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699

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# Geo-Spatial Knowledge and Intelligence

4th International Conference  
on Geo-Informatics in Resource Management  
and Sustainable Ecosystem, GRMSE 2016  
Hong Kong, China, November 18–20, 2016  
Revised Selected Papers, Part II

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# Preface

The 4th Annual 2016 International Conference on Geo-Informatics in Resource Management and Sustainable Ecosystem (GRMSE 2016) was held in Hong Kong, China, during November 18–20, 2016. It aims to bring researchers, engineers, and students to the areas of geo-spatial information science, engineering, and systems in socioeconomic development, resource management, and sustainable ecosystem. GRMSE 2016 features unique mixed topics of spatial data mining, geographical information science, photogrammetry and remote sensing, data science, data engineering, cloud computing, deep learning, and recent applications in the context of building a smarter planet, healthier life, more enjoyable ecology and more sustainable resources.

We received a total of 311 submissions from various parts of the world. The international Program Committee worked very hard to have all papers peer-peer reviewed before the review deadline. The final program consisted of 118 papers. There were four key note speeches and five invited sessions. All the keynote speakers are internationally recognized leading experts in their research fields, who have demonstrated outstanding proficiency and have achieved distinction in their profession. The proceedings are published as a volume in Springer's *Communications in Computer and Information Science* (CCIS) series. Some excellent papers were selected and recommended to the special issue of *Journal of Environmental Science and Pollution*, a Science Citation Index Expanded journal. We would like to mention that, due to the limitation of the conference venue capacity, we were not able to include many fine papers in the program. Our apology goes to those authors.

We would like to express our sincere gratitude to all the members of international Program Committee and organizers for their enthusiasm, time, and expertise. Our deep thanks also go to the many volunteers and staff members for the long hours and hard work they have generously given to GRMSE 2016. We are very grateful to Professor Fuling Bian, Professor Hui Lin and Professor Yichun Xie for their support in making GRMSE 2016 possible. The generous support from Beijing Institute of Technology is greatly appreciated. Finally, we would like to thank all the authors, speakers, and participants of this conference for their contributions to GRMSE 2016.

January 2017

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# **Abstracts of Keynote Speeches**

# Abstracts of Keynote Speeches

**Name: Prof. Hui Lin**

The Chinese University of Hong Kong, Hong Kong, China

Position held:

Chen Shupeng Professor of GeoInformation Science, Department of Geography and Resource Management

Director, Institute of Space and Earth Information Science

Research Interests:

Microwave Remote Sensing Image Processing and Analysis

Virtual Geographic Environments (VGE) Spatial Database and Data Mining

Spatially Integrated Humanities and Social Science

**Keynote Speech Title:**

InSAR Remote Sensing for Urban Infrastructure Health Diagnosis

**Abstract.** The metropolitan area of Hong Kong is characterized by large reclamations with high density skyscrapers and infrastructure. Any inevitable movement of the infrastructure and built environment may pose a threat to infrastructure health and public safety. The development of InSAR remote sensing technology has shown its potential for the diagnosis of the infrastructure health.

**Name: Prof. Shuliang Wang**

Beijing Institute of Technology, Beijing, China

Shuliang Wang, Ph.D., a scientist in data science and software engineering, is a professor in Beijing Institute of Technology in China. His research interests include spatial data mining, and software engineering. For his innovatory study of spatial data mining, he was awarded the Fifth Annual Info Sci-Journals Excellence in Research Awards of IGI Global, IEEE Outstanding Contribution Award for Granular Computing, and one of China's National Excellent Doctoral Thesis Prizes.

Guest Editor:

International Journal of Systems Science

International Journal of Data Warehousing and Mining

Lecture Notes in Artificial Intelligence

**Keynote Speech Title:**

Spatial Data Mining Under Big Data

**Abstract.** It offers a systematic and practical overview of spatial data mining, which combines computer science and geo-spatial information science, allowing each field to profit from the knowledge and techniques of the other. To address the spatiotemporal specialties of spatial data, the authors introduce the key concepts and algorithms of the data field, cloud model, mining view, and Deren Li methods. The data field method captures the interactions between spatial objects by diffusing the data contribution from a universe of samples to a universe of population, thereby bridging the gap between the data model and the recognition model. The cloud model is a qualitative method that utilizes quantitative numerical characters to bridge the gap between pure data and linguistic concepts. The mining view method discriminates the different requirements by using scale, hierarchy, and granularity in order to uncover the anisotropy of spatial data mining. The Deren Li method performs data preprocessing to prepare it for further knowledge discovery by selecting a weight for iteration in order to clean the observed spatial data as much as possible. In addition to the essential algorithms and techniques, the book provides application examples of spatial data mining in geographic information science and remote sensing. The practical projects include spatiotemporal video data mining for protecting public security, serial image mining on nighttime lights for assessing the severity of the Syrian Crisis, and the applications in the government project ‘the Belt and Road Initiatives’.

**Name: Prof. Yong Wang**

University of Electronic Science and Technology of China, Chengdu, China  
East Carolina University, Greenville, USA

**Current research activities**

- Investigation of scale and scale effect on SAR application to urban target Evaluation of water level variations in reservoirs using In SAR technique Thin cloud removal for Landsat 8 imagery
- Submerged aquatic vegetation (SAV) assessment
- Flooding mapping using geo-spatial datasets in rural area

**Keynote Speech Title:**

Issues in Applying Geoinformatics and Big-Data as Additional Assessment Tools for Macro-Socioeconomic Development

**Abstract.** Annual socioeconomic datasets released by governmental agencies at the local, state, and national levels portrait socioeconomic statuses within different levels of political boundaries. The data collection costs labor, time, and money. The collected data may consist of errors. Remote sensors provide constant Earth observation. Remotely sensed datasets are multi-temporal and freely available mostly. The datasets are widely used to assess landuse and land cover (LULC) types changes through time, and the changes intuitively reflect the socioeconomic status and development. Thus, the development of additional assessment tools through analyses of remote sensed data is of great interest. Unfortunately, analyzing both types of datasets, one constantly faces analytical and/or statistical challenges. No matter what an approach is applied, following issues must be considered. Otherwise, one will undoubtedly concern the results and decisions/actions made based on the outcomes. The issues include data selection, distributions of selected datasets, data transformation, missingness of data, single or multiple independent variables, sensitivity of results to sample sizes, and finally alternative. In this study, we use socioeconomic development of Chengdu City, China between 1978 and 2014 as an example to address above issues. In particular, areas of the impervious surface and agricultural land are derived using spaceborne multi-temporal Landsat data. The domestic gross productivity (GDP) per person released by the statistic department of the municipal government of Chengdu is selected. Between 1978 and 2014, the area of the impervious surfaces and GDP per person increase approximately exponentially. The area of agricultural decreased. Proper transformation is individually applied so that each dataset varies linearly with time. Due to pervasive cloud cover in Chengdu, areas of the impervious surfaces and agricultural lands cannot be derived annually. The multiple imputation method based on the Monte Carlo Markov chain (MCMC) approach is used. Then, GDP per person as the function of the impervious surface area, and as the function of the impervious surface area and agricultural area are statistically established and assessed. The result is satisfactory in regression analysis and crosstab evaluation. It should be noted that the minimum number of required sample size increase rapidly as the number of independent variables increases. Therefore, the use of one or two LULC types as independent variables is recommended.

**Name: Prof. Huada Daniel Ruan**

Beijing Normal University, Beijing, China

Hong Kong Baptist University, Hong Kong, China

United International College (UIC), Zhuhai, China

Research interest:

- Synthesis, activation, modification and characterization of nanomaterials, their applications as sorbents, catalysts, medications, pigments, additives in environment, agriculture, chemistry and medicine, and their commercialization
- Applications of modified mineral-waste and organic-waste materials for the removals of heavy metals and toxic organic compounds in relation to environmental remediation
- The characteristics of environmental pollutants relating to human health Environmental auditing and assessment relating to environmental management and evaluation of climate change
- Interactions of soil minerals, heavy metals and microbes in contaminated soil materials and bioremediation of contaminated soils
- Environmental chemistry including water quality; air, water and soil pollution; plant nutrition; sediment chemistry; non-point pollution; eutrophication and heavy metal transport, accumulation and contamination
- Renewable energy with emphasis on bio-fuel and solar energy

**Keynote Speech Title:**

The Application of Environmental GIS

**Abstract.** Geographic Information System (GIS) generally fulfils the following applications: mapping, monitoring, modelling, measurement and management for a number of fields including political science, education, health care, real estate, business, urban planning and environmental science. The application of a GIS in environmental science can be drawn in environmental monitoring; risk assessment; watershed, floodplain, wetland and aquifer management; groundwater modelling and contamination tracking; hazardous or toxic facility siting; pollutant distribution and remediation; and simulation of process in urban and natural environment. Fundamental investigation of environmental pollution with case studies related to the application of GIS is addressed, and the development of GIS for environmental research and education is discussed in this study.

**Name: Prof. Qiang Gao**

Beihang University, Beijing, China

## Position held:

Professor in School of Electronic and Information Engineering, Beihang University, Beijing, China

## Research Interests:

Wireless Communication; Wireless Networks

**Keynote Speech Title:**

Outage Performance Analysis and Comparison of Two-Way Relaying Systems

**Abstract.** Cooperative communication has been an effective method for improving system reliability by utilizing the spatial diversity to combat wireless impairments. However, one-way relaying leads to lower spectrum efficiency because it consumes more resources than conventional direct transmission. Recently, two-way relaying (TWR) has drawn much attention since it can provide spectrally efficient transmission with high reliability.

This talk first compares the outage performance differences between amplify-and-forward (AF) and decode-and-forward (DF) in two-way relaying. It is well known that outage performance differences between AF and DF in one-way relaying are apparently related to the average signal-to-noise ratio (SNR). We reveal that it is the target spectral efficiency rather than SNR that determines the superiority in outage performance of different relaying schemes, i.e. DF outperforms AF in the low target spectral efficiency region and the other way around in the high target spectral efficiency region.

Then we investigate the outage performance of two-way amplify-and-forward relaying over block fading channels. Previous research on TWR has been mainly based on the assumption that the channel quality remains constant for one round of data exchange. However, this assumption does not realistically reflect the actual environment as channel conditions fluctuate over time. Our results show that the outage performance of the TWR-AF system deteriorates over block fading channels compared with that over constant-quality channels. Under block fading channels, the TWR system exhibits the outage floor phenomenon, which is not the case for constant-quality channels.



**Name: Prof. Tao Gong**

Donghua University, Shanghai, China

Prof. Tao Gong received the MS degree in Pattern Recognition and Intelligent Systems and Ph.D. degree in Computer Science from the Central South University respectively in 2003 and 2007. He is an associate professor of immune computation at Donghua University, China, and he was a visiting scholar at Department of Computer Science and CERIAS, Purdue University, USA. He is the General Editors-in-Chief of the first leading journal Immune Computation in its field, and an editorial board member of some international journals. He is a Life Member of Sigma Xi, The Scientific Research Society, a Vice-Chair of IEEE Computer Society Task Force on Artificial Immune Systems, and Chen Guang Scholar of Shanghai. His research has been supported by National Natural Science Foundation of China, Shanghai Natural Science Foundation, Shanghai Educational Development Foundation and Shanghai Education Committee etc. He has published over 100 papers in referred journals and international conferences, and over 20 books such as Artificial Immune System Based on Normal Model and Its Applications, and Advanced Expert Systems: Principles, Design and Applications etc. His current research interests include computational immunology and immune computation. He is also a committee member of intelligent robots committee and natural computing committee in the Association of Artificial Intelligence of China.

**Keynote Speech Title:**

Cooperative Immune Computation Against Collaborative Attacks in Cyberspace

**Abstract.** A security problem of cooperative immunization against collaborative attacks such as Blackhole attacks and wormhole attacks, in the mobile ad hoc networks such as the Worldwide Interoperability for Microwave Access (WiMAX) networks, was discussed. Because of the vulnerabilities of the protocol suites, collaborative attacks in the mobile ad hoc networks can cause more damages than individual attacks. In human immune system, nonselfs (i.e., viruses, bacteria and cancers etc.) can attack human body in a collaborative way and cause diseases in the human body. With the inspiration from the human immune system, a tri-tier cooperative immune model was built to detect and eliminate the collaborative attacks (i.e., nonselfs) in the mobile ad hoc networks. ARM-based Network Simulator (NS2) tests and probability analysis were utilized in the prototype for immune model to analyze and detect the attacks. Experimental results demonstrate the validation and effectiveness of the model proposed by minimizing the collaborative attacks and immunizing the mobile ad hoc networks.

**Name: Prof. Ji Zhang**

University of Southern Queensland, Toowoomba, Queensland

**Research Interest:**

Prof. Ji Zhang is currently working for the University of Southern Queensland (USQ), Australia. He is an Australian Endeavour Fellow, Queensland Fellow and Izaak Walton Killam Fellow (Canada). He received his degree of Ph.D. from the Faculty of Computer Science at Dalhousie University, Canada. Prof. Zhang's research interests in the area of Computer Science include knowledge discovery and data mining (KDD), Big Data analytics, bioinformatics, information privacy and security, and health informatics. He has published over 90 papers, some appearing in top-tier international journals including IEEE Transactions on Dependable and Secure Computing (TDSC), Information Sciences, WWW Journal, Bioinformatics, Knowledge and Information Systems (KAIS), Soft Computing, Journal of Database Management and Journal of Intelligent Information Systems (JIIS) and international conferences such as VLDB, ACM CIKM, ACM SIGKDD, IEEE ICDE, IEEE ICDM, WWW, DASFAA, DEXA and DaWak. Prof. Zhang is the recipient of a number of prestigious grants and awards including International Science Linkages Grants by Australian Academy of Science (2012 & 2010), Australian Endeavor Award (2011), USQ Research Excellence Award (2011), Head of Department Research Award (2011), Queensland International Fellowship (2010), Izaak Walton Killam Scholarship, Killam Trust, Canada (2007–2008) and IEEE ICDM Student Travel Award by Microsoft and IBM, USA (2006). He was the visiting professor of Michigan State University, USA in 2010 and Nanyang Technological University (NTU), Singapore in 2011.

**Keynote Speech Title:**

A Parallelized Graph Mining Approach for Efficient Fraudulent Phone Call Detection

**Abstract.** In recent years, fraud is becoming more rampant internationally with the development of modern technology and global communication. Due to the rapid growth in the volume of call logs, the task of fraudulent phone call detection is confronted with Big Data issues in real-world implementations. In this talk, I will present a highly-efficient parallelized graph-mining-based fraudulent phone call detection framework, namely PFrauDetector, which is able to automatically label fraudulent phone numbers with a “fraud” tag, a crucial prerequisite for distinguishing fraudulent phone call numbers from the normal ones. PFrauDetector generates smaller, more manageable sub-networks from the original graph and performs a parallelized weighted HITS algorithm for significant speed acceleration in the graph learning module. It adopts a novel aggregation approach to generate the trust (or experience) value for each phone number (or user) based on their respective local values. We conduct a comprehensive experimental study based on a real dataset collected through an anti-fraud mobile application, Whoscall. The results demonstrate a significantly improved efficiency of our approach compared to FrauDetector and superior performance against other major classifier-based methods.

**Name: Prof. Quan Zou**

Tianjin University, Tianjin, China

Editorial Board Member of Scientific Report, PLOS ONE

Special issue guest editor for Neurocomputing, Current Proteomics

Organizing Committee Chair of BIIP2015

Special Session Organizer of IJCNN2016

Program Committee member of the CCIB2011 (Special Session on Computational Collective Intelligence in Bioinformatics, during the 3rd International Conference on Computational Collective Intelligence, ICCCI2011 Gdynia, Poland September 21–23, 2011); WAIM2014,2015,2016 (International conference on Web-Age Information Management); FSDK2014(The 11th International Conference on Fuzzy Systems and Knowledge Discovery); APWeb2016

Outstanding Reviewers for Computers in Biology and Medicine (Elsevier, top 10th percentile in terms of the number of reviews completed within two years, 2015.2)

Reviewer of Bioinformatics, Briefings in Bioinformatics, IEEE/ACM Transactions on Computational Biology and Bioinformatics, IEEE Journal of Biomedical and Health Informatics, Scientific Reports, BMC Bioinformatics, PLOS One, Amino Acids, Gene, Neural Networks, Journal of Theoretical Biology, Computers in Biology and Medicine, Computational Biology and Chemistry, Molecular Biology Reports, BioMed Research International, Current Bioinformatics, Protein & Peptide Letters, Computational and Mathematical Methods in Medicine, Frontiers of Computer Science, etc.

**Keynote Speech Title:**

Computational Prediction of miRNA and miRNA-Disease Relationship

**Abstract.** MicroRNA is a kind of “star” molecular, and serves as a “director” since it can regulate the expression of protein. In 2006, related works on gene silence won Nobel price, which made miRNA be the hot topic in molecular genetics and bioinformatics. Mining miRNA and targets prediction are two classic topics in computational miRNAomics. In this talk, we focus on the miRNA mining problems from machine learning views. We point out that the negative data is the key problem for decreasing the False Positive rather than exploring better features. miRNA-disease relationship prediction is another hot topic in recent years. We introduce some novel network methods on calculating miRNA-miRNA similarity, which is the key issue for miRNA-disease relationship prediction.

**Name: Dr. Arun Kumar Saraf**

Department of Earth Sciences, Indian Institute of Technology Roorkee, India

Research specialization: Geographic Information System (GIS), Remote Sensing & Digital Image Processing

**Honours and Awards:**

- a. INSA – Royal Society, UK Fellowship – 2002
- b. INSA – Chinese Academy of Sciences Bilateral Fellowship - 2011
- c. National Remote Sensing Award-2001
- d. GIS Professional of the Year-2001
- e. National Scholarship for Study Abroad 1986, Govt. of India
- f. Indo-US S&T Fellowship, 1994–1995
- g. Khosla Research Award 1996
- h. Khosla Research Prize 1996
- i. Khosla Research Prize 1997
- j. Excellent Performance Recognition by IITR for the years 2001–2002
- k. Excellent Performance Recognition by IITR for the years 2002–2003
- l. Excellent Performance Recognition by IITR for the years 2003–2004
- m. Excellent Performance Recognition by IITR for the years 2004–2005
- n. Best Paper Award in Map Asia 2004 (Beijing, China)
- o. Nominated as Scientific Board Member of the International Geoscience Programme (IGCP) Scientific Board of UNESCO and IUGS

**Keynote Speech Title:**

Geoinformatics in Mapping of Fog-Affected Areas over Northern India and Development of Ion Based Fog Dispersion Technique

**Abstract.** Fog is a phenomenon that affects the Indo-Gangetic Plains every year during winter season (December – January). This fog is sometimes in the form of radiation fog and other also occurs as a mixture with other gases, known as smog (smoke + fog). There are various factors contributing to the formation of fog, that may be either meteorological, topographical or resulting from pollution. Fog has been mapped for the winter seasons of the years 2002–2016. In these winter seasons, fog affected areas were found to be changing significantly. The net cover of fog during a season varies in space, time intensity and frequency of occurrence. Presently, it is now possible to map and to predict fog formation to some extent. However, so far it has not been possible to disperse fog, though theoretically it has been discussed in literature. In the current work, experiments were conducted to find out the possibility and effectiveness of a negative air ionizer for fog dispersion. The experiments were carried out with fog, dhooop smoke and a mixture of both to generate smog. Two different glass chambers of different sizes were used in a closed room and the impact of air ionizer on dispersion was studied by testing the time taken for dispersion with or without the ionizer. The results show a significant performance with air ionizer indicating the effectiveness of the ion generator, which reduced the time taken for dispersion (in comparison to without ionizer) by about half.

## **Abstracts of Invited Talks**

# Abstracts of Invited Talks

**Name: Dr. Ismail Rakip Karas**

Karabuk University, karabük, Turkey

Research Interests:

GeoInformatics, Geographic Information Systems, GIS, Three Dimensional

Geographic Information Systems (3DGIS), Network Analyses, Software Development for GIS, Web based GIS, Geo-Databases, Spatial Data Structures, Computer Graphics, Computational Geometry, Image Processing, Graph Theory, Location Based Services

**Speech Title:**

3D Network Analyses Based on Smart Evacuation System for Indoor

**Abstract.** The number of buildings, which are very tall, complex and located on wider areas, has been increasing in today's modern cities. Having dozens of floors, hundreds of corridors, and rooms, and passages, these buildings are almost like a city in terms of their complexity and number of people accommodated. Due to size and complexity of buildings, there are many new problems to be addressed. Evacuation of the buildings quickly and seamlessly is the leading problem in case of emergency. Fire, power outage, terrorism (explosions, bomb threat, hostage-taking incidents), chemical spills, earthquake, flood, etc., are some of the extraordinary occasions that may be encountered or affect indoors. In such kind of cases, formation of panic, crowd, congestion, crush, unable to reach exit, etc. are frequently encountered.

In this talk, 3D Network Analyses and Interactive Human Navigation System for indoor which consists of three components will be presented. The first component is used to extract the geometrical and 3D topological vector data automatically from architectural raster floor plans. The second component is used for network analysis and simulations. It generates and presents the optimum path in a 3D modeled building, and provides 3D visualization and simulation. And the third component is used to carry out the generation of the guiding expressions and it also provides that information for the mobile devices such as PDA's, laptops etc via Internet.

In addition, an Intelligent Evacuation Model for Smart Buildings will be introduced in this presentation. The model dynamically takes into account environmental (smoke, fire, etc.) and human-induced (age, disability, etc.) factors and generates personalized evacuation route by performing network analysis interactively and in real-time. Intelligent Control Techniques (Feed-Forward Artificial Neural Networks) has been used in the design of the model.

**Name: Dr. Huan Yu**

Chinese Academy of Sciences, Beijing, China

Research Area:

Intelligent Simulation of Landscape Changes; Remote Sensing Application

Education Backgrounds:

2013 - Working as Associate Professor at Chengdu University of Technology;

2012–2014 Working as post-doctoral scientist at Chengdu University of Technology;

2010–2013 Working as lecturer at Chengdu University of Technology;

**Speech Title:**

The Distribution Characteristics of Halogen Elements in Soil Based on RS and GIS Methods

**Abstract.** Soil chemical elements are important parameters for soil origin diagnosis, and are sensitive indicators of human disturbance process. The present study attempts to evaluate the influence from human activities on halogen elements (fluoride and iodine). This study also attempts to seek a route to explore the spatial relationships between human disturbances and halogen elements according to geospatial theories and methods. Moreover, the spatial correlations between element anomalies and human disturbed landscapes are calculated to explore the influence from human activities on halogen elements, thereby determining the specific response mechanism. The study results indicate that landscapes influence halogen elements in diverse ways and that element iodine is closely related with road and mine landscapes. Furthermore, strong relationships exist between fluoride and road landscapes, which suggest that this element is affected by road landscapes significantly. Fluoride and iodine are unrelated with city landscapes, and fluoride is unrelated with mine landscapes. These provide a reference for the research on the interaction mechanism between halogen and environment. Therefore, it can be concluded that a response mechanism exploration of soil element aggregation and human disturbance is practicable according to geospatial theories and methods, which provides a new idea for studying the soil element migration.

**Name: Prof. Chong-yi Yuan**

Peking University, Beijing, China

Graduated from Department of mathematics, Nanjing University, 1964

Graduated from institute of Mathematics, Chinese Academy of Sciences, 1968

Switch from mathematics to the study of computer software, 1975

2 more years in Canada as a visiting scholar, Toronto University and Waterloo University, 1977–1979

3+ years in Germany as a visiting scholar to learn Petri Nets from Prof. Carl Adam Petri, 4 times in the 80s last century

Left Institute of Mathematics and started teaching in Peking University, Dec. 1992, Department of Computer Science at that time, School of Electronics Engineering and Computer Science now

Two master courses were taught: Petri Nets and Parallel Program Design from 1993 to 2009

Retired 2005

Professor and Ph.D. supervisor, named Chong-yi Yuan, born 1941

4 books: Petri Nets (1989), Petri Net Principles (1998), Principles and Applications of Petri Nets (2005), Petri Net Applications (2013)

**Speech Title:**

OESPA: Semantic Oriented Theory of Programming

**Abstract.** Testing is now a necessary step before a program is put to use. Formal semantics, including operational semantics, functional semantics etc., do not help in this regard. OESPA is a new theory that combines syntax and semantics together to allow program verification instead of testing. It consists of 3 parts: OE, operation expression, for programming, SP, semantic predicates, for precise semantics description, a semantic axioms. To compute semantics from OE. Examples are included for illustration.



## Contents – Part II

### Advanced Geospatial Model and Analysis for Understanding Ecological and Environmental Process

Spatial-Temporal Evolution Pattern and Future Scenario Analysis of Water Resources Carrying Capacity of Ningbo City . . . . .	3
<i>Yanjuan Wu, Zhiming Feng, and Yanzhao Yang</i>	
Predict Port Throughput Based on Probabilistic Forecast Model . . . . .	13
<i>Yihan Chen, Zhonghua Jin, and Xuejun Liu</i>	
Principal Component Analysis of Building Cluster Factors . . . . .	22
<i>Hua Ai, Qiang Liu, Zhen Wang, Zezhong Zheng, Yaosen Huang, and Zhiqin Huang</i>	
Progressive Network Transmission Method Research of Vector Data . . . . .	27
<i>Shengli Wang, Zezhong Zheng, Chengjun Pu, Mingcang Zhu, Yong He, Zhiqing Huang, Yicong Feng, Mengge Tian, and Jiang Li</i>	
Comparison of Different Remote Sensing Monitoring Methods for Land-Use Classification in Yunnan Plateau Lake Area . . . . .	37
<i>Ce Wang, Shu Gan, Da Yi, and Yang Wu</i>	
Application of Different Composite Index Methods in the Evaluation of Soil Heavy Metal Pollution . . . . .	43
<i>Yingchao Niu, Zhongfa Zhou, Denghong Huang, and Xu Yuan</i>	
Hyperspectral Image Denoising Based on Subspace Low Rank Representation . . . . .	51
<i>Mengdi Wang, Jing Yu, Lijuan Niu, and Weidong Sun</i>	
A Least-Squares Ellipse Fitting Method Based on Boundary . . . . .	60
<i>Lei Liu and Xiangwei Meng</i>	
Training Convolutional Neural Networks Based on Ternary Optical Processor . . . . .	67
<i>Ruifen Zhang and Shan Ouyang</i>	
An Improved Algorithm for Video Abstract . . . . .	76
<i>Jianlei Zhang, Qin Li, Wenfeng Shen, and Shengbo Chen</i>	
The Prediction of CTR Based on Model Fusion Theory . . . . .	90
<i>Jiehao Chen, Shuliang Wang, Ziqian Zhao, and Jiyun Shi</i>	

An Improved Algorithm of LEACH Protocol Based on Node’s Trust Value and Residual Energy . . . . . 101  
*Miaoyuan Huang, Enjian Bai, Xueqin Jiang, and Yun Wu*

Red Preserving Algorithm for Underwater Imaging . . . . . 110  
*Chunbo Ma and Jun Ao*

Estimating Gas Source Location Based on Distributed Adaptive Deflection Projected Subgradient Method . . . . . 117  
*Zhemin Zhuang, Fenlan Li, and Ye Yuan*

System Locating License Plates with Shadow Based on Self-adaptive Window Size Technique . . . . . 127  
*Jingyu Dun and Sanyuan Zhang*

Energy Prediction Model Based on Kernel Partial Least Squares for Energy Harvesting Wireless Sensor Network . . . . . 138  
*Xuecai Bao*

Deep Convolution Neural Network Recognition Algorithm Based on Maximum Scatter Difference Criterion . . . . . 146  
*Kunlun Li, Xuefei Geng, and Weiduan Li*

Energy Efficient Routing Algorithm Using Software Defining Network for WSNs via Unequal Clustering . . . . . 154  
*Hang Yu, Zhiping Jia, Lei Ju, Chunguang Liu, and Xianzhong Ding*

An Energy Efficient and Secure Data Aggregation Method for WSNs Based on Dynamic Set . . . . . 164  
*Jinsheng Zhu and Zhiping Jia*

A Novel Quality Detection Approach for Non-mark Printing Image . . . . . 173  
*Qiong Zhang, Bin Li, Minfen Shen, and Haihong Shen*

Passive Packet Reordering Measurement on Terrestrial-Based and Satellite-Based Internet . . . . . 181  
*Zhengguo Xu and Hui Zheng*

Research on the Description Method of the Atomic Services in Extensible Network Service Model . . . . . 191  
*Jie Ren and Jun Shen*

The Risk Assessment for Unmanned Vehicle Using Bayesian Network . . . . . 200  
*Dapeng Li, Ting Liu, Tingting Cao, Pingke Deng, Ling-chuan Zeng, and Yi Qu*

Delay-Constrained Least-Energy-Consumption Multicast Routing Based on Heuristic Genetic Algorithm in Unreliable Wireless Networks. . . . . 208  
*Ting Lu, Shan Chang, and Guohua Liu*

A Coarse to Fine Object Proposal Framework for Autonomous Driving Object Detection Using Binocular Image . . . . . 218  
*Xiaolong Liu, Wanzeng Cai, Zhengfa Liang, and Yiliu Feng*

Study on Recognition and Management of Cartographic Topology Preprocessing Mode . . . . . 228  
*Chengming Li, Xiaoli Liu, Wei Wu, and Yong Yin*

Research on Hot Topic Discovery Technology of Micro-blog Based on Biterm Topic Model . . . . . 234  
*Jun Feng and Yu Fang*

A Deduplication Algorithm Based on Data Similarity and Delta Encoding . . . 245  
*Bin Song, Limin Xiao, Guangjun Qin, Li Ruan, and Shida Qiu*

Area Constrained Space Information Flow . . . . . 254  
*Alfred Uwitonze, Jiaqing Huang, Yuanqing Ye, and Wenqing Cheng*

Research on the Algorithm of Converting Files Generated by CALPOST to AVS/Express Platform . . . . . 260  
*Xiaofei Shi, Yunfeng Ma, Qi Wang, Tingshuai Wang, Ping Wang, Shuai Wang, Xuezhong Xu, Weike Xu, Zhongyi Wei, Nan Xiao, Caina Zhang, Xiaorui Ma, Yanwei Qian, and Kunyu Gao*

A Construction Method of Road and Residence Correlation Based on Urban Skeleton Network . . . . . 267  
*Chuang Liu, Haizhong Qian, Haiwei He, Xiao Wang, and Limin Xie*

A Hybrid Parallel Computing Model to Support Scalable Processing of Big Oceanographic Spatial Data . . . . . 276  
*Miaomiao Song, Wenwen Li, Wenqing Li, Enxiao Liu, and Dingfeng Yu*

A Study on Curve Simplification Method Combining Douglas-Peucker with Li-Openshaw. . . . . 286  
*Chengming Li, Pengda Wu, Teng Gu, and Xiaoli Liu*

**Applications of Geo-informatics in Resource Management and Sustainable Ecosystem**

A Mobile Services Collaborative Recommendation Algorithm Based on Location-Aware Hidden Markov Model. . . . . 297  
*Mingjun Xin, Shunxiang Li, Liyuan Zhou, and Guobing Zou*

3D Visualization Analysis of Longtan Reservoir-Induced Earthquakes and Active Faults . . . . . 307  
*Zhengqiang Long, Hong Yao, Shuangqing Liu, and Xuejun Sun*

Identification and Characterization of Geological Hazards in a Coal Mining Area Using Remote Sensing . . . . . 321  
*Jin Liu*

Monitoring Landslides Using Multi-frequency SAR Data in Danba County, Sichuan Province, China . . . . . 330  
*Yansheng Ding, Jie Dong, Lu Zhang, Mingsheng Liao, and Yang Zhou*

Modeling the Avian Influenza H5N1 Virus Infection in Human and Analyzing Its Evolution . . . . . 339  
*Ping Zhang*

The Research of 3D Geological Modeling in the Main Mining Area and East Mining Area of BayanObo Deposit . . . . . 353  
*Mingchao Zhang, Jingchao Li, Yike Li, Qunchao Zuo, Lei Yao, Hui Chen, and Wanjuan Liang*

Application of the Evidence Right in the Quantitative Evaluation of Rural Residential Area . . . . . 363  
*Chao Tang and Longyi Shao*

Research on Detection and Trend Forecasting Technologies of Micro-blog Hot Topic . . . . . 372  
*Qi Fu and Jun Tan*

The Implementation of Human Tracking with Quadrotor Aircraft . . . . . 379  
*Yang Yang, Dongdong Huang, and Nannan Cheng*

QvHran: A QoE-Driven Virtualization Based Architecture for Heterogeneous Radio Access Network . . . . . 389  
*Luhan Wang, Zhaoming Lu, Xiangming Wen, Lu Ma, Xin Chen, and Wei Zheng*

An ID-Based Anonymous Authentication Scheme for Distributed Mobile Cloud Computing . . . . . 401  
*Tianyi Zhang and Fengtong Wen*

QKDFlow: QKD Based Secure Communication Towards the OpenFlow Interface in SDN . . . . . 410  
*Yan Peng, Chunqing Wu, Baokang Zhao, Wanrong Yu, Bo Liu, and Shasha Qiao*

Location System Design Based on Weighted RSSI for High-Speed Railway Landslide Monitoring . . . . .	416
<i>Bo Yang, Yongqiang Zhang, Jifu Yu, Xingxia Wang, and Xinchun Jia</i>	
Application of Computer Simulation in Interference Assessment Between Satellite Systems . . . . .	426
<i>Tingting Cao, Dapeng Li, Aiai Ren, and Pingke Deng</i>	
Research and Application of Three-Dimensional Simulation Technology on Virtual Display of Skirt . . . . .	433
<i>Yan Wan, Zheng Tie, and Zilin Shi</i>	
Database Construction and Map Compilation of Provincial Common Geographic Maps . . . . .	442
<i>Guizhi Wang and Wen Zhou</i>	
Building Geospatial Health Applications from the EASTWeb Framework . . .	451
<i>Yi Liu, Michael D. DeVos, Muhammad Abdul-Ramin, and Michael C. Wimberly</i>	
Ship Navigation and Warning System Based on GPS/BDS Equivalent Satellite Clock Error Method . . . . .	465
<i>Dongjian Cai, Zhanyong Fan, Zongkun Zhen, and Wanghui Zhou</i>	
Research on Cloud Storage of Vector Data Based on HBase . . . . .	473
<i>Ruoxin Zhu, Jianqiao Cheng, Jianyong Fan, and Ke Chen</i>	
Research on Visualization Methods for Academic Papers Analysis of Chinese Surveying and Mapping Journals . . . . .	483
<i>Jing Li, Haiyan Liu, Wenyue Guo, and Ruijie Yang</i>	
<b>Author Index . . . . .</b>	<b>493</b>

# Contents – Part I

## Smart City in Resource Management and Sustainable Ecosystem

Study of Ecosystem Sensitivity Based on Grid GIS in Leishan County . . . . .	3
<i>Shanshan Zhang, Zhongfa Zhou, and Xiaotao Sun</i>	
The Design and Implementation of Field Patrol Inspection System Based on GPS-Tablet PC. . . . .	12
<i>Shengchun Shi and Yicheng Yin</i>	
The Vehicle Route Modeling and Optimization Considering the Dynamic Demands and Traffic Information . . . . .	20
<i>Chouyong Chen and Jun Chen</i>	
Developing a 3D Routing Instruction Engine for Indoor Environment . . . . .	34
<i>Ismail Rakip Karas, Umit Atila, and Emrullah Demiral</i>	
Saliency Detection for High Dynamic Range Images via Global and Local Cues. . . . .	43
<i>Dengmei Xie, Gangyi Jiang, Hua Shao, and Mei Yu</i>	
Research on Vegetable Growth Monitoring Platform Based on Facility Agricultural IOT . . . . .	52
<i>Qingxue Li and Huarui Wu</i>	
A Novel Framework for Analyzing Overlapping Community Evolution in Dynamic Social Networks . . . . .	60
<i>Hui Jiang, Xiaolong Xu, Jiaying Wu, and Xuewu Zhang</i>	
Developing Mobile Software for Extenics Innovation . . . . .	71
<i>Siwei Yan, Rui Fan, Yuefeng Chen, and Xiaohang Luo</i>	
Variable Weight Based Clustering Approach for Load Balancing in Wireless Sensor Networks . . . . .	80
<i>Xuxun Liu and Hongyan Xin</i>	
MDPRP: Markov Decision Process Based Routing Protocol for Mobile WSNs . . . . .	91
<i>Eric Ke Wang, Zhe Nie, Zheng Du, and Yuming Ye</i>	
Medical Insurance Data Mining Using SPAM Algorithm . . . . .	100
<i>Qifeng Cheng and Xiaoqiang Ren</i>	

A Genetic-Algorithm-Based Optimized AODV Routing Protocol . . . . . 109  
*Hua Yang and Zhiyong Liu*

Performance Analysis of PaaS Cloud Resources Management Model  
 Based on LXC . . . . . 118  
*Xuefei Li and Jing Jiang*

Link Prediction Based on Precision Optimization . . . . . 131  
*Shensheng Gu and Ling Chen*

Face Feature Points Detection Based on Adaboost and AAM . . . . . 142  
*Xiaoqi Jia, Qing Zhu, Peng Zhang, and Menglong Chang*

Stock Price Manipulation Detection Based on Machine Learning  
 Technology: Evidence in China . . . . . 150  
*Jiangyun Zhang, Shaojie Wang, Shicheng Xu, and Mengxin Yu*

Study over Cerebellum Prediction Model During Hand Tracking . . . . . 159  
*Shaobai Zhang and Qun Chen*

Forecasting for the Risk of Transmission Line Galloping Trip Based  
 on BP Neural Network . . . . . 168  
*Lichun Zhang, Bin Liu, Bin Zhao, Xiangze Fei, and Yongfeng Cheng*

A Features Fusion Method for Sleep Stage Classification Using EEG  
 and EMG. . . . . 176  
*Tiantian Lv, Xinzui Wang, Qian Yu, and Yong Yu*

Community Detection Algorithm with Membership Function . . . . . 185  
*Dongming Chen, Lulu Jia, Dongfang Sima, Xinyu Huang,  
 and Dongqi Wang*

Task Scheduling in Cloud Computing Based on Cross Entropy Method. . . . . 196  
*Ying Ren, Lijun Zhou, and Huawei Li*

Bad Data Identification Based on Optimized Local Outlier  
 Detection Algorithm . . . . . 203  
*Jingxian Qi, Yuefeng Cao, and Jianhua Shi*

A Novel Approach to Extracting Posts Qualification from Internet . . . . . 213  
*Yi Ding, Bing Li, Yuqi Zhao, and Fengling Liao*

Unclear Norm Minimization and Weighted Sparse Reconstruction Cost  
 for Crowd Abnormal Detection. . . . . 222  
*Shaochao Sun*

Quality Measurement and Evaluation Technology Research of Power Grid Dispatching Automation System Software . . . . . 230  
*Xin Xu, Yujia Li, Lixin Li, Fangchun Di, Qing-bo Yang, Ling-lin Gong, and Lin-peng Zhang*

Identification of Certain Shrapnel’s Air Resistance Coefficient in Plateau Environment Based on CK Method . . . . . 238  
*Ming Jiang, Yuwen Liu, Lijing Cao, and Zhiyuan Zhang*

Image Semantic Segmentation Based on Fully Convolutional Neural Network and CRF . . . . . 245  
*Huiyun Li, Xin Qian, and Wei Li*

Car-Based Laser Scanning System of Ancient Architecture Visual Modeling . . . . . 251  
*Kunyang Wang and Jing Zhang*

Research on Fractal Characteristics of Road Network in Chengdu City . . . . . 257  
*Bowen Qiao and Jing Zhang*

WIFI-Based Indoor Positioning System with Twice Clustering and Multi-user Topology Approximation Algorithm . . . . . 265  
*Xiaofeng Lu, Jianlin Wang, Zibo Zhang, Haibin Bian, and Erzhou Yang*

Surveillance Camera-Based Monitoring of Plant Flowering Phenology . . . . . 273  
*Lijun Deng, Wei Shen, Yi Lin, Wei Gao, and Jiayuan Lin*

Visual Analysis Research of Traffic Jam Based on Flow Data . . . . . 284  
*Wei Tian, Jinming Zhang, and Jialin Ma*

A Design of UAV Multi-lens Camera System for 3D Reconstruction During Emergency Response . . . . . 293  
*Junhui Wu, Fei Wang, and Xiaocui Zheng*

**Spatial Data Acquisition through RS and GIS in Resource Management and Sustainable Ecosystem**

Winter Wheat Leaf Area Index (LAI) Inversion Combining with HJ-1/CCD1 and GF-1/WFV1 Data . . . . . 301  
*Dan Li, Jie Lv, Chongyang Wang, Wei Liu, Hao Jiang, and Shuisen Chen*

Assessment of Wavelet Base Based on Analytic Hierarchy Process in Remote Sensing Image De-noising . . . . . 310  
*Yongmei Zhai, Shenglong Chen, Fuzhen Wang, and Qi Zhao*



Estimation of Fishing Vessel Numbers Close to the Terminator in the Pacific Northwest Using OLS/DMSP Data . . . . .	321
<i>Tianfei Cheng, Weifeng Zhou, Hongyun Xu, and Wei Fan</i>	
Similarities and Differences of Oceanic Primary Productivity Product Estimated by Three Models Based on MODIS for the Open South China Sea . . . . .	328
<i>Hongyun Xu, Weifeng Zhou, Anzhou Li, and Shijian Ji</i>	
Hydrological Feature Extraction of the Tarim Basin Based on DEM in ArcGIS Environment . . . . .	337
<i>Yaping Wei, Jinglong Fan, and Xinwen Xu</i>	
Extraction Method of Remote Sensing Alteration Anomaly Information Based on Principal Component Analysis . . . . .	342
<i>Nan Lin, Menghong Wu, and Weidong Li</i>	
Geographical Situation Monitoring Applications Based on MiniSAR . . . . .	350
<i>Xuejing Shi, Gang Huang, Ming Qiao, and Bingnan Wang</i>	
New Reduced-Reference Stereo Image Quality Assessment Model for 3D Visual Communication . . . . .	356
<i>Ying Wang, Kaihui Zheng, Mei Yu, Baozhen Du, and Gangyi Jiang</i>	
New Tone-Mapped Image Quality Assessment Method Based on Color Space. . . . .	365
<i>Hao Song, Gangyi Jiang, Hua Shao, and Mei Yu</i>	
A Modified NCSR Algorithm for Image Denoising . . . . .	377
<i>Diwei Li, Yunjie Zhang, and Xin Liu</i>	
Aviator Hand Tracking Based on Depth Images . . . . .	387
<i>Xiaolong Wang and Shan Fu</i>	
Reachability Problem in Temporal Graphs . . . . .	396
<i>Kaiyang Liu and Xincan Fan</i>	
Research on Rapid Extraction Method of Building Boundary Based on LIDAR Point Cloud Data . . . . .	403
<i>Minshui Wang, Guodong Yang, Xuqing Zhang, and Liji Lu</i>	
Absorption Band Spectrum Features Extraction for Minerals Recognition Based on Local Spectral Continuum Removal. . . . .	414
<i>Wei Zhou, Qichao Liu, and Zhikang Xiang</i>	
Analysis of Seasonal Variation of Surface Shortwave Broadband Albedo on Tibetan Plateau from MODIS Data . . . . .	423
<i>Zihan Zhang, Shengcheng Cui, and Xuebin Li</i>	

A Novel Multiple Watermarking Algorithm Based on Correlation Detection for Vector Geographic Data . . . . . 429  
*Yingying Wang, Chengsong Yang, Changqing Zhu, Na Ren, and Peng Chen*

A Spatial SQL Based on SparkSQL . . . . . 437  
*Qingyun Meng, Xiujun Ma, Wei Lu, and Zerong Yao*

**Ecological and Environmental Data Processing and Management**

A Comparison of Four Global Land Cover Maps on a Provincial Scale Based on China’s 30 m GlobeLand30 . . . . . 447  
*Xiaohui Ye, Jinling Zhao, Linsheng Huang, Dongyan Zhang, and Qi Hong*

Research Progress on Coupling Relationship Between Carbon and Water of Ecosystem in Arid Area. . . . . 456  
*Xiang Huang*

Karst Rocky Desertification Dynamic Monitoring Analysis Based on Remote Sensing for a Typical Mountain Area in Southeast of Yunnan Province . . . . . 466  
*Ling Yuan, Shu Gan, Xiping Yuan, Ce Wang, and Da Yi*

Guangxi Longtan Reservoir Earthquakes S-Wave Splitting. . . . . 477  
*Lijuan Lu, Bin Zhou, Xiang Wen, Shuiping Shi, Chunheng Yan, Sha Li, and Peilan Guo*

Study on Inversion Forecasting Model for 2011 Tohoku Tsunami. . . . . 494  
*Chao Ying, Yong Liu, Xin Zhao, and Jinbin Mu*

Remote Sensing Dynamic Monitoring and Driving Force Analysis of Grassland Desertification Around the Qinghai Lake Area. . . . . 505  
*Yu’e Du, Baokang Liu, Fujiang Hou, and Zongli Wang*

Leaf Area Index Estimation of Winter Pepper Based on Canopy Spectral Data and Simulated Bands of Satellite . . . . . 515  
*Dan Li, Hao Jiang, Shuisen Chen, Chongyang Wang, Siyu Huang, and Wei Liu*

Geoinformatics in Mapping of Fog-Affected Areas over Northern India and Development of Ion Based Fog Dispersion Technique. . . . . 527  
*Arun K. Saraf, Palash Choudhury, Josodhir Das, Gaurav Singh, Susanta Borgohain, Suman Saurav Baral, and Kanika Sharma*

Ground Subsidence Monitoring in Cheng Du Plain Using DInSAR SBAS Algorithm. . . . . 535  
*Xiaoya Lu and Xiaopeng Sun*

GIS in Seismic Hazard Assessment of Shillong Region, India. . . . .	546
<i>J.D. Das, A.K. Saraf, and V. Srivastava</i>	
Spatial-Temporal Analysis of Soil Erosion in Ninghua County Based on the RUSLE . . . . .	553
<i>Ming Yu, Yao Huang, Chaofeng Sun, and Yong Wu</i>	
Characteristics and Environmental Significance and Physical and Chemical Properties of Karst Cave Water in Shuanghe Cave, Guizhou Province (in China) . . . . .	563
<i>Jie Zhang, Zhongfa Zhou, Mingda Cao, and Yanxi Pan</i>	
Regional Pollutant Dispersion Characteristics of Weather Systems. . . . .	572
<i>Tingshuai Wang, Qi Wang, Yunfeng Ma, Ping Wang, Wei Huang, and Dexin Guan</i>	
Study on the Selection and Moving Model of the Poverty Alleviation and Resettlement in the Typical Karst Mountain Area: —A Case Study of Pan County in Guizhou Province . . . . .	579
<i>Yanxi Pan, Zhongfa Zhou, Qian Feng, and Mingda Cao</i>	
Assessment of Flood Hazard Based on Underlying Surface Change by Using GIS and Analytic Hierarchy Process . . . . .	589
<i>Lin Lin, Caihong Hu, and Zening Wu</i>	
<b>Author Index</b> . . . . .	601