Contents

1   Brief Biography

Shashi Shekhar is a leading scholar of spatial computing and Geographic Information Systems (GIS). Contributions include scalable algorithms for eco-routing, evacuation route planning and spatial pattern (e.g., colocation) mining, along with an Encyclopedia of GIS, a Spatial Databases textbook, and a spatial computing book for professionals. Shashi is a McKnight Distinguished University Professor, a Distinguished University Teaching Professor, and an ADC Chair at the University of Minnesota. He is serving as the Director of a National AI Research Institute, namely, AI-CLIMATE, an Associate Director of his college's Data Science Initiative, a co-chair of the Computing Research Association (CRA) workgroup on socially responsible computing, a co-Editor-in-Chief of the Geo-Informatica journal (Springer), and a general co-chair of the SIAM International Conference on Data Mining (2024). Earlier, he presented at a Congressional reception (2015), co-chaired CRA Snowbird conference (2022), and served as the President of the University Consortium for GIS (UCGIS). He also served as a member of many National Academies' committees and the CRA board. Recognitions include IEEE-CS Technical Achievement Award, UCGIS Education Award, IEEE Fellow and AAAS Fellow.

In early 1990s, Shashi's research developed core technologies behind in-vehicle navigation devices as well as web-based routing services, which revolutionized outdoor navigation in urban environment in the last decade. His recent research results played a critical role in evacuation route planning for homeland security and received multiple recognitions including the CTS Partnership Award for significant impact on transportation. He pioneered the research area of spatial data mining via pattern families (e.g., colocation, mixed-drove co-occurrence, cascade, statistically significant linear hotspots), keynote speeches, survey papers and workshop organization.

Shashi received a Ph.D. degree in Computer Science from the University of California (Berkeley, CA) and an undergraduate degree from the I.I.T. Kanpur (India). More details are provided in the following pages of this c.v.

2 BASIC INFORMATION

CONTACT INFORMATION

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RESEARCH INTERESTS

Spatial data science, spatial computing, geographic information science, spatial data mining, spatial databases.

EDUCATION

- 1989 , Ph.D., Computer Science, University of California, Berkeley. (Thesis: Cooperating Expert Systems.)

- 1989 , M.S., Business Administration, University of California, Berkeley. (Thesis: A Stochastic Learning Algorithm for Neural Networks.)

- 1987 , M.S., Computer Science, University of California, Berkeley. (Thesis: Intelli-Genesis: Software Engineering Environment for AI Programs)

- 1985 , B.S., Computer Science, Indian Inst. of Tech. (IIT), Kanpur (India). (Thesis: Implementation of a Programming Environment for 'C'.)

APPOINTMENTS

- 2022 – present, Associate Director, Data Science Initiative, College of Science and Engineering, University of Minnesota, Minneapolis, Minnesota.

- 2022 – present, ADC/DSI Chair, College of Science and Engineering, University of Minnesota, Minneapolis, Minnesota.

- 2015 – present, Distinguished University Teaching Professor, University of Minnesota, Minneapolis, Minnesota.

- 2005 – present, McKnight Distinguished University Professor, University of Minnesota, Minneapolis, Minnesota.

- 2005 – 07, Director, Army High Performance Computing Research Center, University of Minnesota, Minneapolis, Minnesota.

- 2001– present, Professor, University of Minnesota, Minneapolis, Minnesota.

- 1995– 01, Associate Professor, University of Minnesota, Minneapolis, Minnesota.

- 1989–95 , Assistant Professor, University of Minnesota, Minneapolis, Minnesota.

- 1985–99 , Research Asst. / Post graduate researcher, University of California, Berkeley, California. Worked on cooperating expert systems, reasoning under uncertainty, and neural networks.

- 1985 (summer) , Instructor, Regional Institute of Technology, Jamshedpur, India. Developed courses on programming paradigms.

- 1984 (summer) , Software Engineer, Taj Services Ltd., New Delhi, India. Designed and implemented a Report Generator Package for a Hotel Management System.

PROFESSIONAL MEMBERSHIPS

- IEEE Computer Society (Fellow)
- American Association for Advancement of Science (Fellow)
- Association for Computing Machinery
- University Consortium on Geographic Information Systems (Delegate).

2.1 Awards and Honors

2.1.1 Awards

- 2022: ADC/DSI Chair, College of Science and Engineering with initial term of 3 years from September 1, 2022 through August 31, 2025.

- 2021: Robert C. Johns Research Partnership Award, Center for Transportation Studies (CTS), University of Minnesota, for the project titled "Cloud connected delivery vehicles: boosting fuel economy using physics-aware spatiotemporal data analytics and real-time powertrain control" led by Prof. W. Northrop. Every year, CTS bestows the Robert C. Johns Research Partnership Award to a team of individuals who have collaboratively drawn on their diverse expertise to achieve significant impacts on transportation.

- 2020: Best paper award, ACM SIGKDD International Workshop on Deep Learning for Spatiotemporal Data, Applications, and Sytems (DeepSpatial).

- 2019: Best paper award, International Symposium on Spatial and Spatio-Temporal Databases.

- 2019: Best paper award, Challenges and Vision Paper Track, ACM SIGSPATIAL International Conference on Advances in GIS.

- 2015: UCGIS Education Award for outstanding educational contributions such as a popular textbook, a massive open online course, advising 75 graduate students and co-developing a degree program, University Consortium on Geographic Information Science, May 2015. Each year, this national award is presented to one educator (out of thousands) in the interdisciplinary field of Geographic Information Science. More details are at ucgis.org/ucgisawards/shashishekhar web-site.

- 2015: Post-baccalaureate, Graduate and Professional Teaching Award, University of Minnesota. Each year, the University selects about half a dozen (out of over 3,000) faculty members for this award to recognize excellence in instruction; involvement in students' research, scholarship, and professional development; development of instructional programs; and advising and mentoring of students. They receive a $15,000 one-time grant and are named to the University's Academy of Distinguished Teachers, which serves the University through various activities that aim to improve teaching and learning. The title "Distinguished University Teaching Professor" is conferred upon recipients. More details are at www.scholarswalk.umn.edu/awards/aoce/pdf/2015/DTA_Shashi_Shekhar.pdf web-site.

- 2015: Best paper award, International Symposium on Spatial and Spatio-Temporal Databases, 2015.

- 2nd Best paper award, Challenges and Vision Paper Track, ACM SIGSPATIAL International Conference on Advances in GIS, 2015.

- 2013: Best paper award, 2nd ACM SIGSPATIAL International Workshop on Analytics for Big Geospatial Data (BigSpatial-2013), Nov 5, 2013, Orlando, Florida, USA.

- 2011: Resident Fellow, Institute on Environment, University of Minnesota (2011). The resident fellows program provides support for creative faculty members from a range of backgrounds who wish to work together across disciplines on innovative solutions to environmental problems.

- 2008: Fellow, American Association for Advancement of Science (2008 onwards). A Fellow is defined as "a Member whose efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." Examples of areas in which nominees may have made significant contributions are research; teaching; technology; services to professional societies; administration in academy, industry, and government; and communicating and interpreting science to the public. Fellows are elected annually by the AAAS Council.

- 2006: Technical Achievement Award, Institution of Electrical and Electronics Engineers (Computer Society), 2006. It recognizes outstanding and innovative contributions to the fields of computer and information science and engineering or computer technology, usually within the past ten, and not more than fifteen years.
- 2005: McKnight Distinguished University Professorship, University of Minnesota, 2005 onwards. It honors and rewards highest-achieving faculty, whose work has brought great renown and prestige to the University of Minnesota. Selectivity is less than one sixth of one percent.
- 2003: Fellow, Institution of Electrical and Electronics Engineers (Computer Society), 2003 onwards. the IEEE Grade of Fellow is conferred by the Board of Directors upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. The total number selected in any one year does not exceed one-tenth percent of the total voting Institute membership.
- Fellow, Minnesota Supercomputing Institute, University of Minnesota, 2005 onwards.
- The Center for Transportation Studies (CTS) **2006 Research Partnership Award**, which recognizes research projects within the CTS program that have **resulted in significant impacts on transportation**, and rewards teams of individuals who have drawn on the strengths of their diverse partnerships to achieve those results.
- Designated as CTS Scholar, Center for Transportation Studies, University of Minnesota, 1999 onwards.
- Best paper award, ACM SIGKDD Workshop on Sensor Data Mining, 2007.
- One of 4 best papers, CoMoGIS 2006 - 3rd International Workshop on Conceptual Modeling for Geographic Information Systems.
- One of 4 best papers, IEEE Workshop on Spatial and Spatio-temporal Data Mining, 2006.
- One of 4 best papers, ACM Conference on Geographic Info. Systems, 2003.
- One of 4 best papers, ACM Conference on Geographic Info. Systems, 1998.
- One of the 4 best papers, Symposium on Spatial Databases, 1997.
- Bush Foundation Fellowship, Sabbatical Supplement Program Award, 1997-98.
- Excellence in Teaching Award, Bush Foundation 1992 - 93.
- Best paper award, Indian Computing Congress, 1991.
- Certificate of Appreciation, IEEE Computer Society, 1991.
- Pass with distinction, Qualifying Exam., (thesis proposal defense), 1988, U. C. Berkeley.
- Eugene C. and Mona Fay Gee Fellowship 1987, U. C. Berkeley.
- Best Graduating Student (among 250 students), B. Tech. Computer Sc., 1985, I. I. T., Kanpur, India.
- All India Rank *2* among 100,000 students, Joint Entrance Exam. 1981 for all Indian Institute of Technology, India.
- National Talent Search Scholarship, 1979 to 1985 from the Government of India.
- Silver medal for *2nd* rank in a merit list of 300,000 students, Bihar State Secondary School Examination 1979. Also awarded four gold medals for winning the competitions for debate, general knowledge, personality, and mental ability.

2.1.2   Honors

- Invited presentation, Minnesota House of Representatives, Transportation Policy and Finance Committee hearing on post-pandemic future of transportation, January 2023.
- Scientific American (March 2020) opinion piece titled "As COVID-19 Accelerates, Governments Must Harness Mobile Data to Stop Spread, Scientific American".
- Invited Perspective Article, Communications of the ACM (August 2020), which reaches 100,000+ members of the ACM.
- Certificate for outstanding teaching and dedication to helping students learn, Center for Educational Innovation, University of Minnesota, Fall 2020.

- Certificate for outstanding teaching and dedication to helping students learn, Center for Educational Innovation, University of Minnesota, Fall 2019.

- Cover article (and accompanying short video) for the Communications of the ACM (January 2016), which reaches 100,000+ members of the ACM.

- Springer, one of the largest publishers of scientific journals, selected our paper titled "From GPS and virtual globes to spatial computing 2020 " (downloaded 1900 times) among the "ground breaking articles that have the potential to **change the world**" [1] from among the articles published in 100 journals in 2015 across Earth and Environmental Sciences; Life Sciences and Biomedicine; Medicine and Public Health; Social Sciences, Psychology, Education, Philosophy; Chemistry, Physics, Astronomy, Engineering and Materials; and Business & Economics, Statistics, Mathematics, Computer Sciences.

- Opinions, interviews and quotation reported in major media including Scientific American (2020), ZD-Net/CBS Interactive (2020), Bloomberg CityLab (2021), Star Tribune (2020), Pioneer Press (2020), Business North (2020), Winona Post (2020), British media (The Sun (2018), Daily Star (2018), Daily Mail (2018), Mirror (2018)), Communications of the ACM website (September 2020), Communications of the ACM website (January 2016), NSF Science360.gov (2011), ReadWriteWeb (2011), sciencenewsdaily (2011), sciencedaily.com (2011), scienceblog.com (2011), psychcentral.com (2011), gisandscience.com (2011), newwebmag.com (2011), machineslikeus.com (2011), milkeg.typepad.com (2011), gratis-jobs.blogspot.com (2011), etc. One of these articles generated 600+ facebook posts and 250+ tweets.

    It was also discussed in University of Minnesota news wire (2011), Minnesota Daily (2019, 2010, 2011), University of Minnesota Alumni magazine and website (2007), University of Minnesota bi-annual Research Magazine (2007) from the Office of Vice-President of Research.

    It was covered by FoxTV (2006), the Star Tribune (2006, 1999), the Pioneer Press (2006, 1996) and on public radio (1992). These were also highlighted by the Office of Vice President of Research (2006), University of Minnesota Foundation (2007), Office of Vice President of Public Engagement (2006), and Center of Transportation Studies (2005) within the University of Minnesota.

- President, University Consortium for Geographic Information Science (UCGIS), 2017-2018. The UCGIS is a non-profit organization that creates and supports communities of practice for GIScience research, education, and policy endeavors in higher education and with allied institutions. It is the professional hub for the academic GIS community in the United States, with partnerships extending this capacity abroad. Its mission is to Advance research in the field of Geographic Information Science; Expand and strengthen Geographic Information Science education; Advocate policies for the promotion of the ethical use of and access to geographic information and technologies; and, Build scholarly communities and networks to foster multi-disciplinary GIS research and education

- Member, Board of Director, NSF Midwest Big Data Hub (MBDH), 2017-present. Led a MBDH community whitepaper (May-Nov., 2017)on Agriculture and Big Data to shape forthcoming federal research initiatives on Food and Agriculture Cyberinformatics and Tools from the National Institute for Food and Agriculture.

- Member, Board of Director, Computing Research Association (2016-2019, 2019-2022). The CRA Board of Directors is a distinguished group of leaders in computing research from academia and industry. CRA board members address major issues affecting the computing research community and shape the community's responses and actions. The Board provides the membership for standing committees, such as the Government Affairs, Snowbird Conference, Taulbee Survey, CRA-W, Education, Computing Community Consortium committees. CRA's membership includes more than 200 North American organizations active in computing research: academic departments of computer science and computer engineering, laboratories and centers (industry, government, and academia), and affiliated professional societies (AAAI, ACM, CACS/AIC, IEEE Computer Society, SIAM, USENIX). CRA's mission is to enhance innovation by joining with industry, government and academia to strengthen

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[1] "Change the World, One Article at a Time," Springer, 2016, https://www.springer.com/gp/marketing/change-the-world

research and advanced education in computing. CRA executes this mission by leading the computing research community, informing policymakers and the public, and facilitating the development of strong, diverse talent in the field.

- Member, National Academy of Science - National Research Council (NAS/NRC) - Mapping Sciences - Committee on *Models of the World for USDOD-NGA* 2015-16.

- Chair, Board of Director, SSTD Endowment (2016-2019). The primary purpose of the SSTD Endowment is to oversee the series of conferences termed International Symposium on Spatial and Temporal Databases. The Endowment aims to maintain the conference series as the premier specialized outlet for research contributions in the area of database management for spatial and temporal databases. The SSTD Endowment also aims to promote and coordinate scholarly activities in general within this area.

- Member, Computing Community Consortium (CCC) Council (2012-2015). The CCC is an organization whose goal is to catalyze and empower the U.S. computing research community to pursue audacious, high-impact research. The CCC is governed by an 18-member Council on 3-year staggered terms, representing the diverse nature of the computing research field.

- Member, National Academy of Science - National Research Council (NAS/NRC) - Computer Science and Telecommunications Board - Committee on *Geotargeted Disaster Alerts and Warnings* 2012-13.

- Selected to participate in, Leadership in Science Policy Institute, Computing Community Consortium, November 7th, 2011.

- Member, National Academy of Science - National Research Council (NAS/NRC) Committee on *Future Workforce for Geospatial Intelligence* 2011-12.

- Key difference-maker in Geographic Information Science and systems (2010): Biography highlighted in the most popular GIS textbook, namely, *Geographic Information Systems and Science, Wiley, 2009, isbn 978-0-470-72144-3*. It recognizes committed motivated individuals, whose contributions have made a difference to GIS. This textbook reaches hundreds of thousands of GIS academics, students and professionals around the world. It is co-authored by a member of the National Academy of Science.

- Member, Advisory Board,, Integrated Media System Center (IMSC), University of Southern California, Los Angeles, CA, 2011-onwards.

- Member, Review and Advisory Committee, Strategic Research Cluster in Advanced Geotechnologies, Science Foundation Ireland (ICT Division), Dublin, Ireland, 2010.

- Member, Dean's ad-hoc Committee, Division of Engineering and Applied Sciences, Harvard University, January, 2007.

- Member, DARPA IXO Panel on "Model the Planet" for the very large spatial database program, 2006.

- Selected to present at Congressional breakfast program on GIS and homeland security, University Consortium on GIS, 2/2004.

- Member, Mapping Science Committee, National Research Council of national academies, 2003-2009.

- Member, National Research Council (national academies) Committee to review basic and applied research at the National Geo-spatial Intelligence Agency, 2004-2005.

- Member, Committee to Review Geospatial Research Program of the Army Corps of Engineers, 2010.

- Member, Rand Committee to review Geo-knowledgebase prototype (GKB-p) project at the National Geo-spatial Intelligence Agency, July 2005.

- Board of Directors, University Consortium on GIS, 2003-4.

- Member, Review and Advisory Committee, Strategic Research Cluster in Advanced Geo-technologies, Science Foundation Ireland (ICT Division), Dublin, Ireland, 2007.

- Member, Review and Advisory Committee, GEOIDE: A national research network of excellence on Geomatics, Canada, 2004.

- Member, FY 2008 Director's R&D Fund Review Committee, Laboratory Directed Research and Development (LDRD), Ultrascale Computing Initiative Oak Ridge National Laboratory, U.S. Department of Energy, 2007.

- Member, Review Committee, Pennsylvania Department of Health Final Performance Review, Oak Ridge Associated Universities (ORAU), 2008.
- Member, Review Committee, Florida Centers of Excellence proposals, Oak Ridge Associated Universities (ORAU), 2008.
- Member, Advisory Board, NSF IGERT in Sensor Science, Engineering and Informatics, University of Maine, 2008-2011.
- Member, Advisory Board, NSF IGERT in Geographic Information Science, SUNY Buffalo, 2004-2010.
- Member, Review Board, NSF EPSCoR Center in Geographic Information Science, U. Maine, 2003.
- Selected as a *site visitor* to review NSF research infra-structure grant proposals, May 1999 along with invitations to multiple panels at NSF and NASA.
- Selected as a delegate to represent the University of Minnesota in the University Consortium on GIS, 1999-2000.
- Selected as the Computer Science representative in the national Curriculum Committee of University Consortium on GIS, 1998-99.
- Selected as United Nations international advisor for UNDP projects 1997-98.
- Invited Expert, CalTrans/NCGIA Conference on Navigable Databases, 1996.

2.2 List of Invited Presentations

- Keynote Speaker, Conference on Evaluating the Science of Geospatial AI, Harvards Center for Geographic Analysis and Harvard Data Science Initiative, May 16th-17th, 2024.

- Keynote Speaker, 22nd IEEE International Conference on Pervasive Computing and Communications (IEEE PerCom 2024) March 12th-14th, 2024.

- Keynote Speaker, GIS Student Organization Annual Career Fair, University of Minnesota February 8th, 2024.

- Invited Speaker, Science, Environmental and Tech Policy Seminar, Humphrey School of Public Policy, University of Minnesota January 29th, 2024.

- Panel Speaker, Panel on Ag, Digital ag and Health, Summit on Ai Leadership, October 26th, 2023.

- Plenary Speaker, Chesapeake Global Collaboratory Summit University of Maryland Center for Environmental Science (UMCES), Baltimore (MD), September 29th, 2023.

- Invited Presentation, AI Institute Hill Day, U.S. Senate Office Building, Washington D.C., September 19th, 2023.

- Invited Presentation, National Science Foundation (NSF) Showcase : AI Institutes, National Science Foundation, Washington D.C., September 18th, 2023.

- Invited Presentation, Panel on Spatial Computing Visions and Applications, 18th International Symposium on Spatial and Temporal Databases, Calgary, Canada, August 22nd-24th, 2023.

- Invited Presentation, NSF (National Science Foundation)-TIH (Technology Innovation Hub) PI meeting/workshop, Baltimore (MD), May 22nd-23rd, 2023.

- Invited Presentation, National AI Institute for Climate-Land Interactions, Mitigation, Adaptation, Tradeoffs and Economy (AI-CLIMATE), Cornell Institute for Digital Agriculture, Cornell University, May 8th, 2023.

- Participant, Conversation on Future of Transportation, Minnesota Senate and House Transportation Committees and the House Sustainable Infrastructure Policy Committee, February 3rd, 2023.

- Keynote, Geospatial Data Analysis Workshop, Departmentof Mathematics and Statistics, IIT Tirupati, India, December 12th-14th, 2022.

- Invited Talk, Workshop on Spatiotemporal Computing Roadmap, National Science Foundation (NSF) IUCRC Spatiotemporal Innovation Center, Seattle, WA, USA, Aug. 18-29, 2022.

- Invited Talk, International Online Workshop on GeoSpatial Data Science and GeoAI, Navavishkar I-Hub Foundation (Technology Innovation Hub), IIT Tirupati, India, June 27th-28th, 2022.

- Invited Talk, Data Mining and Knowledge Discovery - virtual expert round table, IEEE International Conference on Data Engineering, May 10th, 2022.

- Invited Talk, Future Leaders Summit, Michigan Institute for Data Science, University of Michigan, April 6th-7th, 2022.

- Inaugural Talk, speaker series on Computing, Data and Beyond-Impact on Our World, Research Computing Center, University of Chicago, Feb. 21st, 2022.

- Invited Speaker, Opening Deliberations of the Minnesota House of Representatives Transportation Finance and Policy Committee for the 2021-2022 Minnesota biennial legislative session, January 14th, 2022.

- Invited Talk, Workshop on Managing Disaster Risk: A Way to Sustainability, Center for International Migration and Development, Nepal German Academic Association - Programme Migration and Dispora (PMD) Activities, Nov. 21st, 2021.

- Invited Talk, Workshop 23: Spatial and Spatial-Temporal informatics: Methods, Tools and Emerging Opportunities for Translational Bioinformatics, American Medical Informatics Association (AMIA) Annual Symposium, San Diego, October 30th - November 3rd, 2021.

- Keynote, 2nd ACM SIGKDD Workshop on Deep Learning for Spatiotemporal Data, Applications, and Systems (DeepSpatial), Singapore, August 15, 2021.

- Invited Talk, Workshop on Applications of Artificial Intelligence on Geospatial Data, Faculty Development Programme, Maulana Abul Kalam Azad University of Technology (West Bengal, India), and All India Council for Technical Education (AICTE) Training and Learning Academy, 26th-30th July 2021.

- Keynote, 33rd Intl. Conf. on Scientific and Statistical Database Management (SSDBM-2021) Tampa, FL, USA, July 6th-7th, 2022.

- Invited Talk, Two-Day Workshop on Data Science and Curation: Spatial Data Science, IEEE Geosciences and Remote Sensing Society (Banglore Chapter) and Indian Statistical Institute (Banglore Center) - Technology Innovation Hub, India, June 24, 2021.

- Invited Panel Presentation, Panel on Scalable Geospatial Processing Architectures, USDOE ORNL International Workshop on The Trillion Pixel Challenge, April 21-22, 2021.

- Invited Panel Presentation, AI for Good Symposium, International Telecommunication Union (ITU) and World Geospatial Council, April 13th, 2021.

- Invited Panel Presentation, Panel on New generation GIS, American Associon of Geographers (AAG) Annual Meeting, April 9th, 2021.

- Invited Presentation, Future of transportation in a post-pandemic world, Transportation Finance and Policy Committee, Minnesota House of Representatives, Jan. 14th, 2021.

- Invited Panel Presentation, What is special about GeoAI?, Panel on Community Voices, GEO.AI - Redefining Geospatial Conference, World Geospatial Council, Dec. 7th-9th, 2020.

- Invited Presentation, Understanding Mobility Impacts of COVID-19 Policy Interventions with Spatial Big Data, Annual Minnesota Transportation Conference, Nov. 5th, 2020.

- Invited Panel Presentation, Panel on The future of AI for Spatiotemporal Data Science, ACM SIGKDD International Workshop on Deep Learning for Spatiotemporal Data, Applications, and Sytems (DeepSpatial 2020), August 24th, 2020.

- Invited Presentation, Spatial Big Data Analysis to Understand COVID-19 Effects on MN, Forum: Impacts of the COVID-19 Pandemic on Minnesota's Traffic and Transit Networks Center for Transportation Studies, University of Minnesota, June 23rd 2020.

- Invited Presentation, US Department of Agriculture National Workshop on Machine learning and Data Fusion for Aerial Imagery Interpretation of Land Use Change, Chicago, IL, June 10-11, 2020.

- **Keynote**, From GPS, Google Maps and Uber to Spatial Computing, 7th International Conference on Big Data Analytics (BDA2019), December 17 - 20, 2019, Ahmedabad, India.

- Invited Talk, Call to include Spatial Perspective in Data Science Curriculum and Degrees, Symposium on Setting the Spatial Data Science Agenda, December 911, 2019, U. C. Santa Barabara, CA.

- **Keynote**, Spatial Computing Education: A Perspective, 1st ACM SIGSPATIAL International Workshop on Geo-computational Thinking in Education (GeoEd 2019) November 5th, 2019, Chicago, Illinois, USA

- Invited Talk, Spatial Data Science Challenges and Oppotunities in Transportation, NSF Workshop on Road Infrastructure Reimagined: Intelligent Infrastructure for Road Transportation, Alexandria, VA, October 3-4, 2019.

- **Keynote**, Transforming Smart Cities with Spatial Computing, Workshop on New mobility and cities: Exploring a research network of urban sustainability observatories via data-enabled university-community partnerships, Ohio State University, Columbus, Ohio, USA July 15-17, 2019.

- Invited Panel Presentation, Transforming Smart Cities with Spatial Computing, Research Forum of the Infrastructure Resilience Division (IRD), Americal Society of Civil Engineers (ASCE), May 9th-10th, 2019.

- **Plenary**, Transforming Assessment of Near-Peer Response with Spatial Data Science, Air Force Workshop on Predictive Analytics for Integrated Assessment of Peer Response, Wright Brothers Institute, Dayton, OH, March 20th-22nd, 2019.

- Invited Speaker, Spatial Data Mining, Quantitative methods for population health (VMED 5442), (Host: Prof. Kim VanderWaal) Animal Sciences Veterinary Medicine building, University of Minnesota, Feb. 4th, 2019.

- Keynote, Spatial data mining and Transportation, All Council Meeting to explore data science initiatives in transportation, Center for Transportation Studies, University of Minnesota, Feb. 20th, 2019.

- Invited Speaker, Transforming Agriculture with Intelligent Infrastructure, Applied Plant Sciences Graduate Program Seminar (Host: Prof. Eric Watkins), University of Minnesota, Feb. 4th, 2019.

- **Keynote**, Transforming Smart Cities with Spatial Computing, AI in Transportation Workshop, Ministry of Transportation and Communication and Qatar Computing Research Institute, Doha, Qatar, Nov. 22nd, 2018.

- From GPS, Google Maps & Uber to Spatial Computing, Qatar Computing Research Institute, Doha, Qatar, Nov. 19th, 2018.

- **Keynote**, Transforming Smart Cities with Spatial Computing, 7th ACM SIGSPATIAL International Workshop on analytics for Big Geospatial Data (BigSpatial 2018), ACM SIGSPATIAL, Seattle, WA, Nov. 6th, 2018.

- **Keynote**, Call for Action to Include Spatial Perspectives in Data Science, Workshop on Data Science Innovation with NSF Big Data Hub, Microsoft Research, Redmond, WA, Oct. 29th-30th, 2018.

- **Keynote**, 11th Workshop on Next Generation GIS, NSF Spatiotemporal Innovation Center, Harvard University, Cambridge, MA, Oct. 11th, 2018.

- **Keynote**, 2018 NSF Smart and Connected Communities (S&CC) Aspiring PI Workshop, National Science Foundation, Kansas City, MO, USA, Sept. 17, 2018.

- **Keynote**, Transforming Smart Cities with Spatial Computing, IEEE International Smart Cities Conference, Kansas City, MO, Sept. 16th-19th, 2018.

- Panelist, Panel on Data Science, P.I. meeting for INFEWS (Interactions of Food Systems with Energy and Water Systems Program), National Science Foundation, Alexandria, VA, May 4th, 2018.

- Panelist, Panel on Crowdsourcing, Geocomputation, and Spatiotemporal Analysis, International Workshop on Illuminating Space and Time in Data Science, Harvard University, Cambridge, MA, April 26th-27th, 2018.

- Invited Speaker, Spatial Data Mining, Quantitative Epidemiology seminar series (Host: Prof. Kim VanderWaal), Haecker Hall, University of Minnesota, April 7th, 2018.

- Panel Speaker, Transforming Agriculture with Intelligent Infrastructure, Annual Meeting of the American Association for Advancement of Science, Austin, TX, February, 2018.

- Panel Speaker, Water Resources Assembly and Research Symposium, Water Resources Center, College of Food, Agriculture and Nutrition, University of Minnesota, January 19th, 2018.

- Keynote, Spatial Computing, International Land Use Symposium 2017: Spatial data modelling and visualisation to enlighten sustainable policy making, Leibniz Institute of Ecological Urban and Regional Development, Dresden, Germany, Nov. 1st, 2017.

- Panel Speaker, 10th ACM SIGSPATIAL Workshop on Computational Transportation Science (IWCTS 2017), ACM SIG-SPATIAL International Conference on Advances in GIS, November 6th, 2017.

- Plenary Speaker, World Cafe : Food-Energy-Water Nexus, Annual Meeting of the American Institute of Chemical Engineers, October 30th, 2017.

- Plenary Speaker, Workshop on Agricultural Data Integration: From Genomics to Unmanned Systems NSF Midwest Big Data Hub and NSF Institute of Mathematics and its Applications (IMA), University of Minnesota, October 26 - 28, 2017.

- Discussant, Open Knowledge Network Workshop (http://ichs.ucsf.edu/open-knowledge-network/), The Networking and Information Technology Research and Development (NITRD) Program, Whithouse Office of Science Technology and Policy, NIH Natcher Conference Center, Bethesda, MD, October 4-5, 2017.

- Panelist, Annual Meeting of the Sustainability Research Network for (SRN) Integrated Urban Infrastructure Solutions for Environmentally Sustainable, Healthy and Livable Cities, National Science Foundation, August 28th-29th, 2017.

- Invited Speaker, Workshop on Smart Urban Transportation Forum, NSF Institute of Mathematics and its Applications (IMA), University of Minnesota, May 15th, 2017.

- **Panel Chair**, Panel Discussion on Understanding and narrowing gaps between Data Science and Mechanistic theories in physical scienes, Workshop on Mining Big Data in Climate and Environment, (https://sites.google.com/a/umn.edu/mbdce-2017/home), SIAM International Conference on Data Mining, Houston, TX, April 28-29, 2017.

- Spatial Data Science Challenge for Machine Learning, **Panel Speaker**, NSF Midwest Big Data Hub Workshop on Machine Learning: Farm-to-Table Workshop, University of Illinois at Urbana Champaign, April 18-19, 2017.

- Spatial Data Science: Interdisciplinary Experiences, **Keynote**, Nebraska Data Analytics Workshop (NeDA 2017), University of Nebraska, Lincoln, NE, April 10th, 2017.

- Plenary Speaker, From GPS, Google Maps and Uber to Spatial Computing, Distinguished Faculty Luncheon for the National Academy members, Regents Professors, and University Leaders, Office of the Provost, University of Minnesota, March 21st, 2017.

- From GPS and Google Maps to Spatial Computing, **Distinguished Colloquium**, COmputer Science Department, University of Georgia, Athens, GA. March 15, 2017

- Invited Speaker, Data Science Seminar Series, NSF Institute of Mathematics and its Applications (IMA), University of Minnesota, January 24th, 2017.

- Spatial Data Analytics A Short Course, School of Computer and System Sciences, Jawaharlal Nehru University, New Delhi, (India), Global Initiative of Academic Networks (GIAN): A US-India (Obama-Modi) Partnership, December 26th-30th, 2016.

- Spatio-temporal Networks and High-Performance Computing, (Future Directions in) Geocomputation Workshop, USDOD National Geospatial Intelligence Agency, October 13, 2016

- Spatial Big Data Trends, NSF Midwest Big Data Hub - All Hands Meeting, (Sensor technologies and big data frontier panel), October 11, 2016

- Linear and ring-shaped cluster detection, Conference on Geospatial Approaches to Cancer Control & Prevention, National Cancer Institute, National Institute of Health, Bethesda, MD, September 12th, 2016

- Data Science Challenges in the Food-Energy-Water Nexus in Islanded Communities and High Latitudes, University of Alaska, Fairbanks, September 8th, 2016.

- From GPS and Google Maps to Spatial Computing 2020, **Keynote Speech**, Annual Meeting of the Air Force Research Laboratory (AFRL) Mathematical Modeling and Optimization Institute (MMOI), University of Florida Research & Engineering Education Facility (REEF), Shalimar, FL, July 25th, 2016.

- Data Science Challenges in nexus of food, energy and water systems, Annual Meeting of the University Consortium on Geographic Information Science, Scottsdale, AZ, May 26th, 2016.

- Computing Challenges in nexus of food, energy and water systems, Workshop on Computing Research: Addressing National Priorities and Societal Needs (http://cra.org/ccc/events/computing-innovation-societal-needs-the-impact-of-computing-research/) Computing Computing Consortium, Ronald Reagan Buidling and International Trade Center, Washington D.C., May, 2016.

- Data Science Challenges and Opportunities related to nexus of food, energy and water systems, Conference on Fate of the Earth : Climate-Food-Energy-Water Nexus (www.espp.msu.edu/fateoftheearth.php), Michigan State University, Lansing, MI, April, 2016.

- Evacuation Route Planning: Scalable Algorithms, Computer Science Department, University of Central Florida, Orlando, FL, April, 2016.

- Panelist, Panel on Data mining and mathematical models for evaluation and prediction of adverse individual and population health events, 2nd Workshop on Smart and Connected Health, College of Information Technology, UAE University, Al Ain, UAE, February 2016.

- **ISTeC Distinguished Lecture**, From GPS and Virtual Earth to Spatial Computing 2020, The Information Science & Technology Center (ISTeC) Colorado State University, October 19th, 2015.

- What is special about mining spatial data? Computer Science Seminar, Colorado State University, October 19th, 2015.

- From GPS and Virtual Earth to Spatial Computing 2020, **Keynote Speech**, IEEE Computer Society International Conference on Contemporary Computing, August 2015 (www.jiit.ac.in/jiit/ic3/) New Delhi, August 2015.

- From GPS and Virtual Earth to Spatial Computing 2020, Computer Science Colloquium, University of Central Florida, August, 2015.

- From GPS and Virtual Earth to Spatial Computing 2020, **Keynote Speech**, International Conference on Geo-Computation: The Art and Science of Solving Complex Spatial Problems with Computers (www.utdallas.edu/geocomputation/), Dallas, May 2015.

- What is special about mining spatial data? Computer Science Seminar, University of Florida, Gaineville, January 16th, 2015.

- From GPS and Virtual Earth to Spatial Computing 2020, Information Technology Seminar, University of Florida, Gaineville, January 15th, 2015.

- From GPS and Virtual Earth to Spatial Computing 2020, USDOE Workshop on High Performance Computing and Geospatial Analytics, Argonne National Laboratory: Theory and Computing Center, April 29th-30th, 2014.

- **Distinguished Colloquium**, What is Special about Spatial Data Mining?, Computer Science Department, University of Central Florida, Orlando, FL, March 21st, 2014.

- Spatial Data Science, Data Science Symposium, National Institute of Standards and Technology, Gaithersburg, MD, March 4th-5th, 2014.

- **Yi-Fu Tuan Lecture** on Spatial Big Data Analytics, Department of Geography, University of Wisconsin, Madison, WI, February 22nd, 2014.

- Spatial Big Data Analytics, Department of Computing Science, University of Alberta, Edmonton, Canada, January 17th, 2014.

- **Keynote**, From GPS and Virtual Earth to Spatial Computing 2020, NSF Workshop on Modeling and Analysis of Environmental Exposures on Public health, United Arab Emirates University, Al Ain, UAE, January 8th, 2014.

- **Distinguished Colloquium**, From GPS and Virtual Earth to Spatial Computing 2020, Division of Cancer Control and Population Sciences, NIH National Cancer Institute, 9609 Medical Center Dr, Rockville, MD 20850, December 12th, 2013.

- **Distinguished Colloquium** on From GPS and Virtual Earth to Spatial Computing 2020, and a short-course on Spatial Data Mining, Aalto University, Finland, School of Engineering (Surveying/Planning Dept.), August 19th-20th, 2013.

- **Distinguished Colloquium** on From GPS and Virtual Earth to Spatial Computing 2020, and a short-course on Spatial DataBases, Korean Advanced Institute for Science and Technology, Daejon, Korea, July 15th-18th, 2013.

- Spatial Big Data Analytics, NIH-AAG Synthesis Workshop on Geospatial Frontiers in Health and Social Environments: Towards a Unified Vision, June 7th, 2013.

- **Distinguished Colloquium**, Spatial Big Data Analytics, Computer Science Department, Arizona State University, Tempe, AZ, USA, May 16th, 2013.

- **Keynote Speech**, Spatial Big Data Analytics, Workshop on Big Data and Demography, Institute of Population Research, Ohio State University, Columbus, OH, USA, May 9th, 2013.

- Plenary Talk, Spatial Big Data, NSF Workshop on Big Data and Urban Informatics, University of Illinois at Chicago, USA, March 28th-29th, 2013.

- Plenary Talk, Interdisciplinary Research: War Stories, Workshop to kick-off Technology Innovation Center on Geographic Information Science, Umm Al-Qura University, Makkah, Saudi Arabia, January 6th-7th, 2013.

- **Keynote Speech**, Spatial Big Data: Challenges and Opportunities, ACM SIG-Spatial International Workshop on Big Spatial Data, November 6th, 2012, Los Angeles, CA, USA.
- Plenary Talk, Geo-social Media, Army Research Office (ARO) Workshop on Human-Centric Computing with Collective Intelligence: Challenges and Research Directions, October 30-31, 2012, Arizona State University, Phoenix, AZ, USA.
- Invited Talk on Spatial Big Data Analytics, Space Time Panel, International Conference on Geographic Information Science, Sept. 18-21, 2012, Columbus, OH, USA.
- Invited Speaker, Spatio-temporal Movement Models of Crowds, Army Research Office (ARO) Workshop on Populations and Crowds: Dynamics, Disruptions and their Computational Models, September 5-7, 2012, University of Southern California, Los Angeles, CA, USA.
- Invited Speaker, Cyber-Infrastructure for Spatial Big Data, NIH-AAG Symposium on Geospatial Frontiers in Health and Social Environments (Cyberinfrastructure for Spatial Analytics in Health Research), July 27-29, 2012, San Diego, CA, USA.
- Invited Speaker, Spatial Big Data, Army Research Office (ARO) Workshop on Big Data at Large Workshop, June 14-15, 2012, near Duke University Durham, NC, USA.
- **Keynote speech**, Spatial Big Data, 11th ACM SIGMOD International Workshop on Data Engineering for Wireless and Mobile Access (MobiDE), May 20th, 2012, Phoenix, AZ, USA.
- Invited Speaker, Spatial Big Data, NSF Workshop on Big Data Benchmarking, Brocade Executive Briefing Center, San Jose, CA, USA, May 7-9, 2012.
- Invited Speaker, Spatial Data Mining, NIH-AAG Symposium on Geospatial Frontiers in Health and Social Environments (Spatiotemporal Analysis for Health Research), April 27-28, 2012, Howard University, Washington D.C., USA.
- Invited Speaker, Evacuation Route Planning, NSF/CCC Workshop on Computing for Disaster Management, April 24-25, 2012.
- **Distinguished Colloquium**, Management Science and Information Systems Department, Rutgers University, Newark, NJ, USA, March 30th, 2012.
- **Distinguished Colloquium**, Computer Science Department, Iowa State University, Des Moines, IA, USA, March 8th, 2012.
- Invited Panelist, Panel on Mobility and Cloud Computing, NSF Workshop on Social Networks and Mobility in the Cloud, February 23-24, 2012.
- **Distinguished Seminar**, Evacuation Route Planning: Scalable Methods, Operations Research Center, University of Florida, Gainesville, FL, USA, November 18th, 2012.
- Invited Panelist, Panel on Challenges and opportunities in High-performance and Distributed GIS (HPDGIS), ACM SIG-Spatial Intl. Conference on GIS, November 1-3, 2011.
- Invited talk, Geo-Social Computing, CDC/FDA Workshop on Food Safety Biosurveillance, Michigan State University, October 24-26th, 2011.
- Invited talk, Eco-Routing: Computational Challenges, USDOE ORNL Symposium on Virtualizing Energy, US Department of Energy ORNL, Fall-Creek Falls, Gatlinburg, TN, September 14-16th, 2011.
- **Keynote speech**, ISPRS Symposium on Spatial-Temporal Analysis and Data Mining, July 18-20th, 2011, University College, London, U.K.
- **Panelist**, Plenary Panel on Sustainability, SECON 2011 : IEEE Communications Society Conference on Sensor, Mesh and Ad-Hoc Communications and Networks, June 28th, 2011, Salt Lake City, Utah, USA.
- **Invited talk**, NSF Workshop on Information and Communication Technologies for Sustainability (WICS), June 27th, 2011, Salt Lake City, Utah, USA.
- **Keynote speech**, Twentieth International Conference on Software Engineeing and Data Engineering, Intl. Society for Computers and their Applications, June 20th-22nd, 2011, Las Vegas, NV.

- Colloquium Speaker, What is Special about Mining Spatial Data, Computer Science Department, Montana State University, April 29th, 2011, Bozeman, MT.
- **Distinguished Colloquium Speaker**, Evacuation Route Planning: Scalable Approaches, College of Engineering, Montana State University, April 29th, 2011, Bozeman, MT.
- Invited talk, Geo-Social Media Revolution: Hype or Reality?, Meeting of the Social Computing Collaborative: an interdisciplinary research community at the University of Minnesota, March 31st, 2011, Minneapolis, MN.
- Invited talk, Geo-Social Media Revolution: Hype or Reality?, annual retreat of the Integrated Media Systems Center (an NSF ERC), University of Southern California, February 17th, 2011, Los Angeles, CA.
- Invited talk, National Academies Transportation Research Board, Workshop on Pervasive Data for Transportation: Innovations in Distributed and Mobile Information Discovery in ITS and LBS January 23rd, 2011, Washington D.C.
- Invited talk, An NSF/ARO Specialist Meeting on Spatio-Temporal Constraints on Social Networks, December 13th-14th, 2010, Santa Barbara, CA.
- **Keynote speech**, Workshop on High-Performance and Distributed Geographic Information Systems, ACM SIG-Spatial, November 2nd, 2010, San Jose, CA.
- **Keynote speech**, Annual GIS Day celeberatio, University of Notre Dame, South Bend, IN, November 19th, 2010.
- **Keynote speech** on Spatial Data Mining for Environmental Sciences, 21st International Conference on Modelling and Simulation, International Association for Science and Technology for Development (IASTED), July 15 - 17, 2010, Banff, Alberta, Canada.
- NSF Workshop on Socially Coupled Systems and Informatics: Decision Making, Science & Computing in a Complex Interdependent World, July 12th-14th, Old Town Alexandria, VA.
- Taiwan Academia Sinica, Taipei, Taiwan, May 5th, 2010.
- US-Taiwan Workshop Mega-City/Mega-Disaster Reduction, US NSF & National Science Council of Taiwan, National Center for Research in Earthquake Engineering, Taipei, Taiwan, May 6th-7th, 2010.
- Dagstuhl-Seminar on Computational Transportation Science, Schloss Dagstuhl, Leibniz-Zentrum for Informatik, Wadern, Germany, March 22nd-26th, 2010.
- International Workshop on Space-Time Modeling and Analysis, Environmental Systems Research Institute (GIS Week), Redlands, CA, February 22nd-23rd, 2010.
- **Keynote Speech**, Indo-US Science & Technology Forum (IUSSTF) eorkshop on Geospatial Information for Developing Countries, Indian Institute of Technology, Bombay, India, December 16th-18th, 2009.
- **Keynote Speech**, Joint Smarter Planet University Research Day, IBM T.J. Watson Research Center, Yorktown Heights, NY, November 20th, 2009.
- DHS S&T Workshop on Emergency Management: Incident, Resource, and Supply Chain Management (EMWS09), University of California, Irvine, Center for Emergency Response Technologies, November 5-6, 2009.
- 19th Annual Minnesota Conference on Geographic Information Systems, Duluth Entertainment Convention Center (DECC), Duluth, Minnesota, October 21-23, 2009.
- NSF Next-Generation Data Mining Summit: Dealing with the Energy Crisis, Greenhouse Emissions, and Transportation Challenges, Columbia, MD, USA, October 1st-3rd, 2009.
- Bi-annual International Symposium on Spatial and Temporal Databases, Aalborg, Denmark, July, 2009.
- **Annual Dangermond Distinguished Lecture**, University of California, Santa Barabara, May 28th, 2009.
- Geospatial Technology Working Group, Mapping and Analysis for Public Safety, National Institue of Justice, U.S. Department of Justice, Annapolis, MD, April 16th, 2009.

- Innovision, National GeospatialIntelligence Agency (Reston, VA), Washington D.C., March 18th, 2009.
- Panel on GIScience and Computational Transportation Science, University Consortium on GIS, Winter Assembly, Jefferson Building (Library of Congress), Washington D.C., February 5th, 2009.
- **Keynote Speech**, Geospatial Science Forum (www.mapworldforum.org/2009/conference/gs.htm), Mapworld Forum, HICC Hyderabad, India February 12th13th, 2009.
- National Science Foundation Workshop on GeoSpatial and GeoTemporal Informatics, Washington D.C., January 89, 2009.
- Board on Earth Sciences and Resources, National Research Council, National Academy of Sciences Beckman Center, Irvine, CA, December 910, 2008.
- NATO NetworkofExperts Workshop Visualizing Network Dynamics, NATO Research Task Group "Visualisation Technologies for Network Analysis", QinetiQ Malvern Technology Centre, United Kingdom, 4th6h Nov. 2008.
- GIScience Journal Editors Panel, Biannual, Intl. Conference on Geographic Information Science, Salt Lake City, Utah, Sept. 2008
- Plenary Session on What have we learned? Suggestions for future IWCTS workshops? Intl. Workshop on Computational Transportation Science (IWCTS), Trinity College, Dublin, Ireland, July 2008.
- Education Plenary Session on Teaching GIScience: A Computational Perspective, University Consortium on GIS, Summer Assembly, Minneapolis, MN, June 2008.
- Informatics Workshop, Summer Institute and Science Advisory Meeting, NSFF IGERT on Sensor Science, Engineering and Informatics, University of Maine, Orono, June 2008.
- Panel on Cyberinfrastructure and Geographic Information Sciences at the "Annual Meeting of the American Association of Geographers", Boston, MA, April 2008.
- Minnesota Population Center, University of Minnesota, MN, February, 2007.
- **Keynote Speech** on "GIS in 2015" at at the "Research & New Venture Showcase: Geospatial Sciences", University of Texas, Dallas, TX, January 2008.
- Electrical Engineering and Computer Science Department, University of Tennessee, Knoxville, TN, December, 2007.
- National Geospatial Intelligence Agency, Workshop on Complicated Features, Airlie Conference Center, Virginia, Novemeber, 2007.
- NSF Workshop on Next Generation Data Mining (NGDM), Baltimore, October, 2007.
- National Geospatial Intelligence Agency PI Workshop, National Academies, Washington D.C., September, 2007.
- Transportation Research Board / Federal Highway Authority Workshop on Advanced Research in Geospatial Information Technologies for Transportation, National Academy of Science, Washington DC, September, 2007.
- China National Laboratory on Machine Perception, Center for Information Sciences, Peking/Beijing University, Beijing, China, August, 2007.
- China State Key Laboratory of Software Engineering, Wuhan University, Wuhan, China, August, 2007.
- China State Key Lab of Information Engineering in Surveying Mapping and Remote Sensing , (LIEMARS), Wuhan University, Wuhan, China, August, 2007.
- Computer Science Department, Fudan University, Shanghai, China, July, 2007.
- Spatial Database Group, Oracle Corporation, Nashua, NH, July, 2007.
- Volpe National Transportation Systems Center, USDOT Research and Innovative Technology Administration, MIT Campus, Cambridge, MA, July 2007.
- IEEE Computer Society President's Awards Banquet, Los Angeles, CA, May, 2007.
- **Keynote Speech**, NSF Workshop on Discrete Mathematical Problems in Computational Biomedicine, DIMACS Center, Rutgers University April, 2007.

- Computer Science Department, University of Houston, February, 2007.
- Workshop on Ubiquitous and Mobile Computing, National Center on Geographic Information and Analysis, January, 2007, Portland, Maine.
- **Keynote Speech** at the IEEE ICDM Workshop on Spatial and Spatiotemporal Data Mining (SSTDM), Dec. 18th, 2006, Hong Kong.
- Computer Science Department, Hong Kong University, Hong Kong, December, 2006.
- Microsoft Virtual Earth Workshop (11/3012/1, 2006), Seattle, USA.
- Panel on Model the Planet, Defense Advanced Research Projects Agency, Summer, 2006.
- Defense Advanced Research Projects Agency, Information Exploitation Office, May, 2006.
- Army Research Laboratory, Computational Science Workshop on Future Directions, June, 2006, Aberdeen, MD.
- 38th Sympoium on the interfaces of statistics, computing science, and applications (Interfaces 2006: Massive Data Sets and Streams), Pasadena, CA, May, 2006.
- 2nd Intl. Statistical Challenges in ECommerce Research Symposium, Carlson School of Management, University of Minnesota, May 2223, 2006 (http://www.misrc.umn.edu/symposia/20060522/)
- IBM T. J. Watson Research Center, NY, March, 2006.
- Panel on Evacuation Planning for Twincities Metropolitan, Minnesota Intelligent Transportation Systems Conference, March, 2006.
- Computational Research Institute, Purdue University, January, 2006.
- Oakridge National Laboratory, TN, February, 2006.
- National Research Council, National Academy of Science, Committee on Confidentiality Issues in linking GeographicallyExplicit and SelfIdentifying Data, Washington DC, December, 2005.
- **Keynote Speech**, ISPRS International Workshop on Spatial Data Mining, Middle Eastern Technical University, Ankara, Turkey, Novemeber 2005.
- **Keynote Speech**, Brazilian National GeoInformation Conference, Campos dos Jordao, Brazil, Novemeber 2005.
- Topographic Engineering Center (an Army ERDC), Alexandria, VA, October 2005.
- IEEE Fellows Local Conference, University of Minnesota, October 2005.
- **Keynote Speech**, Ninth International Symposium on Spatial and Temporal Database, Angora dos Rias, Brazil, August 2005.
- PI Workshop on Sensor Networks for Homeland Defense, Oakridge National Laboratory and Office of Naval Research, Washington D.C., July 2005.
- **Keynote Speech**, NSF Workshop on National Phenology Network, University of Nebraska, Lincoln, May 2005.
- Workshop on Voter Registration Databases for Election Assistance Commission, Computer Science and Telecommunication Boards, National Research Council, National Academies, May 2005.
- Remote Sensing Center, Boston University, Boston, March 2005.
- Topographic Engineering Center, Army Core of Engineers, Alexandria, VA, Feb. 2005.
- National Geospatial Intelligence Agency (NGA) specialist workshop on spatial web, University of California, Santa Barbara, Dec. 2004.
- **Keynote Speech**, Biannual conference on Geographic Information Science, American Association of Geographers, Washington D.C., October 2004.
- Invited speaker, INFORMS annual conference, Denver, Oct. 2004.
- Invited testimony, Minnesota Senate Election Committee, Hearing on the voter registration database for the 2004 presidential election , Aug. 2004.
- Dagstuhl Workshop on Data Warehouses, Dagstuhl, Germany, August 2004.

- Presentation to the Undersecretary for Research and Development, Department of Homeland Security, on Evacuation Planning for Homeland Security, University of Minnesota Science and Technology Day, April 2004.
- Congressional breakfast on GIS for Homeland Security, University Consortium on GIS, February 2004.

- NSA Workshop on Visualization and Mining, University Consortium of GIS, Washington D. C., Novemeber 2003.
- NSF Workshop on Next Generation Geographic Information Systems,, Boston, Novemeber 2003.
- Data Mining and Education Conference, SAS, Las Vegas, October, 2003.
- Workshop on Spatial Data Mining, Army Research Laboratory, Aberdeen, MD, August, 2003.
- Workshop on Data Mining, Army Research Laboratory, Aberdeen, MD, May, 2003.
- AHPCRC/Army Research Lab. PI Workshop on Enabling Technologies, Howard University, May 2003.
- Computer Science Department, University of Illinois, Chicago, March 2003.
- Workshop on Mining Weather Data, Army Research Laboratory, Whitesands, New Mexico, February, 2003.
- NSF workshop on Spatiotemporal Data Models for Biogeophysical Fields, San Diego Supercomputer Center, La Jolla, California, April, 2002.
- NSF Specialist Meeting on Spatial Data Analysis Software Tools, CSISS, Santa Barbara, CA, May 2002.,
- AHPCRC/Army Research Lab. PI Workshop on Enabling Technologies, Minneapolis, MN, summer 2002.
- AHPCRC/Army Research Lab. PI Workshop on Virtual Computing Environments, Florida A&M University, summer 2002.
- Invited plenary talk on spatial data mining, Annual summer assembly of University Consortium on Geographic Information Systems, Buffalo, NY, July 2001.
- University Consortium on GIS Panel on "Critiques of 2010 visions fo GIS Research: A Report from NSF Workshop" May 1999.
- National Science Foundation Workshop on Data Mining in Geographic Information Systems, March 1999.
- National Science Foundation Workshop on Integrating Vector and Rastor Geographic Information Systems, May 1999.
- National Science Foundation Workshop for PIs in Information and Data Management (IDM) Program, March 1999.
- Army Research Lab. PI Workshop, Dec. 2001.
- NASA PI Workshop for Intelligent Data Understanding program, Missoula, Montana, March 2001.
- Army Research Lab. workshop on Virtual Computing Environment, Dec. 2001.
- Army workshop on Scientific Data Mining, July 2000.
- Army workshop on Scientific Data Mining, Fall 1999.
- NASA Workshop for PIs in TerraSIP program, May 1999.
- NASA Workshop for PIs in TerraSIP program, December 1998.
- National Science Foundation Industrial/Academic Workshop on Research Directions in Databases, October 1998.
- Ministry of Science and Technology, Government of India, September 1998.
- Indian Institute of Technology, Delhi (India), September 1998.
- Indian Institute of Technology, Bombay (India), September 1998.
- University of British Columbia, Computer Engineering Dept., January 1998.

- Microsoft Research, Database Group, January 1998.
- Boeing Corporate Research, Database Group, January 1998.
- Ministry of Science and Technology, Government of India, December 1997.
- United Nations Development Program, New Delhi, December 1997.
- Pune University (India), Center for Design of Advanced Computers (CDAC) and Computer Science Dept., December 1997.
- Army Research Laboratory, Workshop on Databases and Object Orientations, July 1997.
- Purdue University, Computer Science Department, November 1997.
- Army Research Laboratory, Digital Battlefield Workshop, July 1997.
- Bell Laboratories, Database Systems Group, March 1997.
- Waterways Experimentation Station, Army Core of Engineers, February 1997.
- Army High Performance Computing Research Center, Support Scientist Workshop ,February 1997.
- Univ. of California, Berkeley, Electrical Eng. and Computer Sc., PATH Project, May 1996.
- CalTrans Center for Interoperability and National Center for Geographic Info. and Analysis (NCGIA, UCSB), March 1996.
- INFORMS Conference on Computer Sc. and Operations Research, Winter 1996.
- ACM Intl. Conf. on Geographic Info. Systems (Panel on Interoperability in GIS), December 1995.
- Environmental Systems Research Institute, Networks Group,($1B software company in GIS, founded by Harvard researchers), Winter 1995.
- Foundation Workshop on Mobile and Wireless Information Systems, October 1994.
- Georgia Institute of Technology, College of Computing, April 1994.
- University of Texas at Austin, Electrical and Computer Engineering Department, February 1994.
- Dartmouth College, School of Engineering, November 1993.
- IBM T. J. Watson Research Center, Database group, May 1993.
- Bell Atlantic, Automatic Records Systems Group, August 1993.
- Bell Laboratories, Advanced Software Group, Spring 1989.
- Bell Core, Multimedia Applications Group and Advanced Software Group, Spring 1989.
- MCC, Artificial Intelligence Group, Spring 1989.
- Andersen Consulting, Center for Strategic Research (Chicago) , Spring 1989.
- Syracuse University, Electrical and Computer Science, Spring 1989.
- George Mason University, Software Engineering group, Spring 1989.
- University of California at Berkeley, Artificial Intelligence Seminar, Spring 1989.

3 RESEARCH GRANTS

3.1 External Grants From Federal/State Agencies & Companies

- P.I., AI Institute for Climate-Land Interactions, Mitigation, Adaptation, Tradeoffs and Economy (AI-CLIMATE) $20M, 6/2023 5/2028. AFRI Competitive Grant No. 2023-67021-39829 / Project No. MINW-2023-03616, USDA National Institute of Food and Agriculture as well as the National AI Research Institute program of the National Science Foundation.

- Co-P.I., ROMULUS and REMUS, Two Systems for Building Mega-City Intelligenee, $900K, HAYSTACK (Hidden Activity Signal and Trajectory Anomaly Detection) Program, Office of the Director of National Intelligence (ODNI)/Intelligence Advanced Research Projects Activity (IARPA), 3/2023 3/2027 (48 months).

- P.I., W911NF-22-P-0065_UMN: Agile Machine Learning in Dynamic Environments for Complex Event Processing $52K, USDOD Army STTR (via Novateur Research Solutions LLC) 9/30/2022 3/31/2023.

- Co-P.I., 2118285: HDR Institute: iHARP- Harnessing Data and Model Revolution in the Polar Regions, $13M, National Science Foundation, 1/1/2022 12/31/2027.

- Co-P.I., 2021-51181-35861: WinterTurf: A Holistic Approach to Understanding the Mechanisms and Mitigating the Effects of Winter Stress on Turfgrasses in Northern Climate, $8M, USDA National Institute for Food and Agriculture (NIFA) 9/1/21-8/31/26.

- P.I., 2040459: EAGER: Spatiotemporal Big Data Analysis to Understand COVID-19 Effects National Science Foundation, $200K , 7/1/2020 - 8/31/2021.

- co-P.I., CX-020456: Improving the Freight Productivity of a Heavy-Duty, Battery Electric Truck, US-DOE Office of Energy Efficiency and Renewable Energy (FOA DE-FOA-0002044 via Volvo Technology of America LLC), $1.5 M 1/1/2020 - 8/31/2023, (with W. Northop).

- P.I., Identifying Aberration Patterns in Multi-Attribute Trajectory Data with Gaps, USDOD National Geospatial Intelligence Agency, $600K , 6/15/2020 - 6/14/2023 (two more option year may go to 6/14/2025).

- P.I., Spatio-temporal Informatics for Transportation Science (8/19 to 7/23) National Science Foundation (Award CISE/IIS-1901099), $1.2 M, 8/1/2019 - 7/31/2023. (co-P.I.: W.Northrop)

- co-P.I., Midwest Big Data Hub: Building Communities to Harness the Data Revolution National Science Foundation (Award 1916518), $5M, 06/01/2019 - 05/31/2024 (UMN P.I.: J. Peterson).

- P.I., Connecting the Smart-City Paradigm with a Sustainable Urban Infrastructure Systems Framework to Advance Equity in Communities, National Science Foundation (Award 1737633), $2.5 M, 9/1/2017 - 8/31/2022.

- Co-I., Planning Grant: Engineering Research Center for Intelligent Infrastructure for Safe, Efficient and Resilient Mobility (ERC-I2SERM), National Science Foundation (Award 1840432), $97.682K, 9/1/2018 - 8/31/2020.

- Co-I., Reducing Winter Maintenance iEquipment Fuel Consumption Using Advanced Vehicle Data Analytics, Minnesota Department of Transportation, $213K (direct cost), 6/20/2018 - 8/26/2020.

- Co-I., Clinical and Translational Science Award (CTSA), (UL1 TR002494, KL2 TR002492, TL1 TR002493), National Center for Advancing Translational Sciences, National Institute for Health (NIH), $42.6 M, 3/30/2018 - 2/28/2023. (P.I.: B. Blazar).

- Co-P.I., Increasing Low-Input Turfgrass Adoption Through Breeding, Innovation, and Public Education, Speciality Crop Research Initiative, National Institute for Food and Agriculture (contract 2017-51181-27222), USDA, $5.4 M, 9/1/2017 - 8/31/2021. (with E. Watkins).

- Co-P.I., Cloud-Connected Delivery Vehicles: Boosting Fuel Economy Using Physics-Aware Spatio-temporal Data Analysis and Real-Time Powertrain Control USDOE ARPA-E, $1.780,671 (1.4M federal), 2/17/2017 - 2/16/2020. (PI: W. Northrop),

- P.I., FEW: A Workshop to Identify Interdisciplinary Data Science Approaches and Challenges to Enhance Understanding of Interactions of Food Systems and Water Systems, National Science Foundation, $50K, 6/1/2015 - 5/31/2017.

- P.I., Ephemeral Network Broker to Facilitate Future Mobility Models and Transactions, Ford University Research Program, $120K, 12/15/2014- 12/14/2017.
- P.I., III: Small: Investigating Spatial Big Data for Next Generation Routing Services (IIS-1320580), National Science Foundation (NSF), $500K (approx.), 9/15/2013- 8/31/2018.
- Co-PI, National Spatiotemporal Population Research Infrastructure, National Institute of Health, $3M (approx.), 09/01/13-05/31/2018.
- P.I., Identifying and Analyzing Paterns of Evasion (HM0210-13-1-0005), National Geospatial Intelligence Agency (NGA) $600K (with option upto $750K), 6/10/2013- 9/9/2018.
- Co-P.I., Datanet: Terra Populus: A Global Population / Environment Data Network (0940818), National Science Foundation (NSF), $7,833,266, 9/1/2011- 8/31/2018. (w/ Steve Ruggles, Jaideep Srivastava, Victoria Interrante, Steve Manson).
- Co-P.I., III: Small: Towards Spatial Database Management Systems for Flash Memory Storage (IIS-1218168), National Science Foundation (NSF), $500K (approx.), 9/2012- 8/2018. (w/ M. Mokbel).
- P.I., From GPS and Virtual Globes to Spatial Computing 2020, Workshop Organization grant managed by Computing Community Consortium (CCC), National Science Foundation (NSF), $100K (approx.), 6/2012- 5/2013.
- Consultant, Spatio-Temporal Analysis in GIS Environments (STAGE): SBIR Phase II, USDOD Joint Warfare Analysis Center (JWAC), $ 750K (approx.), 9/2012- 8/2014. (w/ C. Sanders and R. Ramanujan, Architecture Technology Corporation).
- Co-P.I., Expedition: Understanding Climate Change: A Data Driven Approach, National Science Foundation (NSF), $10 Million (approx.), 8/15/2010- 8/14/2018. (w/ V. Kumar et al).
- Co-P.I., Discovery of synoptic patterns of climate variability and change using data mining and high performance computing, Civilian Research & Development Foundation 2009 Cooperative Grants Program (CGP 2009): Climate change and energy competition, US Department of State, $94,000, 2010. (with Prof. Gennadiy Averin, Donetsk National Technical University, Donetsk, 83001, Ukraine).
- P.I., Spatial and Spatio-temporal Data Mining for Smarter Planet, IBM. Faculty Award, IBM Global University Relations and Innovation Programs, $20,000 (unrestricted gift), 2009-2010.
- Co-P.I., Indo-US Science & Technology Forum, Workshop on Geospatial information for Developing Countries : Science & Technology (IUSSTF/WS/54-2009), $25,000 (approx), (With Prof. N. L. Sarda, Indian Institute of Technology, Bombay, India).
- P.I., Dynamic Purpose-Aware Graph Models for Composite Networks, $750,000, US Department of Defense (HM1582-08-1-0017), Aug. 14th, 2008 - Aug. 13th, 2013.
- P.I., Spatio-Temporal Pattern Mining for Multi-Jurisdiction Multi-Temporal Activity Datasets, $600,000, US Department of Defense (HM1582-07-1-2035), Aug. 14, 2007 - Dec. 31st, 2012. (w/ L. Khan, U. T. Dallas).
- P.I., IGERT: Non-equilibrium Dynamics Across Space and Time: A Common Approach for Engineers, Earth Scientists and Ecologists, $2,819,194 (approx), National Science Foundation (**NSF**), DGE-0504195, Sept. 2008 - September 2012 (PI-role), Aug. 2005 - September 2012 (w/ C. Paola, M. Hondzo, R. Hozalski, J. Finlay and C. Neuhauser).
- P.I., III-CXT: Spatio-temporal Graph Databases for Transportation Science, $449,993 (approx), National Science Foundation (**NSF**), IIS-0713214, Aug. 2007 - September 2012. (w/ H. Liu)
- P.I., USDOD Army Corps of Engineers (Topographic Engineering Center W9132V-09-C-0009), Cascase Models for Multi-Scale Spatio-temporal Pattern Discovery, $150,000, 02/03/09 - 07/31/12.
- Co-P.I., CRI:IAD Infrastructure for Research in Spatio-Temporal and Context-Aware Systems and Applications, $140,403, National Science Foundation (**NSF**), CNS-0708604, July 2007 - June 2011. (w/ A. Tripathi, M. Mokbel).
- P.I., Spatial Database Research for Mapping and Analysis for Public Safety, $100,000 (unrestricted gift), Ned Levine & Associates, 2006-2009.
- P.I., Modeling and Mining Spatio-temporal Data, USDOD Army Corps of Engineers, $111,000, 03/15/06 - 09/30/08.

- P.I., Army High Performance Computing Research Center (AHPCRC), $5,000,000 (approx.), Army Research Lab. and Network Computing Services, Jan. 2006 - Jan. 2007.
- P.I., Discovering perosnal gazetteers from travel histories (GPS tracks), $40,000 (unrestricted gift), Microsoft Mappoint Research Program, 2005-2006.
- P.I., Spatio-temporal data analysis techniques for behavioural ecology, $576,395, National Science Foundation (**NSF**), September 2004 - August 2007. (w/ J. Srivastava, A. Pusey).
- P.I., Spatio-temporal data mining for sensor networks, $200,000, Oakridge National Laboratory, Department of Energy (DOE), June 2005 - June 2008.
- P.I., High Performance Spatial Data Mining, $100,000, Army Research Lab. (AHPCRC), Jan. 2005 - Jan 2006.
- P.I., Evacuation Planning Software for Twin Cities Metro Area Scenario, $53,011, Minnesota Department of Transportation, February 4th, 2005 to November 30th, 2005.
- co-P.I., Planning for full-scale CLEANER: Options for field facilities and cyberinfrastructure in America's heartland, $69,960, National Science Foundation (**NSF**), August 2004 - July 2006. (w. M. Hondzo et al).
- P.I., Decision Support System for Evacuation Planning, $60,000, Federal Highway Authority (FHWA), August 2004 - November 2005.
- Co-P.I., Complexity of Spatial and Categorical Scale in Land Use Classification, $535,914, National Science Foundation (**NSF**), July 2003 - June 2006. (w/ S. Gopal, Boston U).
- P.I., Evacuation Planning for Homeland Security, $120,000, Army Research Lab. (AHPCRC), Jan. 2004 - Jan 2005.
- P.I., Capacity constrained route planning and Parallelizing Spatial Autoregression, $90,000, Army Research Lab. (AHPCRC), Jan. 2003 - Jan 2004.
- Co-PI, Being There: Mobile Devices for Community and Commerce $120,000, National Science Foundation (**NSF**) EIA-0224392, 2002-2004, with L. Terveen et al. (CISE Research Resource).
- Co-P.I., Discovery of Changes from the Global Carbon Cycle and Climate, **NASA** (Ames Research Center), $525,091.00 , March 2001 - February 2004.
- Co- P.I., Map accuracy assessment for A New Approach to Assessing Road User Charges, $250,000, Department of Transportation from 10 states, April 2001 - June 2003. (w/ M. Donath et al).
- P.I., Research in Virtual Computing Environment, $90,000, Army Research Lab. (AHPCRC), Sept. 2001 - August 2002.
- P.I., Research in Mining Geo-spatial Datasets, $190,000, Army Research Lab. (AHPCRC), Jan. 2000 - Jan. 2001.
- P.I., High Performance Spatial Visualization of Traffic Data, $122,929, USDOT (ITS Inst.), 1/2000 - 2/2001.
- Co-PI, Cluster Computing for Mining Diverse Datasets, $74,000, National Science Foundation (**NSF**), 2000-2001, with G. Karypis et al. (shared equipment grant).
- Co-PI, Research in Networked Information Systems, $97,000, National Science Foundation (**NSF**), Jan. 1999 - Dec. 2001, with A. Tripathi et al. (shared equipment grant).
- Co-PI, Precision Agriculture Center, $3,840,000, U. S. Department of Agriculture, 2000-2003, with R. Pierre et al. (CS share is $50,000)
- Co-PI, A New Approach to Assessing Road User Charges $770,000, U of Minn share is $350,000, Federal Highway Administration and the states of California, Illinois, Indiana, Iowa, Michigan, Minnesota, Nevada, S. Dakota, Texas, and Wisconsin, July 1999 - December 2001, with M. Donath et al. (Our share is about $100,000).
- Co-P.I., Institutionalizing MTPE Data for Land and Environment Management, $1,334,552 National Aeronautics and Space Agency (**NASA**), 9/1997- 8/2001. with T. Burke et al. (Our share is about $100,000).

- P.I., Databases for Spatial Graph Management, $103,647, National Science Foundation (**NSF**), 8/1996-7/99.
- P.I., Research in High Performance Geographic Information Systems, $80,000, Army Research Lab. / AHPCRC, Jan. 1999 - Jan. 2000.
- Co-P.I., Research in Enabling Technologies for High Performance Computing, $248,000, Army Research Lab. / AHPCRC, with Prof. G. Karypis and Prof. V. Kumar, Jan 98 -Jan 99 (Our share was $80,000).
- P.I., Archival of Traffic Data (phase II), $100,000, Federal Highway Authority (FHWA), 1997-98.
- Co-P.I., Enabling Technologies: High Performance Geographic Information Systems, $263,432, Army Research Lab. / AHPCRC, with Prof. V. Kumar, Jan. 97 - Jan. 98 (our share was $80,000).
- P.I., Evaluation of Seven County Twincities Roadmap, $59,591, U.S. Dept. of Transportation, 3/16/96-3/15/97.
- P.I., Archival of Traffic Data From TMC, $100,000, Federal Highway Authority (FHWA), 1995-97.
- P.I., High Performance Geographic Information Systems for DIS, about $90,000, Army Research Lab. / AHPCRC, with Prof. V. Kumar, Jan. 94- Jan. 97 (Our share was $50,000).
- P.I., High Performance Neural Network (Technology Transfer), Army Research Lab. / AHPCRC, with Prof. V. Kumar, 1994 (Our share was about $30,000).
- P.I., Application of GLMX to updating digital roadmaps for the Intellegent Vehicle Highway Systems, $30,000 support for one graduate student for 1 year (Industrial Affiliates Program), with Prof. D. Du, Computing Devices International, 1993-94.
- P.I., Traffic Data Management For Advanced Driver Information Systems, $43,000 from Federal Highway Authority (FHWA), 1993-94.
- P.I., Multimedia Information Presentation in Smart Cars and Highways, $43,000 from Federal Highway Authority (FHWA), 1993-94.
- P.I., Evaluation of Data Management Architecture For Advanced Traveler Information Systems, $20,000 from Federal Highway Authority (FHWA), 1993-94.
- P.I., Trace-driven Driving Simulation, $43,000 from Minnesota Dept. of Transportation, 1992-93.
- P.I., Program Visualization Environment, $6,000 equipment grant from MinnNeXT project, NeXT Corporation, 1991-92.
- P.I., Emulation of an External Laboratory in Driving Simulator, $43,000 from the Center for Transportation Studies, 1991-92.
- P.I., Data Management for Driving Simulation, Collision Detection and Incident Detection, $45,000 from Minnesota Dept. of Transportation, 1991-92.
- Co-P.I., Human Factors in Highway Signage, with P. Hancock, $45,000 from Minnesota Dept. of Transportation, 1991-92 (Our share was about $10,000).
- Co-P.I., An Incidence Detection Expert System, with Y. Stephanades. (The Computer Science share was $10,000.) $45,000 from the Center for Transportation Studies 1990-1991 (Our share was $10,000).
- Co-P.I., Information Presentation in Vehicles, with P. Hancock (The Computer Science share was support for one graduate student, one undergraduate student and $7,667.) $50,000 from the Center for Transportation Studies in 1990-1991.

3.2   Internal Grants

- Big-data Transparency in Global Food Supply, Provost's Grand Challenges Exploratory Research and International Enhancements Grants, University of Minnesota, (Co-I. with Tim Smith, Anu Ramaswami, Pennington) $96,000, 2016-2017.
- $30,000, Massive Open Online Course on Spatial Computing, (Co-I with B. Brent et al.), 2014-2015, UMN Round II MOOC Projects under eLearning strategy, Office of the Senior Vice President for Academic Affairs & Provost and College of Science & Engineering, University of Minnesota.

- $2.5 M, U-Spatial (Co-PI with F. Harvey et al.), 2012-2017, Infrastructure Investment Initiative (two thirds with one-third from participating colleges), Office of Vice President of Research, University of Minnesota.
- $25,000, Minnesota Futures (Phase I: Symposium Grant), 2008-2009. Office of Vice President of Research, University of Minnesota.
- $100,000, McKnight Distinguished University Professorship, 2005-2010, Graduate School, University of Minnesota.
- P.I., Indoor navigation system for visually impaired, $29,000, July 2005 - June 2006, Digital Technology Center, University of Minnesota.
- Co-P.I., A digital library to archive research material from Jane Goodall's Gombe chimpanzee project, $27,924, July 2004 - June 2005, Digital Technology Center, University of Minnesota.
- P.I., Exploring Policy Implications of Traffic Management Center Data, Summer 98 - Summer 1999, $40,000 from Center for Urban and Regional Affairs, University of Minnesota.
- $10,000, In eight Undergraduate Research Opportunity Program Awards and a Center for Transportation Studies Undergraduate Research Assistants Program Award from 1990-present for J. Mitchell, M. Kalantar, A. Fetterer, P. Khandelwal, Hsiang Wu, M. Coyle, B. Amin, and Y. Hooshmand.
- $9000 from the Graduate School in 1992-1993, Geographical Data Management
- $8000 from the Graduate School in 1991-1992, Real Time Search Algorithms.
- $8000 from the Graduate School in 1990-1991, Cooperating Expert Systems.
- Summer Support (1 month) from the Graduate School for 1991, Neural Networks for Generalization.

4 GRADUATE STUDENTS, VISITORS, etc.

4.1 Visitors: Faculty, Postgraduate, Graduate Visitors

1. Wayzata High School student, Yuv Magan, is visited my group in 2023-24. He is working on analysis of ship trajecory data with gaps for identify possible rendezvous patterns.

2. Wayzata High School student, Srinath Hariharan, visited my group in 2021-22. He worked on analysis of spaatial pathology data from Mayo Clinic for exploring immune-checkpoint inhibitor therapies for cancer. He was also among a a small number of students in the Twincties Regional Science Fair (TCRSF) to advance to the International Science and Engineering Fair (ISEF).

3. Eden Preraie High School student, Aditya Kulkarni, visited my group from summer 2020 to Spring 2022. He worked on analysis of SafeGraph COVID-19 Consortium dataset. He received admission to undergraduate programs at the Yale University, the University of California, Berkeley, etc. and joined Yale University.

4. Prof. Ning Jing, Department of Computer Science, National University of Defense Technology, Changsha, China, planning to visit for a month in 2020.

5. Ning Guo, Ph.D. student, Department of Computer Science, National University of Defense Technology, Changsha, China, visitor, October 2018 - October 2019.

6. Breck High School students, Samantha Detor and Abigail Roh, visited my group in summer 2018 and summer 2019 to explore machine learning methods to detest Ash trees from aerial imagery. In Spring 2019, they were among 5 top teams in the Minnesota Junior Science and Humanities Symposia (JSHS) competition qualified for the nationals. They also were among a small number of teams in the Twincties Regional Science Fair (TCRSF) to advance to the state competition and the International Science and Engineering Fair (ISEF). Samantha and Abigail joined the undergraduate programs at Yale University and Columbia University respectively.

7. Jiannan Cai, Ph.D. student, Department of Geo-informatics, Central South University, Changsha, China, February 2018 - February 2019.

8. Wayzata High School student, Ruhi Doshi, visited my group from Summer 2017 to Spring 2018 to explore linear hotspot detection methods to analyze road accident data set. She also co-authored a journal paper on transdisciplinary foundations of Geo-spatial data science. She joined the undergraduate program at the University of California, Berkeley.

9. Shrutilipi Bhattacharya, Fullbright-Nehru Scholar, Ph.D. student, Indian Institute of Technology, Kharagpur, India, visited my laboratory from July 2015 to January 2016.

10. Prof. Sonajharia Minz, Computer Science faculty, Jawaharlal Nehru University, New Delhi, India, visited my laboratory in 2015 and 2016.

11. Prof. Ramnath Sarnath, Computer Science faculty, St. Cloud State, MN visited my laboratory during his sabbatical year Sept., 2014 to June 2015.

12. Daniel Cugler, a Ph.D. student at Institute of Computing, University of Campinas, Brazil visited on a fellowship of Brazilian government from Sept., 2012 to August 2013.

13. Prof. Rafal Angryk from Computer Science Faculty, Montana State University visited from September 2012 to November 2012 to collaborate on a survey of spatio-temporal database literature.

14. Prof. Bashkov Evgeniy Aleksandrovich (Vice Rector, R&D) and Prof. Gennadiy Averin (Head, Computer Monitoring Department) from Donetsk National Technical University, Ukraine, visited in January 2011 for two weeks to collaborate on a joint grant on understanding climate change from US Department of State.

15. Mudit Gupta, a Computer Science undergraduate student from Indian Institute of Technology, Guwahati, India visited in summer 2013 for undergraduate research experience.

16. Ravdeep Gill, a Computer Science undergraduate student from Indian Institute of Technology, Kharagpur, India visited in summer 2012 for undergraduate research experience.

17. Ayman Taha, a Ph.D. scholar at Cairo university, Egypt, visited on a fellowship of Egyptian government from Sept., 2011 to May 2012.

18. Abdulvahit Torun from Middle Eastern Technical University (Ankara, Turkey) visited our group from September 14th, 2009 to June 13th, 2010 on a scholarship from TUBITAK (Research Council of Turkey) to collaborate on Spatio-temporal Knowledge Support for Spatial Situation Awareness. He is the Chief of Remote Sensing Branch, General Command of Mapping, Photogrammetry Dept., Ankara, Turkey.

19. Zhanqan Wang, a China Scholarship Council (CSC) scholar, is visiting our group from Fall 2009 to Summer 2010 to collaborate on spatial data mining. He is associate professor of Computer Sc. & Eng. at East China University of Science and Technology, Shanghai, China.

20. Pronab Mohanty, a Humphrey Fellow (U S Dept. of State), is visited our group in Spring 2009 to collaborate on spatial data mining for public safety and security. He is with the Indian Police Service (Banglore, India).

21. Prof. Prabhat Ranjan visted our group for a month in summer 2008 and for a week in summer 2009 to explore collaboration on india center initiative at the University of Minnesota. He heads the Embedded Systems and Sensor Networks research group at the D. Ambani Institute of Information & Communication Technology (intranet.daiict.ac.in), India. His projects include detection of water on the Moon (a part of indian lunar mission, Chandrayaan-2), tracking and preserving wildlife, detection of forest fires, etc.

22. Prof. Sungwon Jung spent a large part of his sabbatical with our group in Fall 2007 and Spring 2008 to collaborate on spatio-temporal databases and query processing. He is with Department of Computer Science, Sogang University, Seoul, Republic of Korea.

23. Prof. Christopher Eick visted our group for a month in two summers (2008, 2006) to explore collaboration on spatial data mining. He is affiliated with the Computer Science faculty at the University of Houston.

24. Dr. (Ms.) Vania Bogorny visited our group during the 2004-5 academic year. She was supported by a government fellowship for the federal government of **Brazil**. She is currently a research fellow (PRODOC/CAPES) at Instituto de Informatica da UFRGS/Brazil.

25. Mete Celik visited our group from Fall 2002 to Summer 2007. He was supported by a NATO fellowship from the government of **Turkey**. He joined the Computer Eng. faculty at the Erciyes University, Turkey.

26. Dr. Sanjay Chawla worked as a post-doctoral fellow with our group from Fall 1997 to Summer 2000 in the Army High Performance Computing Research Center. He is currently the chair of the Department of Computer Science at the University of Sydney, **Australia**.

27. Prof. B. Y. Hwang visited for his sabbatical year in 1999 from the Department of Computer Science, The Catholic University of Korea, Seoul 121250, **Korea**.

28. Prof. Hemlata Diwakar visited on a **United Nations fellowhip** during Fall 1997 from the Faculty of Computer Science, University of Pune, India.

29. Prof. F. Polat visited on a N.A.T.O. fellowship from Fall 1992 to Spring 1993 from Bilkent University, **Turkey**. He is with the Computer Eng. faculty of the Middle East Technical University (METU), Ankara, Turkey.

30. Prof. I. Singh visited on **a Fullbright fellowship** during from Fall 1991 to Spring 1992 from the National Inst. of Tech., India.

31. Hosted colloquium and workshop speakers included

    - Prof. Bharat Bhargava (Purdue University)
    - Prof. Mor Namaan (Rutgers University)
    - Prof. Werner Kuhn (Institute of Geoinformatics University of Muenster, Germany)
    - Sumit Sen, Indian Institute of Technology, Bombay, India.
    - Prof. Paul Torrens (Arizona State University)
    - Prof. Michael Goodchild (U. C. Santa Barbara and a NAS member),
    - Prof. May Yuan (Assoc. Dean, U. Oklahoma),
    - Dr. Kentaro Toyama (Microsoft Research),

- Prof. Michael Worboys (University of Maine, NCGIA),
- Jack Dangermond (President, ESRI),
- Prof. Hanan Samet (University of Maryland),
- Prof. Benjamin Wah (Univ. of Illinois, Urbana-Champaign),
- Prof. Sham Navathe (Georgia Tech.),
- Prof. K. Y. Whang (KAIST, Korea), etc.
- Prof. Bruce Berra (Syracuse U), etc.
- Prof. Arif Ghafoor (Purdue U), etc.
- Dr. Eric Hoel (ESRI Geodatabase lead),
- Dr. Budhendra Bhaduri (OakRidge National Lab., GIS lead),
- Dr. Tim McGrath (Microsoft Mappoint lead),
- Dr. Bhavani Thuraisingham (NSF, UT Dallas),
- Dr. Jim Shine (Topographic Engineering Center, Engineering Research and Development Center, Army Core of Engineers)
- Dr. Ratko Orlandic (Illinois Inst. of Tech.), etc.

4.2 List of Ph. D. Students (33 graduated, 6 current)

1. Prof. Andrew Yang GRADUATED with a Ph.D. in January 1993. He completed a thesis titled "Spatial Data Management for Motion Processing". He is currently with the Computer Sc. faculty, University of Houston (Clear lake). He was previously with University of Connecticut.

2. Prof. Babak Hamidzadeh GRADUATED with a Ph.D. in July 1993. He is currently with Boeing Research. He was previously an Associate Professor of Computer Engineering at the University of British Columbia. Babak completed a thesis titled "Dynamic Scheduling Of Real Time Tasks: A Graph Theoretic Approach". He was selected to be the *program chair* for the IEEE International Conference on Tools with AI, 2000.

3. Prof. Du-Ren Liu GRADUATED with a Ph.D. in July 1995. He is currently with the faculty of Inst. of Info. Management at National Chiao Tung University in Taiwan. His thesis focused on the design and evaluation of geographic databases to support network computations for transportation networks.

4. Dr. Mark Coyle GRADUATED with a Ph.D. in March 1996. He is currently with Siebel Systems. He was previously with the kernel group at Oracle Corporation and rose to the rank of Vice President. His thesis focused on declustering methods for parallel databases for geographic applications. He is now a Senior Vice President with Appirio, a cloud computing company.

5. Dr. Siva Ravada GRADUATED with a Ph.D. in June 1997. He is a technical lead in the Spatial Data Product Division at Oracle Corporation. His thesis focused on high performance parallel formulation of the range query and spatial join problems in spatial databases. He was selected to be the *program chair* for the ACM International Conference on Geographic Information Systems, 2000.

6. Dr. Ms. Xuan Liu GRADUATED with a Ph.D. in August 2000 and joined IBM T. J. Watson Research Center. Her thesis focused on the modeling and processing of direction predicates for spatial query languages. The pioneering nature of her work was recognized by peer scholars via a best paper award.

7. Prof. C. T. Lu GRADUATED with a Ph.D. in Spring 2002. His thesis focused on algorithms for spatial data analysis focusing on problems of spatial outlier detection and join index processing. He is a tenured Computer Science faculty member with Virginia Polytechnic University.

8. Prof. Ms. Wei Li Wu GRADUATED with a Ph.D. in Spring 2002. Her thesis focused on modeling spatial dependence in location prediction problem for geospatial data mining. She is a tenured Computer Science faculty member with the University of Texas at Dallas.

9. Prof. Ms. Huang Yan GRADUATED with a Ph.D. in Spring 2003. Her thesis developed new techniques for mining co-location patterns in spatio temporal datasets. She joined the faculty of Computer Science at University of North Texas.

10. Dr. Pusheng Zhang GRADUATED with a Ph.D. in Summer 2005 and joined Microsoft Mappoint group. His thesis focused on the problem of efficient indexing methods and query processing strategies for correlation based selection and join over spatial time-series datasets in context of climate modeling applications with Earth Science researchers from NASA. He was awarded a doctoral dissertation fellowship from the University of Minnesota in a university wide competition. He was co-advised by Prof. V. Kumar.

11. Prof. Hui Xiong GRADUATED with a Ph.D. in summer 2005 and joined the faculty of Rutgers University. His thesis explored the problem of identifying correlated item pairs from a large collection of items and transactions. He was co-advised by Prof. V. Kumar. He is now a associate head of the Management Science and Information Systems department at the Rutgers University.

12. Dr. Baris Kazar GRADUATED with a Ph.D. in summer 2005 and joined the Spatial Database group at Oracle corporation. His thesis explores computationally-efficient parameter-estimation methods for the spatial autoregression model. He joined Oracle corporation (Spatial group).

13. Dr. Qing Song Lu GRADUATED with a Ph.D. in Winter 2006 and joined the Microsoft Mappoint group. His thesis developed novel capacity constrained routing algorithms for identifying evacuation routes to minimize evacuation time for homeland security applications. The societal impact of his work was recognized by the CTS partnership award (2006). He joined Microsoft (Virtual Earth group).

14. Dr. Vatsai Ranga Raju GRADUATED with a Ph.D. in Summer 2006. He is with the faculty of North Carolina State University. His thesis explored semi-supervised methods for producing land-use classification maps from satellite imagery with very limited ground truth information. He is currently with Oakridge National Laboratory (ORNL) and earlier worked with IBM India.

15. Prof. Ms. Jin Soung Yoo GRADUATED with a Ph.D. in Spring 2007 and joined the faculty of Indiana University Purdue University. Her thesis explored spatio-temporal data mining problems. Earlier she explored the nearest neighbor problem in context of open location based services. The pioneering nature of her work was recognized by peer scholars via a best paper award. She joined faculty of Computer Science at Indiana University - Purdue University.

16. Dr. Sangho Kim GRADUATED with a Ph.D. in Spring 2007 and joined Environmental Systems Research Institute. His thesis explored large scale flow network algorithms for contra-flow aware evacuation route planning. The societal impact of his work was recognized by the CTS partnership award (2006). He joined the Geo-database group at the Environment Systems Research Institute.

17. Prof. Mete Celik GRADUATED with a Ph.D. in Spring 2008 and joined the faculty at Erciyes University, Turkey. His thesis investigated scalable methods to quantify and discover the mixed-drove co-occurrence patterns to identify subsets of vehicle-types which often move together given a spatio-temporal datasets describing vehicle trajectories. He also worked closely with Jane Goodall Institute. He joined the Computer Engineering faculty of the Erciyes University, Turkey.

18. Dr. Ms. Betsy George GRADUATED with a Ph.D. in Spring 2008 and joined Oracle corporation. Her thesis noted that well-known shortest-path algorithms (e.g. A*, Dijktra's) assumed stationary ranking of alternative routes. This assumption is not true due to change in travel time due to rush hours, HOV/Toll lanes, congestion, intersection-control traffic-signals, etc. She proposed new data structures (e.g. time-aggregated graphs) and algorithms to address these challenges. The path-breaking nature of her work was recognized by peer scholars via multiple best paper awards. She joined the Oracle Spatial group in Oracle corporation.

19. Dr. James Kang GRADUATED with a Ph.D. in Summer 2010 and joined USDOD National Geospatial Intelligence Agency. His thesis explored spatio-temporal data mining problems, e.g. flow-anomaly detection from sensor data-streams, in context of environmental science application such as water quality monitoring. Earlier he worked on reverse nearest neighbor queries. He joined Innovision research group at the USDOD National Geospatial-Intelligence Agency. In 2016, former president Obama awarded James a Presidential Early Career Awards for Scientists and Engineers (PECASE).

20. Dr. Xiaobin Ma GRADUATED with a Ph.D. in Spring 2012 and joined Oracle corporation. His thesis explored the problem of Multi-type Nearest Neighbor Queries in context of location based services and mobile commerce. He is with Oracle Corporation. He was previously with Terradata Corporation.

21. Dr. Pradeep Mohan GRADUATED with a Ph.D. in Summer 2012 and joined SAS corporation. His thesis investigated spatio-temporal cascade pattern mining and spatial hot-spot analysis in context of mapping and analysis for public safety. He joined SAS Corporation, a leading software company in the area of data mining and statistics.

22. Mr. Michael Robert Evans GRADUATED with a Ph.D. in Fall 2013 and joined Microsoft. His thesis investigated spatial big data to analyze gps-trajectories to recommend bicycle corridor in context of urban informatics. He received an Doctoral Dissertation Fellowship for 2012-13. His thesis was supported via IGERT fellowship and Doctoral Dissertation Award. He received a doctoral dissertation fellowship for 2012-2013. He joined Microsoft silicon valley laboratory in the area of geo-coding.

23. Dr. Dev Oliver GRADUATED with a Ph.D. in Spring 2014 and joined Environmental Systems Research Institute. His thesis investigated scalable algorithms for summarizing urban datasets via linear hotspots. He received an Doctoral Dissertation Fellowship for 2013-14. He joined ESRI corporation, the leading software companies in the area of Geographic Information Systems. He received a doctoral dissertation fellowship for 2013-2014.

24. Dr. Xun Zhou GRADUATED with a Ph.D. in Summer 2014 and joined the faculty at University of Iowa. His thesis explored computational structure of abrupt change detection, related to a data-driven approach to understanding climate change. He joined the faculty at University of Iowa. He received a NSF CRII grant in 2017.

25. Dr. Viswanath Gunturi GRADUATED with a Ph.D. in Spring 2015 and joined the faculty at I.I.I.T., Delhi (India). His thesis explored computational problems related to time-aggregated graphs for modeling spatio-temporal network datasets in transportation and other application domains. He received an interdisciplinary doctoral fellowship for 2014-2015.

26. Dr. KwangSoo Yang GRADUATED with a Ph.D. in Spring 2015 and join the faculty at the Florida Atlantic University. His thesis investigated development of scalable algorithms for capacity constrained network vornoi diagrams for applications such as shelter assignment. He received a doctoral dissertation fellowship for 2014-2015 and a NSF CAREER award in 2019.

27. Dr. Zhe Jiang GRADUATED with a Ph.D. in summer 2016. He received a doctoral dissertation fellowship for 2015-2016. His thesis explored computational problems related to spatial decision tree learning in context of reducing salt and pepper noise in land-cover classification from remotely sensed satellite imagery. He received an Doctoral Dissertation Fellowship (2015-16). He received a NSF CRII grant in 2019.

28. Dr. Emre Eftelioglu GRADUATED with a Ph.D. in February 2018. His thesis explored foundations of transdiscilpinary spatial data science with case studies on identifying patterns of evasion.

29. Dr. Ms. Reem Ali GRADUATED with a Ph.D. in Spring 2019. Her thesis explored computational structure of spatial sharing economy and non-compliance patterns in engine measurements from connected vehicles. She is currently with the Computer Science faculty of the University of California, Riverside.

30. Dr. Xun Tang GRADUATED with a Ph.D. in Spring 2019. His thesis investigated scalable algorithms for discovering statistically significant linear hotspots. He received an Doctoral Dissertation Fellowship in 2018-19. He is with Facebook.

31. Dr. Yiqun Xie GRADUATED with a Ph.D. in Summer 2020. His thesis explored computational structure of detecting statistically-significant arbitrary-shaped hotspots. He joined the GIS faculty of the University of Maryland, College Park.

32. Dr. Yan Li GRADUATED with a Ph.D. in Spring 2022. His thesis explored computational structure of spatio-temporal graph big data such as engine measurements from modern connected and instrumented cars. He joined Amazon.

33. Mr. Jayant Gupta GRADUATED with a Ph.D. in Spring 2023. He was sellected for participation in the 2022 Future Leaders Summit organized by the University of Michigan Institute for Data Science. His thesis explored responsible spatial data science problem related to smart and connected communities. He joined Oracle Corporation.

34. Mr. Arun Sharma passed thesis proposal examination in Spring 2023. His thesis is exploring spatial data science problem related to evasive patterns. He received a docctoral dissertation fellowship for academic year 2022-23. He is expected to graduate in Summer 2024.

35. Mr. Majid Farhadloo passed written and oral preliminary examination in 2022. His thesis is exploring spatial data science problem intersecting deep learning and raster data from agiculture. He was sellected for participation in the 2024 Future Leaders Summit organized by the University of Michigan Institute for Data Science.

36. Mr. Mingzhou Yang passed written and oral preliminary examination in Spring 2023. He is working on physics-informed deep neural networks for eco-toll estimation.

37. Mr. Subhankar Ghosh passed written and oral preliminary examination in Spring 2024. He is exploring scalable methods to mine statistically-significant regional colocation patterns.

38. Mr. Ruolai Zeng joined the spatial computing research group in Fall 2022. He is investigating the effectiveness of deep neural networks for spatial data science problems.

39. Mr. Shuai An joined the spatial computing research group in Fall 2023. He is investigating trajectory data for identifying co-travel patterns.

4.3 List of M.S. Students (56 graduated), 1 current

Two students graduated with Plan A option as indicated in bold font.

1. Mr. Wai Yat Wong GRADUATED in Fall 1990 with plan B project option. His project was a controlled study of the generalization ability of neural networks.

2. Mr. Cary Bates GRADUATED in Spring 1992 with plan B project option. His project work focused on the design and evaluation of a garbage collection system for Modula 2. Cary is currently with IBM Rochester, MN.

3. Mr. Meir Shargal GRADUATED in Fall 1992 with plan B project option. His project was titled "Evaluation of Search Algorithms and Clustering Efficiency Measures for Part Machine Clustering". He is currently with IDEAS, Bloomington, MN.

4. Ms. Janelle Kojak GRADUATED in Fall 1992 with plan B project option. Her thesis was titled "Is there transfer of training from virtual reality to the real world?". She is currently with the Electronics and Hardgoods Division of the 3M Corporation, St. Paul, MN.

5. Ms. Hua Ping Li GRADUATED in Summer 1993 with plan B project option. Her project was titled "Supporting Computer Aided Teaching of Access Methods". She is currently with Opin Systems, Bloomington.

6. Ms. Yvonne Zhou GRADUATED in Fall 1993 with an M.S. **(Plan A thesis option)** . She worked on disk allocation methods for parallelizing Grid Files for geographic databases. She is currently with Sybase Inc. in California.

7. Ms. Kathleen Mallery GRADUATED in Spring 1994 with plan B project option. She designed a Group Revenue and Displacement System (GRanD) for Northwest Airlines.

8. Mr. C. F. Lee GRADUATED in Fall 1994 with plan B project option. He designed an integrated database system for the Minnesota Department of Commerce. He is currently with the Dept. of Commerce.

9. Mr. Ashim Kohli GRADUATED in Fall 1994 with plan B project option. He evaluated single pair path computation on road map databases. He is with Oracle Corporation with a rank of Director.

10. Mr. Nitin Jain GRADUATED with a M.S. degree in Summer 1996 with plan B project option. He worked on the design and evaluation of algorithms for spatial join. He is currently with SpanLink Corp. in Minneapolis.

11. Mr. A. A. El Haddi GRADUATED with a M.S. **(Plan A thesis option)** in Summer 1996. He worked on parallelizing spatial databases for managing satellite imagery for ice coverage for the data collection center of the National Weather Service.

12. Mr. Brajesh Goyal GRADUATED with a M.S. degree (plan B) in Summer 1996. He worked on the evaluation of hierarchical formulations of algorithms to compute shortest paths for advanced traveler information systems.

13. Ms. Varsha Kelkar GRADUATED with a M.S. degree (plan B) in summer 1996. She carried out the evaluation of newly emerging extensible relational database technologies for advanced traveler information systems.

14. Mr. Rajat Aggarwal GRADUATED with a M.S. degree (plan B) in Winter 1997. He developed HMETIS, a public domain software incorporating hierarchical algorithms for partitioning hypergraphs.

15. Mr. Ron Grenier GRADUATED with a M.S. degree (plan B) in Spring 1997. He benchmarked the typical network traffic at Medtronics and experimentally compared the performance of computer networks, e.g. 155Mbs ATM and 100 Mbs fast ethernet, for the environment.

16. Mr. Andrew Fetterer GRADUATED with a M. S. degree (plan B) in Summer 1997. He worked on hierarchical algorithms for routing.

17. Ms. Anuradha Thota GRADUATED with a M. S. degree (plan B) in Fall 1997. She worked on storage management for traffic data archival.

18. Mr. Thananjayan GRADUATED with a M. S. degree (plan B) in Winter 1997. He worked on temporal data modeling for storing traffic data.

19. Mr. Seshu Guddanti GRADUATED with a M.S. (plan B) in Fall 1998. He worked on algorithms for data mining for patterns in strings.

20. Mr. Leijun Zheng GRADUATED with a M.S. (plan B) in Spring 2000. He worked on a Java based visualization of path descriptions based on direction predicates.

21. Mr. Chang Qing Zhou GRADUATED with a M.S. (plan B) in Spring 2000. He worked on topological data model based implementations for spatial operators specified in Open Geodata Interchange standard.

22. Mr. Neill Michael GRADUATED with a M.S. (plan B) in Spring 2000. He worked on spatial clustering algorithms for shipping affinities among a set of destinations.

23. Ms. Xinhong Tan GRADUATED with a M.S. (plan B) in Fall 2000. She worked on relational table design for the archival of traffic data collected by the Traffic Management Center at MNDOT.

24. Ms. Namita Sahay GRADUATED with a M.S. (plan B) in Spring 2001. She compared XML parsers (e.g. DOM and SAX) for supporting spatial queries on data encoded in GML, a XML standard for geo-spatial datasets. Her was accepted for publication in ACM Intl. Workshop on GIS, 2001. She is with Medtronics Inc.

25. Ms. Wei Hsin Fu GRADUATED with a M.S. (GIS) in Spring 2001. She developed a benchmark dataset and queries to learn topological data models within the Open Geodata Interchange Standard.

26. Ms. Carie Peterson GRADUATED with a M.S. (plan B) in Fall 2001. She developed a web crawler to extract details of technical publications in spatial database area to analyze statistical trends in popularity of topics over last decade. She is with West Publishing group in Twincities.

27. Ms. Judy Djugash GRADUATED with a M.S. (plan B) in Fall 2001. She developed techniques to customize code-dictionaries for dictionary based compression of vector maps. Her work was accepted for publication in Data Compression Conference 2002.

28. Mr. RuLin (Alen) Liu GRADUATED with a M.S. (plan B) in Spring 2002. He developed a visualization software for identifying pattern in spatio-temporal dataset, e.g. freeway traffic measurement dataset for Twincities highways.

29. Mr. Marcus Gallagher GRADUATED with a M.S. (plan B) in Spring 2002. He developed a model to specify location based security in spatial databases and efficient algorithms to check the spatial security constraints.

30. Mr. Zhihong Yao GRADUATED with a M.S. (plan B) in Spring 2003. He developed a geographic information system to road maps and GPS tracks to assess the positional accuracy and map-matching effectiveness of in-vehicle navigation devices. His work was sponsored by the ITS Institute under a project to evaluate technologies for a new approach to road user charges.

31. Mr. Vatsavai Ranga Raju GRADUATED with a M.S. (plan B) in Spring 2003. He developed an online geospatial processing system, namely MapServer, to provide web based access to NASA satellite imagery and derived data (e.g. forest attributes such as NDVI, NPP) about mid-west. This system has hundreds of registered users and dozens of third party application developers. Main results were reported in refereed conferences including ACM Intl. Conf. on GIS and Symposium on Scientific and Statistical Databases.

32. Mr. Nitin Karnani GRADUATED with a M.S. (plan B) in Summer 2003. He developed a digitization assistant to help scan, digitize and interpret paper-based data-sheets for populating spatial database about the Gombe chimpanjee dataset from Jane Goodall Institute for Studies in Primate Behavior.

33. Ms. Durga Gumaste GRADUATED with a M.S. (plan B) in Summer 2003. She developed a spatial database to facilitate query by example for analyzing the Gombe chimpanjee dataset from Jane Goodall Institute for Studies in Primate Behavior.

34. Ms. Alina Rimbu GRADUATED with a M.S. (plan B) in Fall 2003. She implemented an extensible map-cube system to visualize aggregation hierarchies on spatio-temporal datasets. Her software was used by Army Research Laboratory.

35. Ms. Lin Peng GRADUATED with a M.S. (plan B) in Spring 2004. She survey SQL standards and SQL implementations across commercial databases for topics in undergraduate courses on databases.

36. Mr. David Swanson Jr GRADUATED with a MS (Software Eng.) in Spring 2004. His capstone project focused on selection of data modeling tools for health informatics.

37. Mr. Chee Soon Wong GRADUATED with a MS (Software Eng.) in Spring 2004. His capstone project focused on selection of data modeling tools for health informatics.

38. Ms. Vamshi GRADUATED with a M.S. (plan B) in Fall 2004. She developed an indoor navigation system to assist blind persons in unfamiliar buildings.

39. Ms. Xuejin Ruan GRADUATED with a M.S. (plan B) in Fall 2004. She developed an extended join index to improve the computational performance of common spatio-temporal queries on national historical census datasets at the Minnesota Population Center..

40. Ms. Roshmi Bhoumik GRADUATED with a M.S. (plan B) in Spring 2005. Her M.S. project evaluated indoor location estimation using wireless local area network infra-structure.

41. Ms. Jin Soung Yoo completed a M.S. (plan B) in Fall 2005 and continued work towards a Ph.D. degree. Her M.S. project explored spatial data mining problem of designing faster joinless algorithms for discovering colocation patterns

42. Mr. Xiobin Ma GRADUATED with a M.S. (plan B) in early 2006. He worked on location based services to address the problem of identifying optimal routes to visit spatial instances of a collection of service types. He joined NCR Corporation (Terradata group).

43. Ms. Xiaojia M Li GRADUATED with a M.S. (plan B) in Spring 2006. She worked on data modeling and database design for the Gombe chimpanzee dataset in the Jane Goddall Institute.

44. Mr. Jeffrey Wolff GRADUATED with a M.S. (plan B) in Summer 2006. He worked on visualization of evacuation routes and schedules. Part of his work was included in a Fox TV news on the evacuation planning project on May 11th, 2006. He joined BAE corporation.

45. Mr. Abhinaya Sinha GRADUATED ith a M.S. (plan B) in Fall 2006. He worked on efficient implementation of spatial database queries for a natural resource software system and mapserver, a public domain software for creating web-sites for distributing geo-spatial information. He joined CNET corporation.

46. Mr. Vijay Gandhi GRADUATED with a M.S. (plan B) in Summer 2007. He worked on computational structure of statistical computations in context of classification of remote sensing imagery using multi-scale models. He joined Oracle corporation.

47. Mr. Chetan Shivarudrappa GRADUATED with a M.S. (plan B) in Fall 2008. His project compared alternative data-structures to support novel routing algorithms for applications where ranking of candidate routes can change over time. He also worked on modularizing CrimeStat, a popular spatial statistical software for mapping and analysis for public safety. He joined amazon.com.

48. Mr. Mark Dietz GRADUATED with a M.S. (plan B) in Fall 2009. His project explored computationally scalable algorithms for fuel-cache site-selection for polar research. His results were accepted for publication in 2009 ACM SIG-Spatial International Workshop on Computational Transportation Science.

49. Mr. KwangSoo Yang GRADUATED with a M.S. (plan B) in 2011 and is continuing the Ph.D. program. He is investigating development of a library for the visualizing spatio-temporal tracks of chimpanzees in the Jane Goodall Institute datasets. He is also working on efficient storage methods for new generation of digital roadmaps showing time-variation of speed over different time-points in a typical week.

50. Mr. Chintan Patel GRADUATED with a M.S. (plan C) in Summer 2010. He developed a library for the time-aggregated graph data-structure to help researchers using graph representation in exploring temporal questions. He joined Cisco systems.

51. Mr. Pratik Kotwal GRADUATED with a M.S. (plan A) in Spring 2019. He thesis explored algorithms for finding energy efficient routes leveraging vehicle on-board diagnostic big data. The results are under review for a special issue of ACM Transactions on Data Science (Special Issue on Smart Cities).

52. Ms. Wen Jing GRADUATED with a M.S. in Data Science in Spring 2019. Her capstone project explored open source software publication for spatial data science. She created a Github site for linear hotpot detection software from our group.

53. Mr. Ujval Bangalore Umesh GRADUATED with a M.S. in Data Science in Summer 2019. His capstone project investigated for spatial data science methods (e.g., YOLO deep learning method) for mapping urban garden mapping in smart cities.

54. Mr. Alexander Long GRADUATED with a M.S. in Summer 2020. His project characterizes the sensitivity of inequality measures (e.g., Gini Index) computed on Census-like privacy protected aggregated data to the choice of spatial partitions.

55. Mr. Haoming Li GRADUATED with a M.S. in Summer 2020. His project explored methods of finding energy inefficiency hotspots for MnDOT snowplow trajectories annotated with onboard diagnostic data.

56. Ms. Divya Shrinivasa Nairy GRADUATED with a M.S. in Data Science in summer 2021. Her MS in Data Science capstone project explored physics-aware anomaly detection methods to detect abberrant trajectories with significant gaps from global ship trajectory dataset.

57. Mr. Mohammed Hashim joined the group in summer 2021. His MS project is explores physics-aware computational methods for recommending energy-efficient routes.

5 SERVICE TO PROFESSION (Journals, Conferences, Award Committees)...

- Co-Lead, Computing Research Association Workgroup on Socially Responsible Computing, 2023.
- General Co-chair, 24th SIAM International Conference on Data Mining, Houston (TX), April 2024.
- Lead, Computing, Climate and Sustainability subgroup Computing Research Association Workgroup on Socially Responsible Computing, 2022-2023.
- General Co-chair, 23rd SIAM International Conference on Data Mining, Minneapolis (MN), April 2023.
- Program Co-chair, ACM SIG-Spatial International Conference on Advances in Geographic Information Systems, Seattle (WA), Nov. 2022.
- Member Editorial Team, AI/ML Ethics in the Earth, Space, and Environmental Sciences (Modules for Considerations and Capability), Americal GeoPhysical Union (AGU), 2022.
- Co-chair, CRA Conference at Snowbird (UT), July 19-22, 2022.
- Co-chair, Panel on Climate-smart Computing, CRA Conference at Snowbird, July 19-22, 2022.
- Moderator and Co-organizer, Panel Discussion on Intelligent Infrastructure For All: Challenges and Opportunities, American Association for the Advancement of Science (AAAS) Annual Meeting, February 18th, 2022.
- Co-led a Computing Community Consortitum white-paper titled *A National Research Agenda for Intelligent Infrastructure: 2021 Update* to make a case for new research funding to computing community, 2021.
- Program Co-chair, ACM SIG-Spatial International Conference on Advances in Geographic Information Systems, Seattle (WA), Nov. 2021.
- Member, IEEE Fellows Committee to evaluate Fellow Nominations, IEEE Computer Society, 2012, 2013, 2014, 2015, 2018, 2020, 2021, 2022, 2023.
- Member, NSF Panels, January 2020, July 2020, January 2021, March 2021, May 2021, October 2021.
- Guest Co-Editor, Special Issue on Big Spatiotemporal Data Analytics, International Journal of Geographic Information Science, Volume 34, 2020 - Issue 6, Taylor and Francis, 2020.
- Co-organizer, ACM SIGKDD International Workshop on Deep Learning for Spatiotemporal Data, Applications, and Sytems (DeepSpatial 2021), August 2021.
- Co-organizer, Special Session on Water and Big Data, Universities Council on Water Resources (UCOWR)/ National Institute for Water Resources (NIWR) Annual Water Resources Conference, June 810, 2021.
- Senior Program Committee Member, 26th ACM SIGKDD Conference on Knowledge Discovery and Data Mining, August 22 - 27, 2020.
- Senior Program Committee Member, ACM SIGSpatial International Conference on Advances in GIS, November, 2020.
- Senior Program Committee Member, 26th ACM SIGKDD Conference on Knowledge Discovery and Data Mining, August 22 - 27, 2020.
- Co-organizer, ACM SIGKDD International Workshop on Deep Learning for Spatiotemporal Data, Applications, and Sytems (DeepSpatial 2020), August 24th, 2020.
- Co-organizer, Panel on Earth Day at Snowbird: Computing to address grand challenges facing our changing planet, 2020 CRA Conference at Snowbird, Computing Research Association, July 22nd-23rd, 2020. Due to pandemicc, it was postponed.
- Co-organizer, Panel on Using Computing to Sustainably Feed a Growing Population, American Association for the Advancement of Sciences (AAAS) Annual Meeting, February 14th-16th, 2020.
- Chair, Panel Discussion on Role of Big Data in the American AI Initiative, All-Hands Meeting, NSF Midwest Big Data Hub, October 29th-30th, 2019.

- Co-chair, Earth Day, ACM SIGKDD International Conference on Data Mining and Knowledge Discovery, Aug. 2019.
- President , Unviersity Consortium for Geographic Information Science (UCGIS), 2017-2018. Co-organied the annual meeting (May 2018) and co-led the summer 2018 UCGIS call for action to include geospatial perspectives in data science degrees and curricula.
- Member, Board of Director, NSF Midwest Big Data Hub (MBDH), 2017-present.
  - Led a MBDH community whitepaper on Agriculture and Big Data to shape forthcoming federal research initiatives on Food and Agriculture Cyberinformatics and Tools from the National Institute for Food and Agriculture, April-Novemeber 2017.
- Member, Board of Director, Computing Research Association, 2016-2019, 2019-2022 (re-elected).
  - Chair, Ad-hoc Committee on Improving Recruiting: Co-led the CV Database effort as a first step to address faculty recruiting challenges such as a large number of open positions, low yield and increasing amount of faculty time in interviewing numerous candidates. It is being used by a majority of CRA members in 2019-2020.
  - Co-organizer, Panel - Earth Day at Snowbird: Computing to address grand challenges facing our changing planet, 2020 CRA Conference at Snowbird, Computing Research Association, July 22nd-23rd, 2020.
  - Co-chair, Panel on Improving Faculty Recruiting in the Computing Community, 2018 CRA Conference at Snowbird, UT, July 2018.
  - Led a CRA/CCC whitepaper on Intelligent Infrastructure for Smart Agriculture to advocate new federal research initiatives, March-April 2017.
  - Taulbee survey committee, 2016-2017.
  - Co-organizer, Panel Discussion on Faculty Recruiting Challenges and Opportunities, Biennial Computer science Leadership Conference, Snowbird UT, July 2018.
- Co-Organizer, SIAM Workshop on Mining Big Data in Climate and Environment, SIAM International Conference on Data Mining, Houston, TX, April 29th, 2017.
- Co-Organizer, NSF MBDH Workshop on Machine Learning; From Farm to Table, Midwest Big Data Hub, University of Illinois, Urbana-Champaign, April 18th-19th, 2017.
- Co-chair, Committee to Select Best Challenge and Vision Papers, ACM SIG-Spatial International Conference on Advances in Geographic Information Systems, San Francisco, CA, Novemeber 2016.
- Co-Organizer, KDD 2016 Workshop on Data Science for Food, Energy and Water, ACM SIGKDD, August 2016.
- Organizer, Symposium S-E2 Towards a Food-Energy-Water Nexus Data and Data Science Community, National Conference and Global Forum on Science, Policy and the Environment (NCSE), Washington D.C., January 19-21, 2016.
- Co-Organizer, NSF Workshop to Idetify Data Science Approaches and Challenges to Enhance Understanding of Interactions of Food Systems with Energy and Water Systems, USDA National Institute for Food and Agriculture, Washington D.C., October 5-6, 2015.
- Invited Speaker, Congressional reception on Deconstructing Precision Agriculture, (sponsor: house agricultural committee), March 2015.
- Member, Computing Community Consortium Council, 2012-2015. Coordinated the Blue Sky tracks initiative to help many conferences catalyze community to pursue bold new research directions. Also co-organized the CRA/CCC visioning workshop titled "From GPS and Virtual Globes to Spatial Computing 2020" and gist of the workshop report was published recently as a cover article for the Communications of the ACM (January 2016).
- Chair, Board of Director, Symposium on Spatial and Temporal Databases Endowment, 2016-2019.
- Member, IEEE Technical Achievement Award Committee, IEEE Computer Society, 2010, 2011.

- Chair, NSF / CCC Workshop on From GPS and Virtual Globes to Spatial Computing 2020, Computing Community Consortium Visioning Workshop Series, September, 2012.
- Member, Steering Committee, NSF / CCC Workshop on Computing for Disaster Management, Computing Community Consortium Visioning Workshop Series, April, 2012.
- Program Co-Chair, Bi-annual Intl. Conference on Geographic Information Science, Columbus, OH, September, 2012.
- Program Co-Chair, ACM SIS-Spatial International Workshop on Mobile Geographic Information Systems (MobiGIS), Los Angeles, CA, Novemeber, 2012.
- Guest Co-Editor (with H. Xiong, A. Tuzhilin), Special Issue on Intelligent Mobile Knowledge Discovery and Management Systems, 2012-2013, ACM Transactions on Intelligent Systems and Technology.
- Co-Editor-in-chief, *Geo-Informatica: An Intl. Journal on Advances in Computer Science for Geographic Information Systems*, 2002-present. In 2008, this journal received top-tier rating among 50 GIS journals in a peer-review study [2].
- Series Editor, Springer Briefs: A series of eBooks on Geographic Information Science and Systems, 2010-present.
- General Co-Chair, 12th Bi-annual Intl. Symposium on Spatial and Temporal Databases, Minneapolis, MN , August 24th-26th, 2011. It received a prestigious sponsorhip from the NSF/CRA Computing Community Consortium (CCC) for an inaugural track on challenges and vision papers. CCC is charged with revitalizing the computing community by identifying new directions and research initiatives.
- General-Chair, Intl. Workshop on Computational Transportation Science, (colocated with ACM SIG-Spatial Intl. Conf. on GIS), 2009.
- Vice-Chair (Spatial Data Mining), IEEE Intl. Conf. on Data Mining, 2010.
- Vice-Chair (Spatial Data Mining), IEEE Intl. Conf. on Data Mining, 2009.
- Vice-Chair (Spatial Data Mining), SIAM Intl. Conf. on Data Mining, 2009.
- Co-Chair, Workshop on Spatial and Spatio-Temporal Data Mining, IEEE Intl. Conf. on Data Mining, 2007, 2008, 2009, 2010. (http://csdl2.computer.org/comp/proceedings/icdmw/2007/3033/00/3019v.pdf)
- Co-Chair, Indo-US Science & Technology Forum (IUSSTF) Workshop on Geospatial Information for Developing Countries, Indian Institute of Technology, Bombay, India, December 16th-18th, 2009.
- Co-Chair, Panel on GIScience and Computational Transportation Science, Winter Assembly, University Consortium on Geographic Information Science, Washington D.C., February, 2009.
- Co-Chair, Workshop on Exploring Spatio-temporal Future of Geo-Informatics, University of Minnesota, Minneapolis, January, 2009.
- Steering Committee, *ACM Intl. Workshop on Geographic Information Systems,* 2003-present.
- Co-Chair, 2nd Statistical Challenges in E-Commerce Research Symposium, Carlson School of Management, University of Minnesota, May 22-23, 2006 (http://www.misrc.umn.edu/symposia/2006-05-22/).
- Member, Board of Director, University Consortium on Geographic Information Science, 2003-4.
- Editor, *Geo-Informatica: An Intl. Journal on Advances in Computer Science for Geographic Information Systems.*, 2001-2002.
- Associate Editor, *IEEE Transactions on Knowledge and Data Eng.*, 1996-98, and 1998-2000.
- Editor, IEEE-Computer Society Computer Sc. and Eng. Practices Publication Board, 1995-97.
- Editor, Intl. Jr. on Computational Intelligence and Organization, Lawrence Erlbaum and Assoc., Inc., 1996-97.
- *Co-Chair*, Inst. of Math and Its Applications (University of Minnesota) Workshop on Data Models for Multimedia Digital Libraries, January 2001.
- *Co-Chair*, Army Research Laboratory Workshop on Battlefield Visualization, April 2000.
- *Program Chair*, ACM International Conference on Geographic Information Systems, 1996.

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[2]C. Caron et al., GIScience Journals Ranking and Evaluation: An International Delphi Study, Transactions in GIS, 12(3): 293.321, Blackwell Publishing Ltd., 2008.

- Steering Committee Member, National Center on Geographic Information and Analysis (NCGIA) Conf. on Navigable Databases, 1996.
- Co-organizer, Mini-track on Neural Networks in Business, Hawaii International Conference on System Sciences, 1996.
- Publicity Vice-Chair, IEEE Intl. Conf. on Tools with AI, 1995.
- Co-Organizer, Workshop on Neural Networks at the Univ. of Minnesota, 1992, 1993.
- Co-Organizer, AAAI Workshop on Integrating Symbolic AI and Neural Networks, 1992.
- Treasurer, IEEE Intl. Conf. on Tools with AI, 1991.
- Served on numerous program committee, including ACM Intl. Conf. on Geographic Info. Systems (1995-present), ACM Symposium on Spatial Databases (1997-present), World wide web and Geographic Info. Systems (2001-3) IEEE International Conference on Data Mining (2003), SIAM International Conference on Data Mining (2000), IEEE International Conference on Data Eng. (2003), IEEE Intl. Conf. on Tools with AI (1991-97), Int'l Conf. on Software Engineering and Knowledge (1990).
- Refereed for numerous journals, including Intl. Jr. on GIS, IEEE Trans. on Knowledge and Data Engineering, IEEE Trans. on Computers, IEEE Trans. on Software Eng., ACM Trans. on Database Systems, VLDB Journal, IEEE Computer, IEEE Expert, Artificial Intelligence Journal, Journal on Parallel and Distributed Computing, Journal on Intelligent Information Systems, Journal of Software Engineering and Knowledge Engineering , Journal of Computer and Software Engineering, Intl. Jr. on Artificial Intelligence Tools, and Information and Software Technology.
- Refereed for numerous conferences, including IEEE Intl. Conf. on Data Engineering, ACM SIGMOD Natl. Conf. on Management of Data, IEEE Tools with AI, AAAI National Conf. on Artificial Intelligence, IEEE Intl. Conf. on Computer and Software Applications (COMPSAC), Intl. Conf. on Parallel Processing (ICPP), and Scalable High Performance Computing Conference.
- Refereed for several textbook publishers including Addison Wesley (*Software Engineering* by Sommerville) McGraw Hill (*Database System Concepts* by Korth and Silberschatz) and Richard D. Irwin Inc. (Software Engineering by Schach).
- Refereed for the following national and international agencies: National Science Foundation, National Aeronautical and Space Agency, Federal Highway Authority, Center for Transportation Studies and Chinese University of Hong Kong.

6 SERVICE TO UNIVERSITY OF MINNESOTA

6.1 Service to College, University and State

- Member, Sustainable Futures Workgroup, Research and Innovation Office, University of Minnesota, 2023-24.
- Invited Speaker, Presidents Emerging Scholars Emerge Summer STEM course, University of Minnesota, Summer 2023.
- Associate Director, Data Science Initiative, College of Science and Enginering, University of Minnesota (9/1/2022 - 8/31/2025).
- Member, University of Minnesota Senate Research Committee, 7/2019-6/2025.
- Member, Research Advisory Committee, College of Science and Engineering, 2023-2024.
- Member, College Committee to Evaluate candidates for Director, Technology Leadership Institute , 11/2020 - 2/2021.
- Member, College Committee to Evaluate Head of the Computer Sc. and Eng. Department, 11/2019-2/2020.
- Invited Speaker, Spatial Data Mining, Quantitative methods for population health (VMED 5442), (Host: Prof. Kim VanderWaal) Animal Sciences Veterinary Medicine building, University of Minnesota, Feb. 4th, 2019.
- Helped organize a workshop on Spatial data mining and Transportation, All Council Meeting to explore data science initiatives in transportation, Center for Transportation Studies, University of Minnesota, Feb. 20th, 2019.
- Invited Speaker, Transforming Agriculture with Intelligent Infrastructure, Applied Plant Sciences Graduate Program Seminar (Host: Prof. Eric Watkins), University of Minnesota, Feb. 4th, 2019.
- Invited Speaker, Spatial Data Mining, Quantitative Epidemiology seminar series (Host: Prof. Kim VanderWaal), Haecker Hall, University of Minnesota, April. 9th, 2018.
- Member, Organizaing Committee, Inaugural Annual Conference of the Institure on Environment, Fall 2017.
- Invited Speaker, Workshop on Smart Urban Transportation Forum, Institute of Mathematics and its Applications (IMA), University of Minnesota,May 15th, 2017.
- Mock Reviewer, Grant Writing Workshop, College of Science and Engineering, April 18th, 2017.
- Co-organizer, Workshop on Transdisciplinary Foundations of Data Science, Institute of Mathematics and its Applications (IMA), September 14-16, 2016. This workshop helped University of Minnesota form an team and prepare a proposal (involving Mathematics, Statistics and Computer Science) for the NSF 16-615 TRIPODS (Transdisciplinary Research in Principles of Data Science) Phase I RFP.
- Member, Advisory Group on positioning the University of Minnesota for the NSF Cross-Directorate INFEWS initiative, Office of Vice President of Research, 2015-2016. Helped organize a campus meeting (January) and workshop (February) to help form teams to respond to the 2016 solicitation on NSF Big Data Spokes as well as NSF INFEWS.
- Member, Internal Review Committee, Moore Inventor Fellowship Competition, Office of the Senior Vice President for Academic Affairs and Provost, Spring 2016.
- Biennial meeting of the UMN Academy of Distinguished Teachers (Fall 2016): organized and co-led the break-out session on International and Underrepresented Students under the Provost's Initiative on Mental Health.
- Participant, Faculty Recruiting for Bio-Statistics, School of Public Health, 2013-2014. I met with half a dozen candidates for a tenure-track faculty position in Bio-Statistics to provide interdisciplinary collaboration perspective on six candidates. The effort led to a successful hiring in the area.
- Member, Committee to review nomination for McKnight Land-grant Professorships, Office of Vice-President of Research, University of Minnesota, 2011 - 2013.

- Member, Senate Information Technology Committee, University of Minnesota, 2011-2013. Facilitated review and decisions related to information technology at the office of information technology at the University of Minnesota. Participated in selection of the Chief Information Officer (Fall 2011) including meeting with four candidates.

- Participant, Faculty Recruiting for Electric Power Engineering, Electrical and Computer Engineering, 2011-2012. I met with half a dozen candidates for a tenure-track faculty position in Electrical Power group to provide interdisciplinary collaboration perspective on six candidates. The effort led to a successful hiring in the area.

- Member, Technical Advisory Group (2010-2011), Metropolitan Council - Long-term Forecast for Land-Use and Tranportation Planning: Metropolitan Council is charged by state of Minnesota to prepare models for long-term (20-25 years out) forecasts of land-use and transportation demands to assist policy makers. It will use this model to help develop our long-range population and employment forecasts for metropolitan-area cities. The objective is to adopt a model that allows the Council to forecast the local distribution of regional population and employment for multiple scenarios involving different growth rates, land use policies, and transportation network improvements. Another objective is to develop a forecast model that allows us to better utilize available regional spatial data. The Council plans to develop this forecast model using Cube Land, the commercial version of the MUSSA model (http://www.mussa.cl/E_index.html) developed by Dr. Francisco Martinez at the University of Chile in Santiago. A consultant team will consist of Citilabs (Cube Land' s vendor), Dr. Martinez, and a modeler at his University of Chile modeling laboratory. As part of this project, Council Research has formed a Technical Advisory Group of local subject matter experts representing knowledge areas relevant to land use modeling - such as transportation planning, land use planning, real estate economics and computational spatial analysis. The role of the Technical Advisory Group is to help Council Research review and comment on the results and deliverables of each major project task. I am serving on this technical advisor group to periodically review the project and provide technical advice.

- Faculty Representative, Employee Reward, Recognition and Appreciation Study Committee, Office of the President, University of Minnesota, 2009-2010. Served with representatives of University Senate (Vickie Courtney, Becky Hippert), Office of Human Resources (Stacy Doepner-Hove, Jeff Stafford, Lori Ann Vicich, Deb Kinsley, Mo Perry), University Relation (Ann Freeman, Adam Overland), Facilities Management (Chris Kelleher), University Services (Kathleen Krueger), Recreational Sports (Karen Lovro), and U of M Morris (Sarah Mattson). The charge of the ERRA team was to conduct a study of employee rewards, recognition, and appreciation programs and develop recommendations for such initiatives at the University of Minnesota with the goal of improving employee morale, productivity, and retention. The study was to include a review of existing internal efforts, relevant literature, best practices at other universities as well as corporations, and discussions with employees. Recommendations were to be realistic, taking into account limited resources. The ERRA team was formally charged in January 2010 and it sent a 40-page report with recommendations to the President in summer 2010.

- Chair, All-University Honors Committee, University of Minnesota Senate, 2009-2010. Facilitated review and decisions related to nomination for honorary degrees, distinguished alumni award, honorary naming of buildings, etc. Interfaced with alumni association, university foundation, university senate, and offices of the President and Board of Regents. A key challenge formulation of building naming policy acknowledging the needs of development while protecting university honor.

- Chair, Committee to review President's Award for Outstanding Service nominations, University of Minnesota, 2009-2010. Facilitated review of and decisions for nominations. A key challenge is to develop consensus across three employee groups including faculty, professional/administrative staff and other employees. Assisted the University President in honoring the awardees during award ceremony.

- Senate Honors Committee Representative, Committee to Recommend Naming a Building for a Past President, Office of the Board of Regents, University of Minnesota, 2009-2010.

- Member, Committee to review nominations towards President's Award for Outstanding Service nominations, University Honors and Awards, University of Minnesota, 2008-2009.

- Member, Minnesota Supercomputing Institute Committee to review Database Activities, University of Minnesota, 2009-2010.

- Member, Information Exchange Leadership Committee, Academic Health Center, University of Minnesota, 2010-2011. Attended meetings and teleconference calls to review options (e.g. UofM Masonic Cancer Center Information Exchange, Ohio State Open Metadata Repository, University of Southern Carolina approach, etc.). Provided technical review of the options.

- Faculty Representative, All-University Honors Committee, University of Minnesota Senate, 2007-2009. Participated in review of nomination for honorary degrees, distinguished alumni award, honorary naming of buildings, etc. Specific contributions include revision of honorary degree categories and definitions.

- Member, Geo-spatial Steering Committee, University of Minnesota, 2007-2010. Assisted in creation of GIS undergraduate minor, organizing visit of Jack Dangermond (President and founder, ESRI) to receive a honorary doctorate. Led a successful proposal to Minnesota Futures program (Office of Vice President of Research) and organized a workshop (Jan. 30th-31st, 2009) to bring together the GeoInformatics community across a dozen departments from half a dozen colleges to facilitate. A major goal of the Minnesota Futures initiative is to promote more in-depth work to convert ideas into viable research questions to enable faculty members to respond collaboratively and boldly to emerging opportunities in interdisciplinary research and scholarship.

- Member, Committee exploring India Center, University of Minnesota, 2007-2010. Assisted Vice President McQuaid with strategy formulation towards exploring creation of India Center as requested by Rep. Eric Paulsen and State of Minnesota. Hosted Dr. Mitra, Director of Indo-US Joint Science and Technology Forum (Fall 2008) and Dr. Kentaro Toyama (Microsoft Research). Visited MapForum conference (Feb. 2009) to meet with Secretary of Science & Technology (Government of India), Dr. R Siva Kumar (CEO, National Spatial Data Infrastructure, Govt. of India), Dr. N. L. Sarda (IIT Bombay), to explore possible collaboration opportunities. Also met with Dr. Krishna Kant (NSF, Intel) and Prof. R. Sangal (Director, IIIT-Hyderabad) as well as talked to US leadership of IUSJST to explore opportunities.

- Director, Army High Performance Computing Research Center, Fall 2005-Summer 2007. Defined strategic focus of the center, helped form a new research cluster around network sciences, interfaced with 5 partner universities, and sponsors.

- Member of the Graduate Research Advisory Committee (GRAC), Graduate School, University of Minnesota, Fall 2000 - Spring 2006. Reviewed faculty research proposals to the grant-in-aid program.

- Recruiting Committee, Distinguished ADC Chair, Digital Technology Center, University of Minnesota, 2003-5.

- Program Committee, Carlson School of Business Conference on Electronic Commerce, 2001-2003.

- Faculty organizer, Army Center Summer Institute, 2000.

- Technical contributor, **congressional presentation to members of US House of representatives** by University Consortium on GIS, 1998-99.

- Technical contributor, **congressional presentation to members of US House of representatives** by University Consortium on GIS, 1997-98.

- Member, University Committee on Professional M.S. degree in Geographic Information Systems, 1998-99.

- Member, Institute of Technology Committee on M.S. degree in Computer Engineering, 1997-98.

- Member, Organizing Committee for the University of Minnesota Digital Technology Summit called by President Yudof. Organized the track on Geographic Information Systems with Prof. T. Burk, Fall 1997.

- Member, Institute of Technology Curriculum Committee, 1996-97.

- Member, Institute of Technology Committee on Professional Courses. Assisted Prof. Doug Ernie plan professional courses.

- Member, Institute of Technology Committee on the Bachelor of Information Networking program, 1993.

6.2 Service to Computer Science Department

- Member, Untenured Faculty Evaluation Committee, 2023-2024.
- Member, Teaching Faculty Evaluation Committee, 2022-2023.
- Chair, Committee on Teaching Load Measurement, 2021-2022.
- Chair, Untenured Faculty Evaluation Committee, 2020-2021.
- Member, Graduate Admissions Committee, 2020-2021.
- Member, Graduate WPE Committee, 2020-2021.
- Member, Faculty Recruiting Committee, 2017-2020. Led efforts to successful hiring a new faculty member in spatio-temporal data science area.
- Member, Untenured Faculty Evaluation Committee, 2018-2020.
- Member, Strtegic Planning Committee, 2018-2019.
- Member, 50th Anniversary Celebration Planning Committee, 2018-2019.
- Member, Graduate Committee, 2016-2018.
- Member, WPE Committee, 2016-2017.
- Chair, Awards Committee, 2014-2016. Facilitated preparation of nomination for a variety of faculty award by working closely with nominees, sponsoring faculty members, award committee members, etc. The department received eight awards including first ever Regents Professor (Vipin Kumar), second ever President's Distinguished Service Award (Jim MacDonald), McKnight Distinguished Professor (George Karypis), Distinguished Teaching Professorships (Maria Gini, Shashi Shekhar), McKnight Landgrant (Dan Knights), College Teaching Award (Ravi Janardan), and College Research Award (Tian He).
- Chair, Tenured Faculty Evaluation Committee, 2013-2014. Coordinated review of 9 tenured faculty members and prepared evaluation reports. Coordinated presentation and discussion of five cases at the faculty meeting.
- Chair, Mentoring Committee for Prof. Brent Hecht, 2013-2016. Organized mentoring committee meeting, advice and feedback on a variety of issues ranging from annual review, time management, MOOC proposal and preparation, Google Education grant proposal preparation, NSF CAREER proposals, etc.
- Member, Awards Committee, 2012-2013. Facilitated preparation of nomination for a variety of faculty award by working closely with nominees, sponsoring faculty members, award committee members, etc.
- Member, Tenured Faculty Evaluation Committee, 2011-2014. This committee reviews tenured faculty members and prepares evaluation reports for discussion at the faculty meeting. It makes recommendations to the department head.
- Member, Open House Planning Committee, 2010-2011, 2012-13. This committee identifies possible topics and speakers for the open house. It also reviews nominations for outstanding alumni award. It makes recommendations to the department head.
- Member, Strategic Planning and Recruiting Committee, 2011-2012. This committee reviewed many hundreds of applications for four tenure-track faculty positions to select about a dozen candidate for campus visit and interview. It facilitates the discussion on comparison of candidates towards recommendation for making offers. Besides participating actively in all activities, I hosted one of the candidates and articulated his case to the committee and faculty. A key success was hiring of four new tenure-track faculty members in Spring 2012.
- Elected Member, Tenure-track Faculty Evaluation Committee, 2010-2011. Prepared and presented review for a tenure track faculty member to CSE faculty in Spring 2011.
- Member, WPE and Graduate Student Evaluation Committee, 2009-2011. Helped review all graduate students in the department. Served on numerous WPE oral examination committees.
- Member, Committee for DTC Space Reallocation, 2010-2011. Helped resolved potential conflict across CSE faculty members and DTC leadership by identifying space needs, space usage and developing consensus.

- Chair, Awards Committee, 2007-2010. Facilitated preparation of nomination for a variety of faculty award by working closely with nominees, sponsoring faculty members, award committee members, etc. I am proud to see our department received the following awards for the first time in its history: President's award for outstanding service (Prof. Marvin Stein, 2009), and Outstanding International Alumni Award (Dr. Ajay Bhushan Pandey, 2010). We are also proud to share many other successes including McKnight Land-grant Professorships (Volkan Isler, Arindam Banerjee, Tian He, Nick Hopper), McKnight Distinguished University Professorship (Joe Konstan), and Award for Outstanding Contributions to Post-baccalaureate, Graduate, and Professional Education (Joe Konstan).

- Chair, Mentoring Committee for Prof. Mohammed Mokbel, 2007-2010. Organized mentoring committee meeting, advice and feedback on a variety of issues ranging from annual review, summer trip to Microsoft, NSF proposal preparation and revisions in response to reviews, etc. I am proud to see flourishing of Mohammed's career with NSF grants, ACM SIGSpatial leadership, etc.

- Chair, Strategic Planning Committee, 2004-2005. Facilitated shared goal setting and creation of an environment of mutual trust. Major accomplishments include
  1. Successful formulation of a consensus policy on faculty recruiting to resolve an going rift on this issue.
  2. Analysis of departmental strengths and weaknesses
  3. Identification of strategies to improve national ranking

- Chair, Colloquia, 2002-2005. Supervised nomination, review and selection of speakers for departmental colloquium. Major accomplishments include
  1. Successfully invited following distinguished speakers:
     (a) A current and a past presidents of ACM
     (b) A current and a past member of the ACM Fellows selection committee
     (c) Two members of the CRA board
     (d) A NSF program manager
     (e) Three NAE memebrs
     (f) A member of the NRC CSTB
  2. Web-based management of nomination, review and selection of speakers
  3. Redesign of the brochure for Cray colloquia
  4. Revision of Csci 8970, Graduate course related to Colloquia. Introduced a web-based reporting by students on the main ideas in each lecture. Helped students identify hypothesis, key claims and supporting evidence.

- Member, Computing Committee, 2002-2003.

- Chair, Computing Committee, 2001-2002. Key achievement include a complete redesign of the departmental web-site (www.cs.umn.edu) content.

- Member, Graduate Committee for Computer Science, 2001-2002.

- Member, Graduate Committee for Computer Engineering, 2001-2002.

- Member, post-tenure evaluation committee, 2000-2001.

- Member, Graduate committee, 2000-2001.

- Member, Curriculum committee, 2000-2001.

- Member, recruiting committee for a joint faculty position with Department of Psychology, 2000-2001.

- Member, External Affairs Committee, 1999-2000.

- Coordinator, Written Preliminary Examinations (software systems area), 1998 - 2000. Key achievements included
  - Developing a consensus strategy for revision of the WPE syllabus in face of the semester conversion.
  - Consolidation of WPE examination schedule from five evening sessions over a week to two Friday afternoon sessions.
  - Successful negotiation to move compilers to Computer Engineering

- Smooth coordination of a large group of faculty members working on examination preparations and grading.

- Chair, Curriculum Committee, 1998-2000. Key accomplishments include
  - Developing a consensus strategy for moving our first course (CSci 1902) from C++ to Java to modernize our curriculum.
  - Guiding the development of writing intensive courses
  - Developing detailed week by week syllabi for required undergraduate courses to reduce variation across offerings.
  - Starting discussion of comprehensive curriculum revision towards goals of ACM/IEEE-CS Curriculum 2001.

- Director, Undergraduate Studies (DUGS), 1995-1997. Key accomplishments include
  - Started the COOP program for Computer Science and recruited over two dozen companies and students to participate in it.
  - Started a highly visible WWW-page competition to increase the visibility of the committee among undergraduates, faculty and staff.
  - Created an undergraduate colloquium to allow technical interaction between undergraduates and industries.
  - Streamlined the operation of undergraduate committee by instituting clear division of responsibilities.
  - Substantially improved the relationship of Computer Science department with colleges (IT and CLA) as acknowledged by the head of the department.

7 SOFTWARE DEVELOPED

7.1 UMN MapServer: Software to Publish Geo-spatial Data on Internet

Our group (e.g. R. R. Vatsavai, A. Sinha) played a key role in development of many components and design decisions related to computational scalability of MapServer. MapServer is an open source development environment for building spatially-enabled Internet applications. It can run as a CGI program or via MapScript which supports several programming languages (using SWIG). Since mid-1990s, it is used by thousands of web-sites to distributed geo-spatial data on Internet.

MapServer was originally developed at the University of Minnesota under leadership of Prof. Tom Burk with support from NASA, which needed a way to make its satellite imagery available to the public. Recently, Autodesk, the MapServer Technical Steering Committee Members, the University of Minnesota, and DM Solutions Group announced the creation of the MapServer Foundation. More details are available from its wikipedia entry (http://en.wikipedia.org/wiki/MapServer) and homepage (http://mapserver.org/).

7.2 CrimeStat : Crime Analysis Software

CrimeStat is a spatial statistical software to identify spatial patterns in crime reports. The software and manual are distributed for free by the U.S. Department of Justice under the program on Mapping and Analysis for Public Safety within the National Institute of Justice (NIJ). This software is used by hundred of police departments around the country.

CrimeStat performs spatial analysis on objects located in a GIS. The objects can be points (e.g., events, locations), zones (e.g., blocks, traffic analysis zones, cities) or lines (e.g., street segments). The program can analyze the distribution of the objects, identify hot spots, indicate spatial autocorrelation, monitor the interaction of events in space and time, and model travel behavior. There is a regression module for non-linear spatial modeling. Some of its tools are specific to crime analysis. Others can by applied in many fields. There are 55 statistical routines in the software. More details are available from its wikipedia entry (http://en.wikipedia.org/wiki/CrimeStat) as well as software distribution web-site (http://www.icpsr.umich.edu/CrimeStat/).

Our group helped Dr. Ned Levine and Ron Wilson in modernizing the software (release 3.2 in 2009 and 3.3 in 2010) towards scaling it up to large datasets and re-architecting it into components. We talked to a number of users to understand the requirements before re-engineering the software. Our group helped develop documentation on the application programming interfaces for the components. It also developed drivers to test the components. We also conducted a alpha-testing and beta-testing of new releases with a large number of users. Our group was honored in the bi-annual USDOJ/NIJ Crime Mapping conference for these contributions. Scalability results were also accepted for publication in the ACM SIG-Spatial International Conference on GIS (2008).

7.3 Evacuation Route Planning Software

My research group developed a web-based software system to help transportation professionals and first responders to develop *evacuation route* for many scenarios as mandated by the Department of Homeland Security. It was used by Emergency Management professionals to prepare evacuation plan for Twin-cities metropolitan area. It is receiving wide publicity in local media including newspaper (March 8th, 2006 Pioneer Press) and TV (FoxTV news, summer 2006). It was also highlighted by the University of Minnesota Vice President of Research in the 2007 annual report (Research magazine) as well as University of Minnesota foundation magazine.

The software uses databases to get transportation network (e.g. road maps), census (e.g. night time population) maps and employment statistics by location. The software tool has a web-based interface to display a map showing evacuation routes (and schedules) to minimize evacuation time after taking critical evacuation parameters including the geographic location and size of evacuation area, destinations, time of evacuation (e.g. day or night) to estimate population, transportation modes (e.g. driving vs. pedestrian). These options help first responders to compare possible alternatives of scenarios and evaluate their impacts. For example, they compared the overall efficiency of evacuation scenarios around the Mall of America when the affected people move out either with vehicles or by walking.

The software system was built on a Web server with mapping technology, thereby, reducing the cost of installation and maintenance and increasing the accessibility and availability. The graphic user interface of the software was improved after feedback given at two major evacuation workshops and a number of user meetings. At the second workshop, we installed a small booth for potential users to play the software. The testing and calibrating tasks were carried out using the five predefined evacuation scenarios. The resulting routes from this software were delivered to the parent project, Metro Evacuation Planning. The software and users manual were finalized in 2005 based on suggestions received from workshop participants including Mn/DOT, State and Local Emergency Management and Public Safety Officials, Transit Providers, and private sector personnel.

Computer Science Contributions: Mass evacuations are among the most difficult challenges faced by transportation professionals, but planning for a complete evacuation of a specific city is particularly difficult because such evacuations are only rarely necessary. As a result, developing evacuation plans has been carried out largely on the basis of engineering judgment and educated guesses about how to best make use of the road system.

Previously, computational techniques for solving evacuation problems often relied on the mathematical programming (MP) approach, which is widely used in optimization problems involving flow within transportation networks. Mathematical programming techniques are proven to produce optimal solutions to network flow problems and are known to work well for computing evacuation plans for smaller networks such as a single building. However, the high computational cost associated with current MP methods makes it difficult to scale MP methods up to problems involving extensive urban transportation networks with large numbers of evacuees.

Our research team focused its efforts on developing a novel and more practical form of heuristic algorithm for evacuation planning one that would take into account the capacity constraints built into transportation networks but also determine a good solution to any large-scale evacuation problem in much less time than a mathematical programming approach would require. After development of two preliminary algorithms, this effort culminated in the Capacity Constrained Route Planner (CCRP) algorithm. Experiments with synthetic and real evacuation datasets showed that CCRP took significantly less computational time and resources to identify evacuation routes. In addition, the evacuation routes produced by CCRP were comparable to those produced by mathematical programming techniques in terms of total evacuation time.

This is a significant scientific breakthrough in terms of the design of the evacuation planning algorithm, which is not only novel but also improved. It is also significant from a transportation perspective, since the reduced computational cost of CCRP helps emergency planners at two different stages. During planning and preparedness, emergency planners can evaluate many more scenarios using CCRP given specific computational resources relative to mathematical programming techniques. During operation, they have the option of revising evacuation routes using CCRP in response to major events (e.g. bridge failure in New Orleans) which were not anticipated during planning and preparedness.

Accrued, quantifiable benefits: In 2005, the software implementing the novel CCRP evacuation

planning algorithm was used to identify evacuation routes for five selected scenarios in the Twin-Cities for the Metro Evacuation Traffic Management Plan, which is now serving as the baseline for the entire mass evacuation plan that the US Department of Homeland Security is requiring every state to submit by March 2006. Discussions are underway with Metro Emergency Management Officials regarding the adoption and use of these tools in their emergency management plans as well.

The CCRP algorithm aims at identifying the most efficient routes among all possible route combinations. Thus, it can identify some critical routes which might be missing in the handcrafted plans typically used by local and state governments. One example is the comparative results of the University of Minnesota scenario. Even though the handcrafted version made by a select group of emergency planners covered several major routes including those to I-94 or I-35, our system was able to find additional routes to reduce evacuation time by using routes through Riverside Avenue or another way to I35 through Como Avenue. In an earlier evaluation, the CCRP algorithm identified ways to reduce evacuation time for the Montecillo Nuclear Power Plan evacuation zone by identifying potential congestion near the destination and adding additional routes to relieve it.

Recognitions: The Center for Transportation Studies (CTS) honored this work via the **2006 Research Partnership Award**, which recognizes research projects within the CTS program that have **resulted in significant impacts on transportation**, and rewards teams of individuals who have drawn on the strengths of their diverse partnerships to achieve those results. This work was invited for presentation in multiple public forums including the Intelligent Transportation Systems forum (March 8th, 2006), and the Annual CTS Conference (May, 2006). University of Minnesota venture center is evaluating this software towards potential commercialization.

Activities during 2011-2014: UMN Office of Technology Commercialization (OTC) started an effort to commercialize the evacuation route planning algorithms.

- Patent Filing: UMN OTC filed two patent applications. It took substantial time to respond to numerous questions from lawyers for preparing the patent applications.

- User Interface Development: We developed a web-based user interface to demonstrate the evacuation route planning algorithms to customers.

- Customer Meetings and Presentations: We helped OTC sponsored business developers with customer meetings. Activities included preparation of slides and presentations as well as participation in numerous conference calls and face to face to meeting. We also implemented case studies provided customers to assess value of software in their current efforts.

8   PUBLICATIONS

8.1   BOOKS [1 - 22]

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9 Highlights of Research, Teaching and Service (2020 - 2023)

Spatial computing has transformed our lives via pervasive services (e.g., navigation and ride-sharing apps), ubiquitous systems (e.g., GPS, geographical information system, spatial database management system), and novel scientific methods (e.g., spatial statistics). Many transformative opportunities lie ahead as report from McKinsey and National Academies project substantial additional annual value. Current initiatives include Amazons Earth on AWS, Google Earth Engine, Microsoft AI for Earth, and NSF Navigating the new Arctic towards meeting societal challenges such as climate change, and environmental sustainability. However, many spatial data science questions need to be probed to realize the transformative potential. For example, how may modern economy survive wide-spread GPS-jamming (or spoofing)? How may algorithms scale up to spatial big data to learn unbiased models for out-of-sample predictions? How may machine learning methods be generalized to address spatial challenges (e.g., auto-correlation, variability) ? How may we leverage vehicle big data for eco-routing despite lack of edge independence in transportation graphs?

Shashi's research aims at improving understanding the computational structure of very large geo-spatial computations. In early 1990s, Shashi's research developed core technologies behind in-vehicle navigation devices as well as web-based routing services, which revolutionized outdoor navigation in this century. His recent research results played a critical role in evacuation route planning for homeland security and received multiple recognitions including the CTS Partnership Award for significant impact on transportation. He pioneered the research area of spatial data mining via pattern families (e.g. collocation, cascade), keynotes, survey papers and community organization.

9.1 Research Highlights

During last 4 years, Shashi's research explored a framework for transdisciplinary foundations of spatial data science using four dimensions, namely, use-case domain requirements, statistics, mathematics and computational scalability.

Consider hotspot analysis to identify spatial regions with high concentration of disease, crime, accidents, etc. Spurious patterns have high social costs (e.g., stigmatization, economic losses) in public health and public safety. Thus, gold-standard techniques (e.g., SatScan) use statistical significance tests to weed out chance patterns. However, they are only capable of finding circular regions and may miss accident prone roads (linear shape) or crime-prone areas around evasive sources (doughnut hole patterns). Shashi's group first provided scalable methods for finding statistically significant linear and ring shaped hotspots. Further, we proposed methods to find hotspots of any shape by generalizing DBScan with statistical significance. Also, consider deep neural networks which are trending and fueling growth in AI. Traditional feed-forward neural networks examine assume that the learning sample are drawn indepdently of each other from identical distribution. However, these assumptions are violated by spatial data due to spatial auto-correlation and spatial variability. Recent developments such as Convolutional Neural Networks have modelled spatial auto-correlation and succeeded in object recognition tasks in computer vision as well as remote sensing. Our group generalized those to Spatial Variability Aware Neural Networks (SVANN) to model spatial variability and improve the performace further. THis work recevied the best paper award in the 2020 SIGKDD workshop on spatial deep learning.

Research-related Recognitions:

During last four years, the research results were recognized by one best paper award in ACM SIGKDD DeepSpatial Workshop (2020). Additional recognition included the Robert C. Johns Research Partnership Award (Center for Transportation Studies (CTS)), University of Minnesota, 2021. It recognizes a team of individuals who have collaboratively drawn on their diverse expertise to achieve significant impacts on transportation.

In addition, the College of Science and Engineering awarded the ADC/DSI Chair (2022-2025).

Furthermore, opinion pieces, interviews or quotations were published by broad media such as FoxTV (2023), Scientific American (2020), ZDNet/CBS Interactive (2020), Bloomberg CityLab (2021), Star Tribune (2020), Pioneer Press (2020), Business North (2020), Winona Post (2020), etc.

Publications: Different subsets of results were published as books (references 1-2), book chapters (references 23-27), journal papers (references 75-88), conference papers (references 183-199) and workshop papers (references (362-371). Journals included IEEE Transactions, ACM Transactions, etc. Conferences included the ACM SIG-Spatial International Conference on Advances in GIS, the biennial Symposium on Spatial and Temporal Databases, the International Conference on Geographic Information Sciences, the

ACM SIG-KDD International Conference on Data Mining, the SIAM International Conference on Data Mining, etc.

Grants: In 2023, we were fortunate to receive a center-scale ($20M) grant for an AI Institute for Climate-Land Interactions, Mitigation, Adaptation, Tradeoffs and Economy (AICLIMATE).

The spatial computing research was also supported by grants from NSF ("HDR Institute: iHARP-Harnessing Data and Model Revolution in the Polar Regions", "EAGER: Spatio-temporal Big Data Analysis to Understand COVID-19 Effects", "Spatio-temporal Informatics for Transportation Science", "Connecting the Smart-City Paradigm with a Sustainable Urban Infrastructure Systems Framework to Advance Equity in Communities," "Investigating Spatial Big Data for Next Generation Routing Services" , and "Midwest Big Data Hub: Building Communities to Harness the Data Revolution National Science Foundation"), USDOD ("Identifying Aberration Patterns in Multi-Attribute Trajectory Data with Gaps", "Identifying and Analyzing Patterns of Evasion"), USDOE/E-ARPA "Improving the Freight Productivity of a Heavy-Duty, Battery Electric Truck", "Cloud-Connected Delivery Vehicles: Boosting Fuel Economy Using Physics-Aware Spatio-temporal Data Analysis and Real-Time Powertrain Control"), USDA/NIFA SCRI ("WinterTurf: A Holistic Approach to Understanding the Mechanisms and Mitigating the Effects of Winter Stress on Turfgrasses in Northern Climate", "Increasing Low-Input Turfgrass Adoption Through Breeding, Innovation, and Public Education"), etc.

9.2   Teaching and Mentoring Highlights

Teaching-related Recognitions: included a Certificate for outstanding teaching and dedication to helping students learn, Center for Educational Innovation, University of Minnesota, Fall 2020.

Summary of Advising and Mentoring: Alumnus Prof. Zhe Jiang (2016 Ph.D.) joined the Computer Science faculty of the University of Florida (Gainesville) and Prof. Yiqun Xie joined the GIS faculty at the University of Maryland (College Park).

During last four years, four PhD students graduated including Prof. Yiqun Xie (a faculty member at University of Maryland, College Park). Dr. Yan Li (Amazon Last Mile), and Dr. Jayant Gupta (Oracle).

Current Ph.D. students include Arun Sharma (passed thesis proposal examination in Spring 2023), Majid Farhadloo (passed WPE), Mingzhou Yang (passed WPE), Subhankar Gupta (passed WPE), Ruolei Zeng and Shuai An.

All Ph.D. students were supported during all semesters. Some received doctoral dissertation fellowship (Sharma). Most semester, one Ph.D. student served as a teaching assistant in a course I was teaching. Almost all other Ph.D. students were supported via research grants or fellowships.

In addition, 3 MS students graduated. These include Alexander Long, Haoming Li and Divya Shrinivasa Nairy.

Our group also hosted year-long visits from international Ph.D. students, namely, Ning Guo (supported by the National University of Defense Technology, China). Furthermore, we hosted a UROP student (Gaoxing Luo) in 2020-21. We also hosted year-long visits from highschool students, namely Yuv Magan (Wayzata HS), Srinath Hariharan (Wayzata HS), Samantha Detor and Abigail Roh (Breck HS), and Aditya Kulkarni (Eden Preraie HS). Srinath is currently with U. C. Berkeley. post participation in the International Science and Engineering Fair by the Twincities Regional Science Fair. Aditya is with Yale University after presenting his work at a NSF workshop on COVID-19. Samantha and Abigail won awards at MN state science fairs and are at Yale University and Columbia University respectively.

Other teaching-related efforts: I co-authored a book on spatial computing (MIT Press, 2020) for general professional audience. MIT Press Essential Knowledge Series requested this project given great demand for this topic by broad professional audience.

We have started development of a book on spatial data science due to rising demand for the topic.

9.3   Service Highlights
9.3.1   Service to Department, College and University

- Associate Director, Data Science Initiative, College of Science and Enginering, University of Minnesota (9/1/2022 - 8/31/2025).
- Member, College of Science and Engineering Research Advisory Committee, 7/2022-6/2024.
- Member, University of Minnesota Senate Research Committee, 7/2019-6/2025.

- Member, College Committee to Evaluate candidates for Director, Technology Leadership Institute , 11/2 020 - 2/2021.
- Member, College Committee to Evaluate Head of the Computer Sc. and Eng. Department, 11/2019-2/2020.
- Served as a member of the ¡F6¿ntenured faculty evaluation committee (2023-24), teaching faculty evaluation committee (2022-23), the chair for departmental teaching load measurement committee (2021-2022) and departmental untenured faculty evaluation committee (2020-2021). Also served on committees for WPE (2020-2021), graduate admissions (2016-2018, 2020-2021), faculty recruiting (2017-20), untenured faculty evaluation (2018-2020), 50th anniversary celebration (2018-19), and strategic planning (2018-19),

9.3.2 Service to Profession

- General Co-Chair, SIAM International Conference on Data Mining, 2024.
- General Co-Chair, SIAM International Conference on Data Mining, 2023.
- Co-Chair, Socially Responsible Computing Workgroup, Computing Research Association Workgroup, 2023-onwards.
- Lead, Computing, Climate and Sustainability subgroup Computing Research Association Workgroup on Socially Responsible Computing, 2023.
- Program co-chair for CRA Conference at Snowbird (2022), ACM SIGSpatial International Conference on Advance in GIS (2022).
- Program Co-Chair, ACM SIGSpatial International Conference on Advances in GIS, November, 2021.

- Member, Board of Directors, Computing Research Association (2016-2019, 2019-2022). Chair of the sub-committee on Faculty Recruiting (2019-2020).
- Co-editor-in-chief for the Springer journal titled "GeoInformatica: An International Journal on Advances of Computer Sciences for GIS"
- Member, IEEE Fellows Committee to evaluate Fellow Nominations, IEEE Computer Society, 2012, 2013, 2014, 2015, 2018, 2020, 2021, 2022, 2023.
- Member, NSF Panels, January 2020, July 2020, January 2021, March 2021, May 2021, October 2021.
- Co-organizer, Special Session on Water and Big Data, Universities Council on Water Resources (UCOWR)/ National Institute for Water Resources (NIWR) Annual Water Resources Conference, June 810, 2021.
- Guest Co-Editor, Special Issue on Big Spatiotemporal Data Analytics, International Journal of Geographic Information Science, Volume 34, 2020 - Issue 6, Taylor and Francis.
- Co-organizer, ACM SIGKDD International Workshop on Deep Learning for Spatiotemporal Data, Applications, and Systems (DeepS patial 2021), August 2021.
- Senior Program Committee Member, 26th ACM SIGKDD Conference on Knowledge Discovery and Data Mining, August 22 - 27, 2020.
- Senior Program Committee Member, ACM SIGSpatial International Conference on Advances in GIS, November , 2020.
- Chair, CRA/CCC Panel Discussion on Using Computing to Sustainably Feed a Growing Population, American Association for the Advancement of Sciences Annual Meeting, February 14th-16th, 2020.
- Chair, Endowment for International Symposium on Spatial and Temporal Databases (2016-2020).
- In 2021, I co-led a Computing Community Consortium white-paper titled *A National Research Agenda for Intelligent Infrastructure: 2021 Update* to make a case for new research funding to computing community.

9.4   Other Requested Information

- **Goals for 2024:** Major 2023 goals include (a) Set AI-CLIMATE on path to success (b) Continue mentoring Prof. Yao-Yi Chiang, (c) successful organization of the 2024 SIAM International Conference on Data Mining and (d) Make progress on a book on spatial data science.
- **What the department can do to help you achieve these goals?** Large center-scale projects (e.g., AI-CLIMATE, NSF HDR Institute) take a substantial amount of time. It is not possible to carry these out while carrying full teaching and service load. The department can provide relief from teaching and service to help.
- **Awards for which I may qualify** include (a) CSE Distinguished Professor, and (b) President's Community Engaged Scholar Award. Relevant activities for the latter include the assistance to local and state government during COVID-19 to analysis mobility big data (2020-21), evacuation route planning (2005), and other collaborations. Relevant activities for the latter include catalyzing formation of U-Spatial in research computing, chairing Senate Awards and Honors committee, etc.
- **Diversity, recruiting, and outreach activities** I co-organized a Big Data Workshop for the Geoscience Alliance Conference, which brought hundreds of students from underrepresented communities (e.g., native American) to campus in July 2022. In addition, I have hosted multiple high-school students for year-long research experiences.