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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
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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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.
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 portray 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 undoubtly 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)

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 miRNAnomics. 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
d. GIS Professional of the Year-2001
e. National Scholarship for Study Abroad 1986, Govt. of India
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, dhoop 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
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 descrip-
tion, a semantic axioms. To compute semantics from OE. Examples are included for
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