on one particular type of vegetation height product: a raster grid that stores the upper surface height of vegetation canopy, i.e. canopy height model (CHM). The section outlines the CHM generation processes, the challenges in processing and approaches and methods to address those challenges and problems by giving examples with detailed explanations. Readers of the book will find the flowcharts, diagrams and formulas in the section helpful for their understanding of the discussions in this section. LiDAR Metrics for Vegetation Analysis discusses lidar-based metrics for predicting the forest attributes in the vegetation analysis with a specific example of 22 metrics for vegetation modeling. Individual Tree Isolation and Mapping covers a lot of details about Grid-Based Tree Mapping and Point-Based Tree Mapping. This section also discusses Remaining Challenges in Tree Mapping and introduces A Simulation Study For Tree Isolation that I found very interesting. Area-Based Modeling and Mapping explains how after-based approaches are used in a larger project area. In the Modeling, Mapping and Estimating Biomass section, the authors point out that "...forest biomass is a key climate variable for the global carbon cycle and has attracted the attention of both scientists and policymakers" and "...is also an attribute that is very difficult to estimate". Because of this, the authors describe lidar that "has emerged as the most promising technology for biomass estimation". In this section, the authors discuss the existing studies on area-based approaches using lidar with great technical details. Both the student and the industry practitioner will appreciate the useful information provided in this section. Following the chapter, two hands-on projects, Extraction Canopy Heights from Leaf on and Leaf Off LiDAR Data and Identifying Disturbances from Hurricanes and Lightning Strikes to Mangrove Forests using LiDAR Data in Everglades National Park are very helpful. Questions in the projects are designed to help readers think through the exercise.

Chapter 5, LiDAR for Urban Applications, discusses the lidar applications used in Road Extraction, Building Extraction and 3D Reconstruction, Population Estimation, Change Detection, Assessment of Post Disaster Building Damage, and Assessment of Post Disaster Road Blockage. In each section, the authors describe the lidar technology in each application with detailed background information, techniques used in the processing, and mathematical theories of the technology. Most of the sections include a flowchart of the application and expla-

nations of major steps with pictures and diagrams, which help readers follow the line of thought the authors convey in the chapter. Following the chapter, project exercises, Locating 3D LiDAR Points Near a Powerline in the City of Denton, TX, USA and Small Area Population Estimation using Count, Area and Volume of Residential Building Extraction from LiDAR Data in Denton, TX, provide additional opportunities to get hands-on exercises to better understand the chapter content.

The final chapter, LiDAR for Geoscience Applications, I found to be the most interesting section of the book. The chapter focuses on lidar applications in the study of six major features/phenomena in geosciences: Aeolian Landforms, Fluvial Landforms, Surface Hydrology, Volcanic and Impact Landforms, Tectonic Landforms, and Lithology and Geologic Structures. Similar to the previous chapters, the authors use pictures, diagrams, flowcharts and detailed explanations to discuss the lidar technologies used in a variety of landform studies. Following the chapter, two hands-on project exercises Measuring Sand Dune Migration using Multi-temporal LiDAR Data in White Sands Dune Fields, NM, and Deriving Trend Surfaces of Simple Fold using LiDAR Data in Raplee Ridge, UT, USA, are quite helpful for understanding the chapter better and also demonstrate a very interesting use of the technologies.

*LiDAR Remote Sensing and Applications* is well written and well organized. The data for hands-on exercises are properly selected, step-by-step instructions, content, and questions in the project exercises are very helpful and thoughtfully constructed for readers to learn through hands-on learning. The book can function as a reference book as well as a textbook, not only for readers, but also for the geospatial professional who produce or use lidar data on a daily base. The authors present their own work and findings while introducing other expert and scholarly studies and research in the lidar application. The user will benefit from studying the contents, checking out the references provided, and working with the hands-on project exercises.

Just like anything else, the book is not perfect. Some suggestions might include a better-coordinated coloring/contrast of some of the illustrations to better present the information. Fonts in the book could be a little bit larger. The questions in the project exercises are only found in chapters 4 through 6, where it might be better to provide questions for every project to maintain consistency for the learning process. The picture (black & white) in Figure 4.34 on page 100 should be presented in blue and green, based on the illustration's description. Nevertheless, the book is highly recommended for its rich information and well-presented contents.