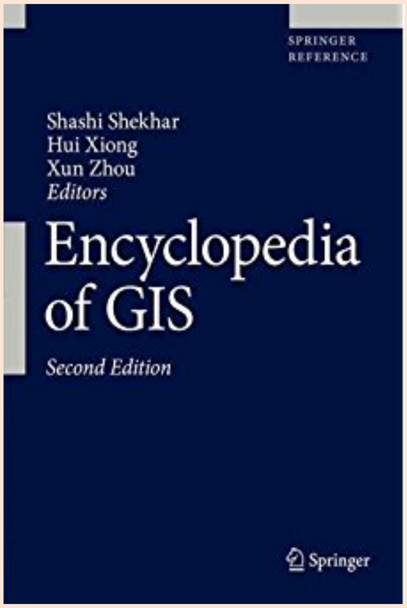



## The Significant Growth of GIS

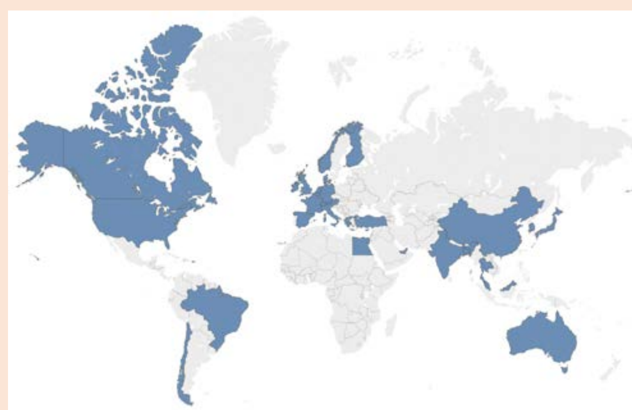
The "Encyclopedia of GIS First Edition" has been well received by a broad audience in industry, government and academia. By 2016, the cumulative downloads via Springer have exceeded 160,534 not counting additional downloads via other web-sites such as Google Books. Furthermore, it has received numerous recognitions such as the CHOICE outstanding title award. During this period of time, we have witnessed numerous significant advances in mobile technology and disruptive development in business that are transforming the world: the widespread use of smartphones, the increasing popularity of mobile apps, the wide deployment of location-based services (LBSs), the fast-growing taxi-hailing services like Uber, the evolution of mobile social networks, and more recently, the global interests in big data, unmanned aerial vehicles, and self-driving vehicles to improve people's lives. Nowadays, there are over one billion GPS users, exceeding the number of Microsoft Windows users. While various disciplines have been contributing to these new advances, spatial computing and GIS techniques no doubt are playing a key role here. For instance, localization is a fundamental issue for smartphones, connected and self-driving vehicles, unmanned aerial vehicles, taxi-hailing services, etc. Location information and location privacy are the essentials of LBSs. Check-in recommendation is a key function of mobile social networks. The study of spatial big data, such as Global Positioning Systems (GPS) traces of vehicles and global climate data, help people better understand human mobility patterns as well as Earth climate change. Consequently, an influential 2011 report on big data from McKinsey included a chapter on location-based big data.

To acknowledge the growth, the Association of Computing Machinery (ACM) formed a special interest group namely, SIG-Spatial, and its annual meeting attracts over 300 attendees. In addition, the Computing Research Association's Computing Community Consortium organized a multi-sector multi-disciplinary workshop titled "From GPS and Virtual Globes to Spatial Computing 2020" at national academies in 2012 to assess the state of the art and catalyze new research visions. A summary of the workshop report appeared in the Communications of the ACM in January 2016 as the cover article titled "Spatial Computing". In summary, experts in GIS related fields and researchers from other disciplines have shown strong interests in understanding these new spatial technologies and developments. Therefore, we believe it is the time to develop the second edition of the encyclopedia and include entries on the new emerging topics.

## The Second Edition of Encyclopedia of GIS

The second edition of Encyclopedia of GIS provides us an opportunity to enhance topic coverage and content timeliness of the first edition. While over 200 entries across 50 different fields were included in the first edition, there are still a few important topics left out, such as basic concepts in GIS and GPS. As suggested by GIS colleagues, we have included some of these topics in the second edition. Moreover, new research advances on some existing fields of the first edition are also updated either by adding new entries or through the revision of existing entries. The contributors of this book come from 31 counties in all the continents except Antarctica.

The second edition inherited all the key features from the previous edition. Typical entries are 3,000 words with sections such as definition, scientific fundamentals, application domains, and future trends. Regular entries include key citations and a list of recommended reading materials regarding the literature. The encyclopedia is also simultaneously available as an HTML online reference with hyperlinked citations, cross-references, four-color art, links to Web-based maps, and other interactive features.



The contributors come from 31 countries of 6 continents (All except Antarctica).

## Free Online Access in 7,700 Institutions and via Google Books

Encyclopedia of GIS is included in the Springer package available in over 7,700 institutions world-wide as well as on third-party websites such as Google Books. At the University of Minnesota, the Encyclopedia of GIS has been used as teaching materials in spatial computing and spatial database courses at no cost to students. Its articles were used for the Fall 2014 Coursera's massively open online course titled "From GPS and Google Maps to Spatial Computing," with over 21,800 students from 182 countries. We hope that the second edition could continue serving the research community and the general public as a helpful introductory material to GIS, a resourceful research reference, and an illustrative GIS textbook.

### Print Edition

2nd ed. 2017. LIV, 2507 p. 1054 illus., 507 illus. in color.
ISBN: 978-3-319-17884-4

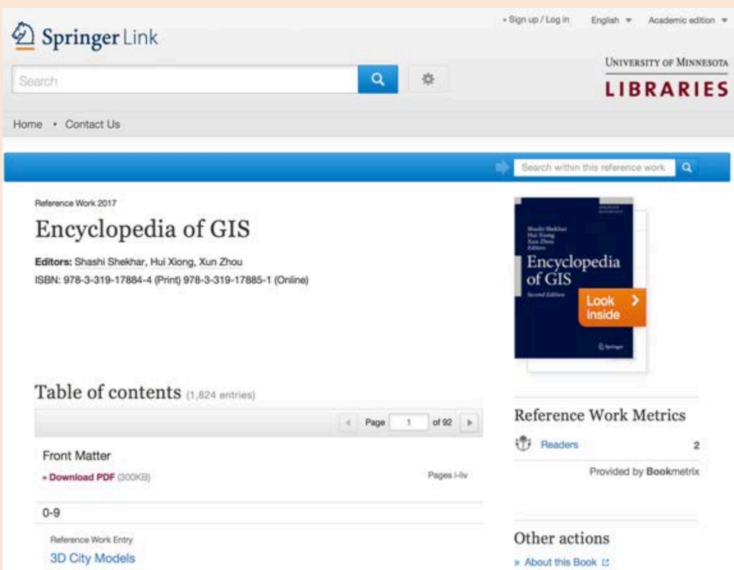
### eReference

ISBN: 978-3-319-17885-1

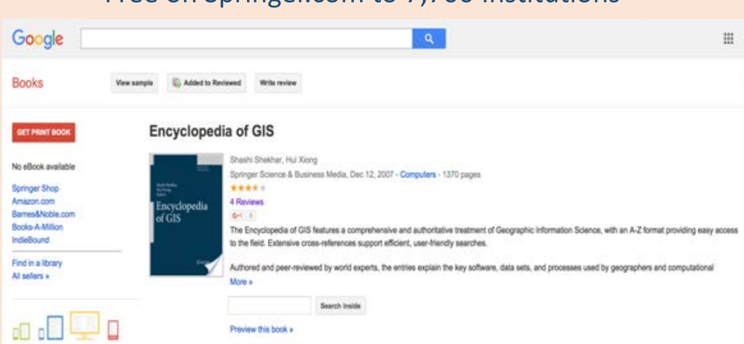
## Springer.com

### New Fields and Topics

The second edition includes 25 additional fields that are either previously absent from the first edition or recently emerged as new research topics. Each field has typically 3–10 articles. These fields include spatial computing infrastructure, spatial cognitive assistance, volunteering geographic information (VGI), GPS-denied environment, statistically significant spatiotemporal pattern mining, mobile economy, mobile recommender systems, spatial network routing, spatial optimization, web-based GIS (industry perspective), location- based recommendation systems, linear anomaly window detection, intelligent transportation, GPU-based spatial computing, spatiotemporal analysis of climate data, geospatial weather and climate nexus, spatial statistics, concepts in spatial statistics, data science for GIS applications, 3D modeling and analysis, geometric nearest-neighbor queries, modeling of spatial relations, concepts in statistics for spatial and spatiotemporal data, high-performance computing in GIS, and trends. Furthermore, there are two fields, road network databases and constraint databases and data mining, which have been updated by the original editors with new concepts added or existing articles revised to accommodate more recent research results and technical advances.




Free on Springer.com to 7,700 Institutions




Majority of Articles Available for Free on Google Books

## Encyclopedia of GIS (Second Edition)

### Praise For The First Edition

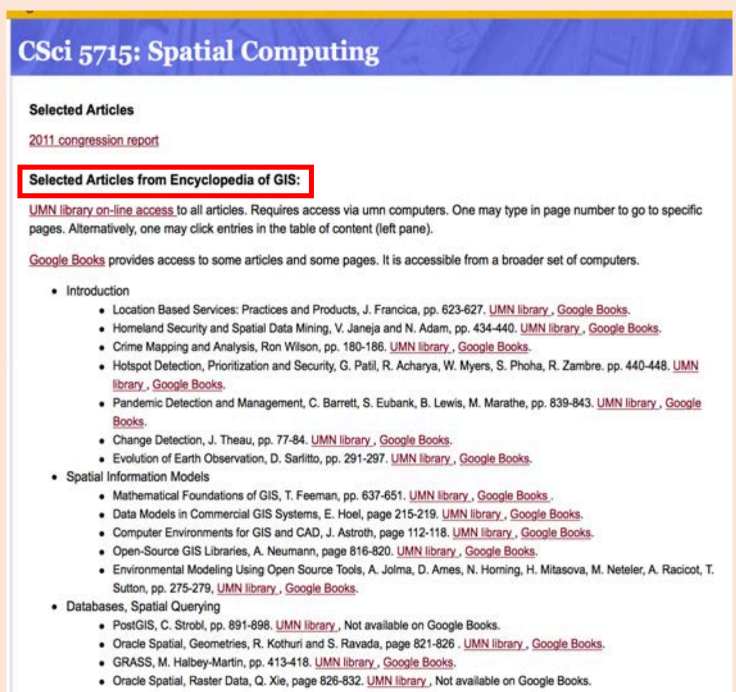
"The focus here, however, is on the mathematical and computational aspects of GIS … . This is very welcome to those practitioners who have been less exposed to some of the mathematical and computational aspects of GIS. This is also very welcome to the researcher or graduate student within any of the interdisciplinary areas that use GIS. … I highly recommend it."

(***Pascal V. Calarco, ACM Computing Reviews, November, 2008***)

"This single-volume reference work is a highly welcome … addition to the rapidly advancing field of geographic information systems. Peer-reviewed entries from over 300 contributors cover 41 topical subfields, with an overall emphasis on computational aspects of GIS. The volume is adequately illustrated with 723 figures and 90 tables in black and white. A full bibliography and concise list of entry terms are provided at the back of the work. … Summing Up: Highly recommended. Upper-division geography students through professionals."

(***C. E. Smith, CHOICE, Vol. 45 (11), 2008***)

"The encyclopedia is divided into 41 fields, each one an important sub-area within GIS. ... the editors' organization of the material and comprehensive and systematic approach are superb and shall give students, eager readers as well as researchers an understanding of the topics in quite full depth and breadth. … is lavishly illustrated with figures, graphs and tables, the design and execution of which are as perfect as the material they illustrate. … it is sturdy and opens out nicely for study and reference." (***Current Engineering Practice, 2008***).

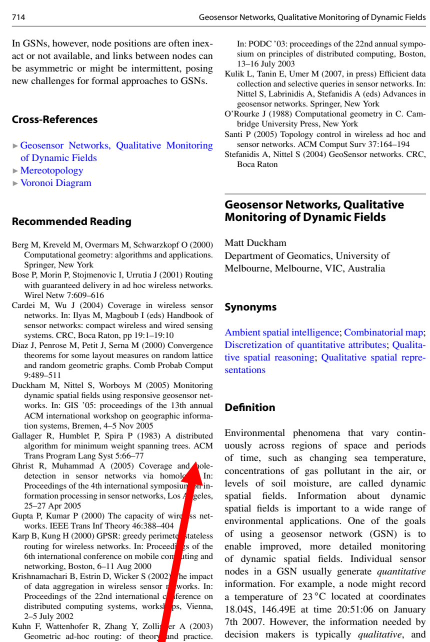


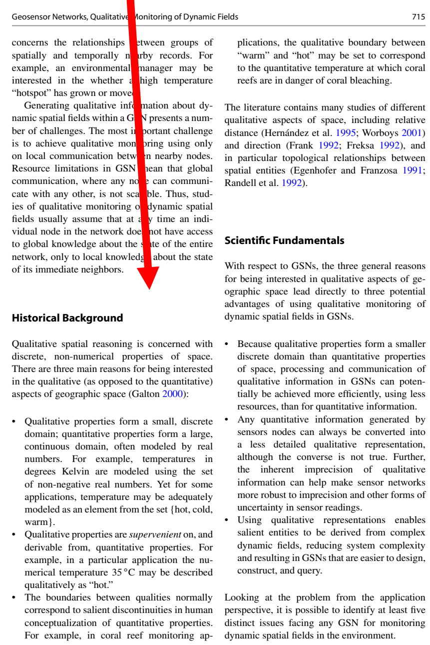

Used In-campus course at University of Minnesota

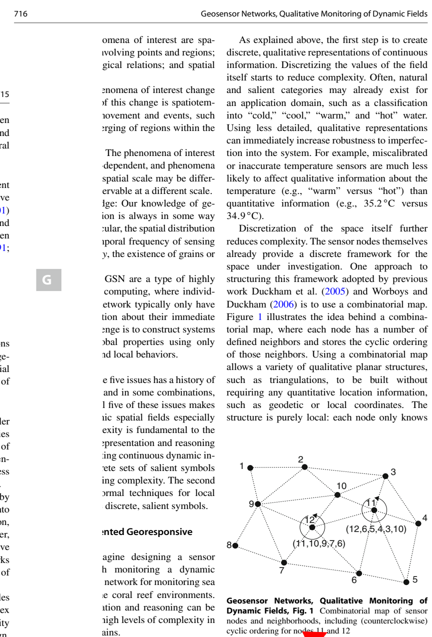
Springer.com

An Example Article

Backgrounds and fundamentals

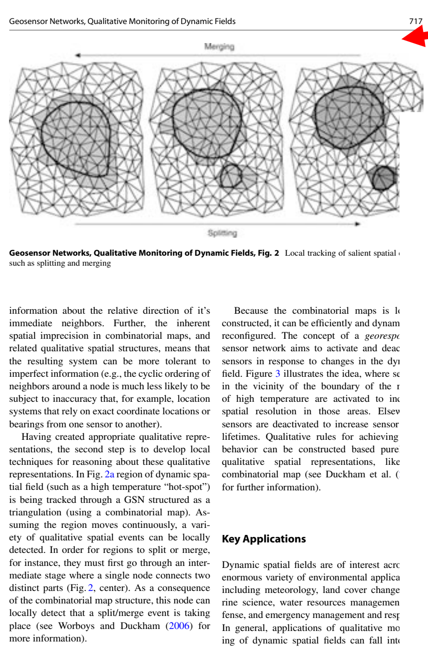


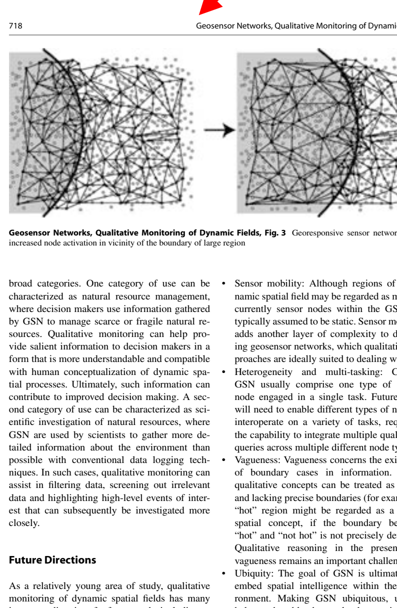




Clear problem definition

Extensive illustrations





Future research directions

Reference list

Outline of An article

- Synonyms
- Definition
- Historical Background
- Scientific Fundamentals
- Key Applications
- Future Directions
- References

**Springer.com**

# Fields and Field Editors (New fields are red)

**Spatial Computing Infrastructure**
Mohamed Ali, Microsoft, USA

**Security and Privacy in Geospatial Information Systems**
Vijay Atluri, Rutgers University, USA

**Statistical Modeling for Spatial Data**
Sudipto Banerjee, University of California at Los Angeles, USA

**Spatial Database Modeling for Applications**
Yvan Bedard, Université Laval, Canada

**Spatial Association Discovery; Data Science for GIS Application**
Sanjay Chawla, University of Sydney, Australia

**Location-Based Recommendation Systems**
Chi-Yin Chow, City University of Hong Kong, HK

**Modeling of Spatial Relations**
Eliseo Clementini, University of L'Aquila, IT

**Geospatial Weather and Climate Nexus**
Scott Collis, Argonne National Laboratory, USA

**Web-Based GIS (Industry)**
Jing (David) Dai, Google, USA

**Digital Road Map**
Robert Denaro, NAVTEQ, USA

**Critical Evaluation of Standard Proposals**
Liping Di, George Mason University, USA

**Geospatial Semantic Web**
Frederico Fonseca, The Pennsylvania State University, USA

**Spatial Thinking**
Andrew Frank, Technical University of Vienna, Austria

**Emergency Evacuations**
Oscar Franzese, Oak Ridge National Laboratory, USA

**Spatiotemporal Analysis of Climate Data**
Auroop Ganguly, Northeastern University, USA

**Mobile Recommender Systems**
Yong Ge, The University of Arizona, USA

**Intelligent Transportation**
Glenn Geers, ARRB, AU

**Spatial Statistics**
Daniel Griffith, The University of Texas at Dallas, USA

**Information Collection Using Sensor Network**
Dimitrios Gunopulos, University of California at Riverside, USA

**Spatial Network Routing**
Viswanath Gunturi, IIT Ropar, India

**Volunteering Geographic Information**
Brent Hecht, Northwestern University, USA

**Spatiotemporal Data Modeling**
Kathleen Hornsby, The University of Maine, USA

**Spatial Colocation Rule Mining**
Yan Huang, University of North Texas, USA

**Linear Anomaly Window Detection**
Vandana Janeja, University of Maryland, Baltimore County, USA

**GIS Issues and Applications**
Robert Kauffman, Arizona State University, USA

**Spatial Prediction; 3D Modeling and Analysis**
Baris Kazar, Oracle Corporation, USA

**Basic Concepts**
Sangho Kim, ESRI, USA

**Commercial Spatial Databases**
Ravi Kothuri, Oracle Corporation, USA

**Indoor Positioning**
Xinrong Li, University of North Texas, USA

**Evacuation Planning and Operations**
Henry Liu, University of Minnesota, USA

**Spatial Outlier Detection**
Chang-Tien Lu, Virginia Tech, USA

**Spatial Data Warehousing and Decision Support**
Nikos Mamoulis, The University of Hong Kong, HK

**Photogrammetry**
Helmut Mayer, Institute for Photogrammetry and Cartography, Germany

**Cartography and Visualization**
Liqui Meng, Technical University Munich, Germany

**Concepts in Statistics for Spatial and Spatiotemporal Data**
Pradeep Mohan, SAS Institute Inc, USA

**Basic Storage and Retrieval Structure**
Mohamed Mokbel, University of Minnesota, USA

**Spatial Optimization**
Kyriakos Mouratidis, Singapore Management University, SG

**Open Source GIS Software**
Andreas Neumann, Institute of Cartography, Switzerland

**Geosensor Networks**
Silvia Nittel, The University of Maine, USA

**Use of Spatial Data for Simulation**
Leon Osborne Jr., University of North Dakota, USA

**Tesselation Data Models**
Sudhanshu Panda, Gainesville State College, USA

**Spatial Aspects of Bioinformatics**
Srinivasan Parthasarathy, The Ohio State University, USA

**GPU-Based Spatial Computing**
Sushil Prasad, Georgia State University, USA

**Spatial Constraint Databases**
Peter Revesz, University of Nebraska- Lincoln, USA

**Spatial Analysis**
Ashok Samal, University of Nebraska-Lincoln, USA

**Representation of Inexact Spatial Informatior**
Markus Schneider, University of Florida, USA

**Road Network Databases**
Cyrus Shahabi, University of Southern California, USA

**GIS in Business Intelligence, Routing**
Jayant Sharma, Oracle Corporation, USA

**Trends**
Shashi Shekhar, University of Minnesota, USA

**Spatial Indexing**
Yufei Tao, The Chinese University of Hong Kong, HK

**Spatiotemporal Databases**
Vassilis Tsotras, University of California at Riverside, USA

**Spatial Aspects of Mobile Computing**
Ouri Wolfson, University of Illinois at Chicago, USA

**Mobile Economy**
Keli Xiao, Stony Brook University, USA

**Trends**
Hui Xiong, Rutgers University, USA

**Spatial Aspects of Distributed Computing**
Chaowei (Phil) Yang, George Mason University, USA

**GPS-Denied Environment**
Alper Yilmaz, The Ohio State University, USA

**Spatial Time Series**
Pusheng Zhang, Microsoft Corporation, USA

**Data Exchange and Interoperability**
Naijun Zhou, University of Maryland, USA

**Statistically Significant Pattern Mining**
Xun Zhou, The University of Iowa, USA

**High-Performance Computing in GIS**
A-Xing Zhu, University of Wisconsin, USA

**Springer.com**

# Contributors (1/2)

**Raj Acharya** Department of The Pennsylvania State University, USA
**Nabil R. Adam** Rutgers University, USA
**Dinesh Agarwal** Georgia State University, Atlanta, USA
**Pragya Agarwal** University College London,UK
**Graeme Aggett** Riverside Technology,Inc., USA
**Ablimit Aji** Hewlett Packard Labs, USA
**Ashraful Alam** The University of Texas at Dallas, USA
**Bardia Alavi** Worcester Polytechnic Institute, USA
**Reem Y. Ali** University of Minnesota, USA
**Mohammed Eunus Ali** Bangladesh University of Engineering and Technology, Bangladesh
**Mohamed Ali** University of Washington, USA
**Phyllis Altheide** U.S. Geological Survey Geospatial Information Office, USA
**Leonardo Lacerda Alves** Pontifical Catholic University of Minas Gerais, Brazil
**Daniel P. Ames** Idaho State University, USA
**Scot Anderson** Southern Adventist University, USA
**Allen Anselmo**, Idaho State University, USA
**François Anton** Technical University of Denmark, Denmark
**Ali Arab** Georgetown University, USA
**Walid G. Aref** Purdue University, USA
**Ami Arthur** University of Oklahoma, Norman, USA
**Joe Astroth** Autodesk Location Services, USA
**Umit Atila** Karabuk University, Turkey
**Vijay Atluri** Rutgers University,USA
**Suhaibah Azri** Universiti Teknologi Malaysia, Malaysia
**Thierry Badard** Université Laval, Canada
**Yuqi Bai** George Mason University, USA
**Chris Bailey-Kellogg** Dartmouth College, USA
**Spiridon Bakiras** University of Hong Kong, China
**Sreeram Balakrishnan** GoogleInc.,USA
**Shivanand Balram** Simon Fraser University, Canada
**Sudipto Banerjee** University of California at Los Angeles, USA
**Jie Bao** Microsoft Research, China
**Christopher L. Barrett** Virginia Tech, USA
**Sajib Barua** University of Alberta, Canada
**Peter Batty** Intergraph Corporation, USA
**Yvan Bédard** Laval University, Canada
**Stefan Berchtold** stbAG, Germany
**Claudio Bettini** University of Milan, Italy
**Budhendra Bhaduri** Oak Ridge National Laboratory, USA
**Udit Bhatia** Northeastern University, USA
**Shrutilipi Bhattacharjee** Indian Institute of Technology Kharagpur, India
**Roland Billen** University of Liege, Belgium
**Yaser Bishr** Image Matters LLC, USA
**Thomas Bittner** State University of New York at Buffalo, USA
**Roger Bivand** Norwegian School of Economics and Business Administration, Norway
**Laura Blumenfeld** Northeastern University, USA
**Arnold P. Boedihardjo** Virginia Polytechnic Institute and State University, USA
**Christian Böhm** University of Munich, Germany
**José Luís Braga** Federal University of Vicosa (UFV), Brazil
**Sotiris Brakatsoulas** RA Computer Technology Institute, Greece
**Jessica Breen** University of Kentucky, USA
**Lindsey Bressler** Northeastern University, USA
**Jean Brodeur** Natural Resources Canada, Canada
**James D. Brown** Hydrologic Solutions Limited,UK
**Mark A. Bullimore** The Ohio State University, USA
**Dirk Burghardt** University of Zurich, Switzerland
**Thomas E. Burk**, University of Minnesota, USA
**Benjamin Bustos** University of Chile, Chile
**Chen Cai** Data61-CSIRO, Australia
**Jorge Campos** Salvador University, Brazil
**André L.F. Cançado** Universidade de Brasília, Brazil
**Claude Caron** University of Sherbrooke, Canada
**Salem Chakhar** University of Paris, France
**Daniel Chamberland-Tremblay** University of Sherbrooke, Canada
**Omair Chaudhry** The University of Edinburgh, UK
**Sanjay Chawla** University of Sydney, Australia
**Aijun Chen** George Mason University, USA
**Ching-Chien Chen** Geosemble Technologies, USA
**Cindy X. Chen** University of Massachusetts, USA
**Feng Chen** Virginia Polytechnic Institute and State University, USA
**Lailin Chen** Idaho State University, USA
**Dihan Cheng** Boston University, USA
**Reynold Cheng** Hong Kong Polytechnic University, China
**Yi-Chang Chiu** University of Arizona, USA
**Dong-Wan Choi** Korea Advanced Institute of Science and Technology, Korea
**AndyH.F.Chow** University College London, UK
**Chi-Yin Chow** City University of Hong Kong, China
**George Christakos** San Diego State University, USA
**Soon Ae Chun** City University of New York, USA
**Yongwan Chun** The University of Texas at Dallas, USA
**Chin-Wang Chung** Chongqing University of Technology, China
Korea Advanced Institute of Science and Technology, Korea
**Kevin D. Clark** Northeastern University, USA
risQ Corporation, USA
**Eliseo Clementini** University of L'Aquila, Italy
**Anthony G. Cohn** University of Leeds, UK
**Paul Colley** Oracle America Inc, USA
**Anthea Coster** Massachusetts Institute of Technology, USA
**Michael Cramer** Stuttgart University, Germany
**Martin D. Crossland** Oral Roberts University, USA
**Jing (David )Dai** Google, USA
**David M. Danko** ESRI, USA
**Clodoveu A. Davis Jr.** University of Minas Gerais, Brazil
**Ugur Demiryurek** University of Southern California, USA
**Nan Deng** Northeastern University, USA
**Liping Di** George Mason University, USA
**Jürgen Döllner** University of Potsdam, Germany
**Suzana Dragićević** Simon Fraser University, Canada
**Robin Dubin** Case Western Reserve University, USA
**Matt Duckham** University of Melbourne, Australia
**Luiz H. Duczmal** Universidade Federal de Minas Gerais, Brazil
**Harold Dunsford** Idaho State University, USA
**H. Sebnem Düzgün** Middle East Technical University, Turkey
**Emre Eftelioglu** University of Minnesota, USA
**Khaled Elbassioni** Saarbrücken, Germany
**Ahmed Eldawy**, University of California, Riverside, USA
**J. Paul Elhorst** University of Groningen, The Netherlands
**Amr Elmasry** Alexandria University, Egypt
**Philip Erickson** Massachusetts Institute of Technology, USA
**Stephen Eubank** Virginia Tech, USA
**John Evans** Global Science & TechnologieInc, USA
**Babak Fard** Northeastern University, USA
**Timothy G. Feeman** University, Villanova, USA
**Hakan Ferhatosmanoglu** The Ohio State University, USA
**Katie M. Filbert** National Institute of Justice, USA
**Jugurta Lisboa Filho** Federal University of Vicosa (UFV), Brazil
**Andrew O. Finley** Michigan State University, USA
**Peter Fisher** City University, UK
**Stephen E. Flynn** University, Boston, USA
**Paolo Fogliaroni** Vienna University of Technology, Austria
**Kristen M. Foley** North Carolina State University, USA
**Frederico Fonseca** The Pennsylvania State University, USA
**Marie-Josée Fortin** University of Toronto, Canada
**Samuel Foucher** Computer Research Institute of Montreal, Canada
**Joseph R. Francica** Directions Media, USA
**Oscar Franzese** OakRidge National Laboratory, USA
**Chuck Freiwald** Oracle, USA
**Montserrat Fuentes** North Carolina State University, USA
**Edith Gabriel** Avignon University, France
**Stephen G. Gaddy** Meridian Environmental Technology, Inc., USA
**Antony Galton** University of Exeter, UK
**Vijay Gandhi** University of Minnesota, USA
**Chandana Gangodagamage** University of Minnesota, USA
**Poulomi Ganguli** Northeastern University, USA
**Auroop R. Ganguly** Northeastern University, USA
**Huiji Gao** LinkedIn, USA
**Lauren M. Gardner** University of New South Wales, Australia
**Rafael M. Gasca** Universidad de Sevilla, Spain
**Yong Ge** The University of Arizona, USA
**Betsy George** Oracle, USA,
**Arthur Getis** San Diego State University, USA
**Gabriel Ghinita** National University of Singapore, Singapore
**Soumya K. Ghosh** Indian Institute of Technology Kharagpur, India
**Michael Gibas** The Ohio State University, USA
**María Teresa Gómez-López** Universidad de Sevilla, Spain
**Huiling Gong** Oracle, USA
**Michael F. Goodchild** University of California at Santa Barbara, USA
**Pierre Goovaerts** Bio Medware Inc, USA
**Michael Goshey** University of Minnesota, USA
**Jonathan J. Gourley** NOAA National Severe Storms Laboratory, USA
**Damon Grabow** University of North Dakota, USA
**Benedikt Gräler** Ruhr University Bochum, Germany
**Daniel Griffith** University of Texas at Dallas, USA
**Marco Gruteser** Rutgers University, USA
**Joachim Gudmundsson** NICTA, Australia
**Ignacio Guerrero** Intergraph Corporation, USA
**Dimitrios Gunopulos** The University of California at Riverside, USA
**Ashish Gupta** Ohio State University, USA
**Sandeep Gupta** University of California at Riverside, USA
**Ralf Hartmut Güting** Distance University of Hagen, Germany
**Pierre Hadaya** University of Québec at Montréal, Canada
**Marios Hadjieleftheriou** AT&TLabsInc., USA
**Jerome F. Hajjar** Northeastern University, USA
**Malte Halbey-Martin** Freie Universität Berlin, Germany
**ScottA.Hale** University of Oxford, UK
**Tyler Hall** Northeastern University, USA
**Jiawei Han** University of Illinois at Urbana-Champaign, USA
**Robert D. Hart** Meridian Environmental Technology, Inc., USA
**Ahmad Hatami** Worcester Polytechnic Institute, USA
**Christian Heipke** Leibniz University Hannover, Germany
**Rachael Heiss** Northeastern University, USA
**Olaf Hellwich** Berlin University of Technology, Germany
**Deanna Hence** University of Illinois at Urbana-Champaign, USA
**Abdeltawab M. Hendawi** University of Virginia, USA
**Hayden Henderson** Northeastern University, USA
**Gerard B. M. Heuvelink** Wageningen University and ISRIC World Soil Information, The Netherlands
**Stephen C. Hirtle** University of Pittsburgh, USA
**ErikHoel** Environmenta lSystems Research Institute, USA
**BaikHoh** Rutgers University, USA
**Mevin B. Hooten** Colorado State University, USA
**Ned Horning** American Museum of Natural History, USA
**Siavash Hosseinyalamdary** The Ohio State University, USA
**Wei Hu** International Business Machines Corp., USA
**Miaoqing Huang** University of Arkansas, USA
**Qunying Huang** University of Wisconsin – Madison, USA
**Yan Huang** The University of North Texas, USA
**Marco Hugentobler** ETHZurich, Switzerland
**Lorenz Hurni** ETH Zurich, Switzerland
**CiranoIochpe** Federal University of Rio Grande do Sul, Brazil
**Umit Isikdag** Mimar Sinan Fine Arts University, Turkey
**Karen Jacqmin-Adams** GoogleInc., USA
**H.V.Jagadish** University of Michigan, USA
**Vandana P. Janeja** University of Maryland, USA
**Christian S. Jensen** Aalborg University, Denmark
**Jinwei Jiang** Ford Motor Company, USA
**Zhe Jiang** University of Alabama, USA
**Guang Jin** University of Maine, USA
**Ari Jolma** Helsinki University of Technology, Finland
**Dmitri Kalashnikov** Purdue University, USA
**Panos Kalnis** National University of Singapore, Singapore
**Vana Kalogeraki** University of California at Riverside, USA
**Ibrahim Kamel** University of Sharjah, UAE
**Muzaffer Kanaan** Worcester Polytechnic Institute, USA
**James M. Kang** US Department of Defense, USA
**Murat Kantarcioglu** The University of Texas at Dallas, USA
**Sophia Karagiorgou** Institute for the Management of Information Systems, Greece
**Ismail Rakip Karas** Karabuk University, Turkey
**Hassan A. Karimi** University of Pittsburgh, USA
**Baris M. Kazar** Oracle, USA
**Carsten Keßler** City University of New York, USA
**Peter Keenan** University College Dublin, Ireland
**Daniel Keim** University of Konstanz, Germany
**Serkan Kemeç** Middle East Technical University, Turkey
**Eamonn Keogh** University of California at Riverside, USA
**Latifur Khan** The University of Texas at Dallas, USA
**Sangho Kim** ESRI, USA
**Mark Knapp** Meridian Imagery, USA
**Craig A. Knoblock** University of Southern California, USA
**Evan Kodra** Northeastern University, USA
**George Kollios** Boston University, Boston, USA
**Ravi Kothuri** Firsthelp Financial, USA
**Yufeng Kou** Virginia Tech, USA
**Haris N. Koutsopoulos** Northeastern University, USA
**Menno-Jan Kraak** International Institute for Geoinformation and Earth Observation, The Netherlands
**Hans-Peter Kriegel** Ludwig-Maximilians University Munich, Germany
**Bart Kuijpers** Hasselt University and Transnational University of Limburg, Belgium
**Lars Kulik** The University of Melbourne, Australia
**Devashish Kumar** Northeastern University, USA
**Manoj Kumar** Indian Institute of Technology Bombay, India
**Peter Kunath** Ludwig-Maximilians University Munich, Germany
**A. Kushki** University of Toronto, Canada
**Phaedon Kyriakidis** Cyprus University of Technology, Cyprus
**Dwight Lanier** Gainesville State College, USA
**Cédric Lapierre** University of Sherbrooke, Canada
**Suzie Larrivée** Laval University, Canada
**Patrick Laube** University of Melbourne, Australia
**Robert P. Laudati** GE Energy, USA
**Jason Laura** Arizona State University, USA
**Andrew B. Lawson** University of South Carolina, USA
**Iosif Lazaridis** University of California at Irvine, USA
**Sang-Il Lee** Seoul National University, South Korea
**James P. LeSage** Texas State University – San Marcos, USA
**Ned Levine** Ned Levine & Associates, USA
**Bryan Lewis** Virginia Tech, USA
**Feifei Li** University of Utah, USA
**Lixin Li** Georgia Southern University, USA
**Wenwen Li** George Mason University, USA
**Xiaolin Li** Nanjing University, China
**Xinrong Li** University of North Texas, USA
**Defu Lian** University of Electronic Science and Technology of China, China
**Thérèse Libourel** University of MontpellierII, France
**Hyeeun Lim** University of Minnesota, USA
**Steve Lime** Minnesota Department of Natural Resources, USA
**Dan Lin** National University of Singapore, Singapore
**Henry Lin** The Pennsylvania State University, USA
**Song Lin** University of California at Riverside, USA
**Cheng Liu** Oak Ridge National Laboratory, USA
**Henry X. Liu** University of Minnesota, USA
**Huan Liu** Arizona State University, USA
**Qi Liu** University of Science and Technology of China, China
**Siyuan Liu** The Pennsylvania State University, USA
**Yan Liu** University of Southern California, USA
**Cheng Long** The Hong Kong University of Science and Technology, China
**Chang-Tien Lu** Virginia Tech, USA
**Thomas Luhmann** Institute for Applied Photogrammetry and Geoinformatics, Germany
**Yan Luo** University of Illinois at Chicago, USA
**Markus Lupp** lat/lonGmbH, Germany
**William A. Mackaness** University of Edinburgh, UK
**David J. Maguire** ESRI, USA
**Julie Binder Maitra** Federal Geographic Data Committee, USA
**Rajarshi Majumder** The University of Burdwan, India
**Nikos Mamoulis** University of Hong Kong, Hong Kong, China
**Yannis Manolopoulos** Aristotle University, Greece
**Madhav V. Marathe** Virginia Tech, USA
**Keith Marsolo** The Ohio State University, USA
**Sergio Mascetti** University of Milan, Italy
**Rod McChesney** Google, USA

# Contributors (2/2)

**Chris McColl** Central Washington University, USA
**J. Chris McGlone** SAIC, USA
**Michael P. McGuire** Towson University, USA
**Sharad Mehrotra** University of California at Irvine, USA
**John J. Mewes** Meridian Environmental Technology, Inc., USA
**Christopher D. Michaelis** Idaho State University, USA
**Harvey J. Miller** University of Utah, USA
**Darka Mioc** Technical University of Denmark, Denmark
**André Miralles** Montpellier Cedex 5, France
**Gianluca Miscione** University College Dublin, Ireland
**Helena Mitasova** North Carolina State University, USA
**Mohamed F. Mokbel** University of Minnesota, USA
**George Moon** Map Info Corporation ,USA **Reinhard Moratz** University of Maine, USA
**David Moretz** University of Minnesota, USA
**Kara Morgan** Northeastern University, USA
**Catherine Moskos** Northeastern University, USA
**Kyriakos Mouratidis** Singapore Management University, Singapore
**Vincent Mousseau** University of Paris, France
**Sourav Mukherji** Indian Institute of Management Bangalore, India
**David J. Mulla** University of Minnesota, Minneapolis, USA
**Wayne Myers** The Pennsylvania State University, USA
**Shahed Najjar** Northeastern University, USA
**Daniel B. Neill** Carnegie Mellon University, USA
**Markus Neteler** The Trentino Cultural Institute, Italy
**Andreas Neumann** ETH Zurich, Switzerland
**Hoang Nguyen** Data61-CSIRO, Australia
**Silvia Nittel** University of Maine, USA
**Sarana Nutanong** City University of Hong Kong, China
**Atsuyuki Okabe** Aoyama Gakuin University, Japan University of Tokyo, Japan
**D. J. O'Neil** University of Minnesota, USA
**Beng Chin Ooi** National University of Singapore, Singapore
**Peter van Oosterom** Delft University of Technology, The Netherlands
**Yasin Ortakci** Karabuk University, Turkey
**Leon F. Osborne Jr.** The University of North Dakota, USA
**R. Kelley Pace** Louisiana State University, USA
**Kaveh Pahlavan** Worcester Polytechnic Institute, USA
**Bei (Penny) Pan** Microsoft Corp., USA
**Sudhanshu Panda**, Gainsville State College, USA
**Victor Pankratius** Massachusetts Institute of Technology, USA
**Dimitris Papadias** Hong Kong University of Science and Technology, China
**Christine Parent** University of Lausanne, Switzerland
**Srinivasan Parthasarathy** The Ohio State University, USA
**Ganapati P. Patil** The Pennsylvania State University, USA
**Roberto Patuelli** University of Bologna, Italy The Rimini Centre for Economic Analysis, Italy
**Neal Patwari** University of Utah, USA
**Alejandro Pauly** University of Florida, USA
**Edzer Pebesma** University of Münster, Germany
**George Percivall** Open Geospatial Consortium, USA
**Dieter Pfoser** RA Computer Technology Institute, Greece
**Shashi Phoha** The Pennsylvania State University, USA
**James B. Pick** University of Redlands, USA
**K. N. Plataniotis** University of Toronto, Canada
**Rachel Pottinger** University of British Columbia, Canada
**Sunil Prabhakar** Purdue University, USA
**Sushil K. Prasad** Georgia State University, USA
**Satish Puri** Georgia State University, USA
**Cheng-Zhi Qin** Chinese Academy of Sciences, China
**Qiang Qu** Chinese Academy of Sciences, China
**Aaron Racicot** Ecotrust, USA
**Alias Abdul Rahman** Universiti Teknologi Malaysia, Malaysia
**Naren Ramakrishnan** Virginia Tech, USA
**Robert Raskin** California Institute of Technology, USA
**Martin Raubal** University of California at Santa Barbara, USA
**Siva Ravada** Oracle, USA
**Chinya V. Ravishankar** University of California at Riverside, USA
**Farid Razzak** Rutgers University, USA
**Tumasch Reichenbacher** University of Zurich, Switzerland
**Matthias Renz**, Ludwig-Maximilians University Munich, Germany
**Peter Revesz** University of Nebraska-Lincoln, USA
**Sergio J. Rey** Arizona State University, USA
**Kai-Florian Richter** University of Zurich, Switzerland
**Bill Rideout** Massachusetts Institute of Technology, USA
**Carsten Rönsdorf** Ordnance Survey, UK
**Stéphane Roche** University of Laval, Canada
**Christine Rottenbacher** Institute of Geoinformation and Cartography, Austria
**Joyashree Roy** Jadavpur University, India
**AnneRuas** IGN-France, France
**Matthias Ruth** Northeastern University, USA
**Mokhtar Saada** University of Sherbrooke, Canada
**Marko Salmenkivi** University of Helsinki, Finland
**Simonas Šaltenis** Aalborg University, Denmark
**Ashok Samal** The University of Nebraska at Lincoln, USA
**Hanan Samet** University of Maryland, USA
**Jörg Sander** University of Alberta, Canada
**Mark Sanderson** University of Sheffield, UK
**Michael Sanderson** Laser-scan, Cambridge, UK
**Temuulen Tsagaan Sankey** Idaho State University, USA
**Raimundo F. Dos Santos Jr.** Virginia Polytechnic Institute and State University, USA
**L. Tiina Sarjakoski** Finnish Geodetic Institute, Finland
**Tapani Sarjakoski** Finnish Geodetic Institute, Finland
**Somwrita Sarkar** University of Sydney, Australia
**Daniel J. Sarlitto** Summit Point Management LLC, USA
**Peter Scheuermann** Northwestern University, USA
**Markus Schneider** University of Florida, USA
**Christopher J. Semerjian** Gainesville State College, USA
**Monika Sester** Leibniz University of Hannover, Germany
**Sharad Seth** The University of Nebraska at Lincoln, USA
**Lei Sha** MayoClinic, USA
**Cyrus Shahabi** University of Southern California, USA
**Hongrae Shapley** Google Inc., USA
**Rebecca Shapley** Google Inc., USA
**Mehdi Sharifzadeh** University of Southern California, USA
**Shashi Shekhar** University of Minnesota, USA
**Lei Shi** University of Maryland, USA
**Xuan Shi** University of Arkansas, USA
**Heechang Shin** Rutgers University, USA
**Eric Shook** University of Minnesota, USA
**Abhinaya Sinha** University of Minnesota, USA
**Spiros Skiadopoulos** University of Peloponnese, Greece
**Leen-Kiat Soh** The University of Nebraska at Lincoln, USA
**Amir Soheili** ESRI, USA
**Stefano Spaccapietra** Swiss Federal Institute of Technology, Switzerland
**Laurynas Speicˇys** Aalborg University, Denmark
**Marci Sperber** University of Minnesota, USA
**Panu Srestasathiern** Geoinformatics and Space Technology Development Agency, Thailand
**Sumeeta Srinivasan** Tufts University, USA
**John G. Stell** University of Leeds, UK
**Christian Strobl** German Remote Sensing Data Center (DFD), German Aerospace Center (DLR), Germany
**Erik Stubkjær** Aalborg University, Denmark
**Ganesh Subbiah** The University of Texas at Dallas, USA
**Yue Sun** Nanjing University, China
**Tim Sutton** Reference Center on Environmental Information, Brazil
**Egemen Tanin** University of Melbourne, Australia
**Yufei Tao** Chinese University of Hong Kong, China
**Christos D. Tarantilis** Athens University of Economics & Business, Greece
**Benjamin M. Taylor** Lancaster University, UK
**Sabine Timpf** University of Würzburg, Germany
**Goce Trajcevski** Northwestern University, USA
**Allison Traylor** Northeastern University, USA
**Thomas Triplet** Computer Research Institute of Montreal, Canada
**Austin Troy** University of Vermont, USA
**Nectaria Tryfona** Talent Information Systems SA, Greece
**Vassilis J. Tsotras** University of California at Riverside, USA
**Mark Tuttle** Oak Ridge National Laboratory, USA
**Michael Twa** The Ohio State University, USA
**Leong Hou U** University of Macau, China
**Uznir Ujang** Universiti Teknologi Malaysia, Malaysia
**Ranga Raju Vatsavai** North Carolina State Univeristy, USA
**A. N. Venetsanopoulos** University of Toronto, Canada
**Parvatham Venkatachalam** Indian Institute of Technology Bombay, India
**Juha Vierinen** Massachusetts Institute of Technology, USA
**Baxter E. Vieux** University of Oklahoma, USA
**Michail Vlachos** IBM T.J. Watson Research Center, USA
**Agnès Voisard** Fraunhofer ISST and FU Berlin, Germany
**George Vosselman** International Institute for Geo-Information Science and Earth Observation, The Netherlands
**Lance A. Waller** Emory University, USA
**Cheng-Hua Wang** Oracle, USA
**Fusheng Wang** Stony Brook University, USA
**Shuhui Wang** Chinese Academy of Sciences, China
**X. Sean Wang** University of Vermont, USA
**Yaxing Wei** George Mason University, USA
**Robert Weibel** University of Zurich, Switzerland
**Zhen Wen** IBM, T.J. Watson Research Center, USA
**Christopher K. Wikle** University of Missouri-Columbia, USA
**Rhett Wilfahrt** University of Minnesota, USA
**Ronald E. Wilson** National Institute of Justice, USA
**Devon Wolfe** Map Info Canada, Canada
**Ouri Wolfson** The University of Illinois at Chicago, USA
**Thomas Wolle** Sydney, Australia
**Brian Wolshon** Louisiana State University, USA
**Raymond Chi-Wing Wong** The Hong Kong University of Science and Technology, China
**Jordan Wood** University of Minnesota, USA
**Peter Woodsford** Laser-scan, UK
**Jiang Wu** Nanjing University, China
**Shasha Wu** Spring Arbor University, USA
**Huy Van Pham** University of Southern California, USA
**Nico Van de Weghe** Ghent University, Ghent, Belgium
**Yuni Xia** Purdue University, USA
**Keli Xiao** Stony Brook University, USA
**NectariaTryfona** Talent Information Systems SA, Greece
**Vassilis J. Tsotras** University of California at Riverside, USA
**Mark Tuttle** Oak Ridge National Laboratory, USA
**Michael Twa** The Ohio State University, USA
**Leong Hou U** University of Macau, China
**Uznir Ujang** Universiti Teknologi Malaysia, Malaysia
**Ranga Raju Vatsavai** North Carolina State Univeristy, USA
**A. N. Venetsanopoulos** University of Toronto, Canada
**Parvatham Venkatachalam** Indian Institute of Technology Bombay, India
**Juha Vierinen** Massachusetts Institute of Technology, USA
**Baxter E. Vieux** University of Oklahoma, USA
**Michail Vlachos** IBM T.J. Watson Research Center, USA
**Agnès Voisard** Fraunhofer ISST and FU Berlin, Germany
**George Vosselman** International Institute for Geo-Information Science and Earth Observation, The Netherlands
**Lance A. Waller** Emory University, USA
**Cheng-Hua Wang** Oracle, USA
**Fusheng Wang** Stony Brook University, USA
**Shuhui Wang** Chinese Academy of Sciences, China
**X. Sean Wang** University of Vermont, USA
**Yaxing Wei** George Mason University, USA
**Robert Weibel** University of Zurich, Switzerland
**Zhen Wen** IBM, T.J. Watson Research Center, USA
**Christopher K. Wikle** University of Missouri-Columbia, USA
**Rhett Wilfahrt** University of Minnesota, USA
**Ronald E. Wilson** National Institute of Justice, USA
**Devon Wolfe** Map Info Canada, Canada
**Ouri Wolfson** The University of Illinois at Chicago, USA
**Thomas Wolle** Sydney, Australia
**Brian Wolshon** Louisiana State University, USA
**Raymond Chi-Wing Wong** The Hong Kong University of Science and Technology, China
**Jordan Wood** University of Minnesota, USA
**Peter Woodsford** Laser-scan, UK
**Jiang Wu** Nanjing University, China
**Shasha Wu** Spring Arbor University, USA
**Huy Van Pham** University of Southern California, USA
**Nico Van de Weghe** Ghent University, Ghent, Belgium
**Yuni Xia** Purdue University, USA
**Keli Xiao** Stony Brook University, USA
**Xiaokui Xiao** Nanyang Technological University, Singapore
**Qingyun Xie** Oracle, USA
**Xiaopeng Xiong** Purdue University, USA
**Jingyuan Yang** Rutgers University, USA
**Chaowei (Phil) Yang** George Mason University, USA
**Hui Yang** San Francisco State University, USA
**Jue Yang** University of North Texas, USA
**Phil Yang** George Mason University, USA
**Wenli Yang** George Mason University, USA
**Man Lung Yiu** Aalborg University, Denmark
**Moustafa Youssef** Alexandria University, Egypt
**Rose Yu** University of Southern California, USA
**May Yuan** University of Oklahoma, USA
**Nicholas Jing Yuan** University of Electronic Science and Technology of China, China Microsoft Research, China
**Rajan Zambre** Erallo Technologies Inc. USA
**Ilya Zaslavsky** University of California at San Diego, USA
**Demetrios Zeinalipour-Yazt** Open University of Cyprus, Cyprus
**Donghui Zhang** Northeastern University, USA
**Jia-Dong Zhang** City University of Hong Kong, China
**Li Zhang** Stony Brook University, USA
**Liqin Zhang** University of North Texas, USA
**Pusheng Zhang** Microsoft Corporation, USA
**Rui Zhang** The University of Melbourne, Australia
**Peisheng Zhao** George Mason University, USA
**Yu Zheng** Microsoft Research, China
**Bin Zhou** George Mason University, USA
**Naijun Zhou** The University of Maryland at College Park, USA
**Xiaobo Zhou** The Pennsylvania State University, USA
**Xun Zhou** University of Iowa, USA
**Haijun Zhu** George Mason University, USA
**Esteban Zimányi** Free University of Brussels, Belgium
**Sisi Zlatanova** Delft University of Technology, The Netherlands
**Matthew Zook** University of Kentucky, USA