

Big Data for Remote Sensing: Visualization, Analysis and Interpretation

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Editors

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Digital Earth and Smart Earth

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Foreword

In this digital era, the size of the data involved in countless applications of our society has been increased substantially. Therefore, new computational methods, algorithms, and infrastructures are highly demanded in order to handle such sets of big data more efficiently, mainly in numerous real-time applications, requiring less powerful computational resources, so can be processed by common computational solutions.

Among the various areas where big data sets have become common, the ones related to Remote Sensing and information and communication technology are foremost, since the datasets involved have reached huge dimensions, which makes exceptionally complex their visualization, analysis, and interpretation. Therefore, this book assumes imperative and timely significance for these areas by presenting, discussing, and suggesting applications, infrastructures, methods, and techniques to overcome the present drawbacks. Five chapters are included in this book addressing issues of big data in e-health, aerial and satellite imagery, many-particle systems, earth science, and Remote Sensing.


The three editors of this book are well-known academics and researchers: Dr. Nilanjan Dey is Professor at Techno India College of Technology, is editor of several international journals, editor of various books published by renowned publishers, is co-author of numerous articles published in the most respectable journals and conferences, has supervised several M.Sc. and Ph.D. theses and organized many scientific events. Dr. Dey's research interests include medical imaging, soft computing, data mining, machine learning, rough set, mathematical modeling and computer simulation, biomedical systems, robotics, information hiding and security. Dr. Chintan Bhatt is Assistant Professor at Charotar University of Science and Technology, is co-author of several articles published in journals and conferences, has organized special sessions devoted to Internet of Things and big data, and his research topics are: Data Mining, Networking, Big Data, Internet of Things and Mobile Computing. Dr. Amira S. Ashour is Professor and Vice Chair of Computer Engineering Department, Computers and Information Technology College, Taif University, is editor of journals and of books published by international publishers, and co-author of numerous articles published in the most

well-known journals and conferences. Dr. Ashour's research interests include image processing and analysis, pattern recognition, signal, image, and video processing, medical imaging, biomedical systems, soft computing, artificial intelligence, and wireless and mobile communication.

At this time, I would like to congratulate the editors of this book for their amazing effort to tackle so timely and interesting topic and relevant knowledge, experiences, and guidelines that are going to contribute to overcome the current difficulties concerning the visualization, analysis, and interpretation of Remote Sensing big data. In addition, my special acknowledgment goes to the authors of the included chapters for sharing their expertise with the scientific community.

Finally, I am pleased to recommend this book to all students, researchers, and end users related to problems comprising Remote Sensing big data, since it will facilitate their endeavors in developing more competent solutions for such problems.

Porto, Portugal

João Manuel R. S. Tavares 
Universidade do Porto

Preface

The current advances in remote detecting (RS) and ICT technologies give birth to huge amount of remote detecting (RS) information. The RS information collected by a solitary satellite is drastically growing by a few terabytes for every day. As per the insights of Open Geospatial Consortium (OGC), the worldwide observation information would most likely surpass one exabyte. Particularly, the coming of the high-resolution earth observation period (EOS-4) has likewise prompted the high dimensionality of the RS image information. Remote detecting information is perceived as “big data” in some specific sense. In the meantime, the precise and cutting-edge data provided worldwide earth observations are changing the way that earth is interpreted. Clearly, expansive remote sensing applications overpowered with huge remote sensing information are viewed as data-intensive issues.

This book involves five chapters. The work *Big Data Approach for Managing the Information from Genomics, Proteomics, and Wireless Sensing in e-Health* by J. Demongeot, M. Jelassi, C. Taramasco aims to show that big data techniques can serve for dealing with the information coming from medical signal devices such as bio-arrays, electrophysiologic recorders, mass spectrometers, and wireless sensors in e-health applications, in which data fusion is needed for the personalization of Internet services allowing chronic patients, such as patients suffering cardiorespiratory diseases, to be monitored and educated in order to maintain a comfortable lifestyle at home or at his place of life. The information provided by the pathologic profiles detected and clustered thanks to big data algorithms, is exploited to calibrate the surveillance at home, personalize alarms, and give adapted preventive and therapeutic education.

The work *Aerial and Satellite Imagery and Big Data: Blending Old Technologies with New Trends* by J. Salazar Loor, P. Fdez-Arroyabe does brief review of RS history presented in section one. Then, basic properties, which are also challenges, of RS big data are concisely discussed. Volume, variety, and velocity are mainly described as characteristics of RS big data while variety, value, and visualization are primarily denoted as new challenges. The third section is concentrated on justifying the relevance of RS big data in today’s society and the needs to integrate it with other kind of data sources to develop useful services. In this sense, a special section is

dedicated to Copernicus initiative, and some case studies of specific applications are also shown. Finally, some general conclusions are presented paying attention to the spatial nature of RS big data, which gives it a special added value in the new digital era.

The work *Structure and Dynamics of Many-Particle Systems: Big Data Sets and Data Analysis* by Wolfram Schommers underlined that the structure and dynamics of many-particle systems determine essentially the properties of the systems in solid-state physics, materials science, and nanotechnology. The fundamental description of such systems is based on atoms or molecules that interact with each other. The physical background is discussed in detail. In particular, it is argued that the characteristic features and properties of such systems are already reflected by relatively small parts consisting of 10^2 – 10^7 particles. It is outlined that for all the systems used in solid-state physics, etc., no reliable analytical models exist and we have to recourse to numerical methods. The procedure is to solve Newton's equations of motion numerically using the interaction potential as input, and these fundamental equations of motion are expressed by coupled differential equations (molecular dynamics). The essential features of the molecular dynamics method have been discussed.

The focus of the work *Earth Science [Big] Data Analytics* by Mani Madhukar, Pooja is to analyze what exactly does big data mean in earth science applications and how can big data provide added value in this context. Furthermore, this chapter demonstrates various big data tools which can be mapped with various techniques to be used for experimenting earth science datasets, processed, and exploited for different earth science applications. In order to illustrate the aforementioned aspects, instances are presented in order to demonstrate the use of big data in remote sensing. Firstly, this chapter presents earth science studies, application areas/research fields, and a brief insight on earth science data. Then various techniques implemented in this domain are elaborated, viz. classification, clustering, regression, deep learning, pattern recognition, machine learning, earth data analysis, and processing. Finally, it is shown how different tools are mapped to earth science datasets using ArcGIS to illustrate with experimental instances the inferences and patterns generated.

The work *Retrieval of Urban Surface Temperature using Remote Sensing Satellite Imagery* by Jinxin Yang, Man Sing Wong, Hung Chak Ho presents the Urban Surface Temperature (UST) retrieval with consideration to the urban geometric characteristics in different seasons, analyzing the effective emissivity and urban surface temperature. Emissivity is crucial for surface temperature retrieval. However, the cavity effects and thermal heterogeneity caused by complex buildings affects the effective emissivity over urban areas. In this study, the effective emissivity from ASTER products in different seasons was collected to study the thermal heterogeneity effects on the applications of temperature and emissivity separation (TES) algorithm on the UST retrieval. Thermal images of Landsat 5 in different seasons were collected for analyses, in which the retrieved USTs, with and without considerations to geometric effects, were compared and analyzed. Finally, SUHI

estimates based on two sets of USTs and its impacts on SUHI intensity estimation at different seasons were also analyzed.

We hope this book introduces capable concepts and outstanding research results to support further development of big RS data for analysis, interpretation, and visualization.

Kolkata, India
Changa, India
Tanta, Egypt

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Contents

1	Big Data Approach for Managing the Information from Genomics, Proteomics, and Wireless Sensing in E-health	1
	J. Demongeot, M. Jelassi and C. Taramasco	
2	Aerial and Satellite Imagery and Big Data: Blending Old Technologies with New Trends	39
	J. Salazar Loor and P. Fdez-Arroyabe	
3	Structure and Dynamics of Many-Particle Systems: Big Data Sets and Data Analysis	61
	Wolfram Schommers	
4	Earth Science [Big] Data Analytics	99
	Mani Madhukar and Pooja	
5	Retrieval of Urban Surface Temperature Using Remote Sensing Satellite Imagery	129
	Jinxin Yang, Man Sing Wong and Hung Chak Ho	

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Amira S. Ashour is currently an Assistant Professor and Head of Department, EEC, Faculty of Engineering, Tanta University, Egypt. She has been the Vice Chair of Computer Engineering Department, Computers and Information Technology College, Taif University, KSA, for one year from 2015. She has been the Vice Chair of CS Department, CIT College, Taif University, KSA, for five years. Her research interests are smart antenna, direction of arrival estimation, targets tracking, image processing, medical imaging, machine learning, signal/image/video processing, image analysis, computer vision, and optimization. She has published 10 books and about 70 published journal papers. She is an Editor-in-Chief of *International Journal of Synthetic Emotions* (IJSE), IGI Global, USA. She is an Associate Editor of *International Journal of Rough Sets and Data Analysis* (IJRSDA), IGI Global, USA, as well as of *IJACI*, IGI Global, USA. She is an Editorial Board Member of *International Journal of Image Mining* (IJIM), Inderscience.