Hongwei Zhang

Iowa State University
Electrical and Computer Engineering
311 Durham Center, 613 Morrill Road
Ames, Iowa 50011, USA

Phone: +1 614 286 3246
Skype/WeChat: hzhang_cse
hongwei@iastate.edu
http://www.ece.iastate.edu/~hongwei

Research Interests

◇ Areas:
- *Cyber-physical-human systems*: augmented reality, smart energy grid, connected and automated vehicles, industrial automation, smart and connected health, real-time collaborative 3D vision, predictable wireless networking, co-design of wireless networking and networked sensing and control, multiscale architectures and systems
- *Wireless sensing and control networks*: predictability-centered design, network planning, real-time network capacity, capacity-achieving protocols, wireless interference, network dynamics & uncertainties
- *Dependable networked systems*: dependable middleware, fault-tolerant network protocols, fault containment, self-stabilization, security

◇ Methodologies:
- *Science and engineering of experimentation*: measurement-based modeling and analysis, software-defined infrastructures, open-innovation platforms and testbeds, real-time cyber-physical emulation, resource management in cyber-physical experimental infrastructures
- *Theory*: control, optimization, machine learning, formal methods

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Education

◇ *Ph.D.*, Computer Science & Engineering, The Ohio State University, August 2006

◇ *M.S.*, Computer Engineering, Chongqing University, China, June 2000

◇ *B.S.*, Computer Engineering, Chongqing University, China, June 1997

Experience

◇ *Associate Professor*, Wayne State University, August 2012 -

◇ *Visiting Researcher*, Ford Research, June 2013 - April 2014

◇ *Assistant Professor*, Wayne State University, January 2007 - July 2012

◇ *Instructor*, Wayne State University, August 2006 - December 2006

◇ *Research Intern*, Motorola Labs, June 2005 - September 2005

◇ *Graduate Research Associate*, The Ohio State University, September 2001 - August 2006

Honors & Awards

◇ Annual Best Paper Award, Journal of Systems Science and Complexity (Springer), 2016

◇ Best Demo Award, 23rd National Science Foundation (NSF) GENI Engineering Conference, 2015

◇ Best Demo Award, 21st NSF GENI Engineering Conference, 2014

◇ Best Demo First Runner-up Award, 20th NSF GENI Engineering Conference, 2014

◇ NSF CAREER Award, 2011

◇ Spotlight Paper of IEEE Transactions on Mobile Computing, November 2010

◇ Best Paper Candidate, IEEE International Conference on Network Protocols (ICNP), 2010

◇ Excellence in Teaching Award, College of Liberal Arts and Sciences, Wayne State University, 2009

◇ Outstanding Research Award, Department of Computer Science and Engineering, The Ohio State University, 2006

◇ Graduate Fellow, The Ohio State University, 2000

◇ Honorable Mention in the International Mathematical Contest in Modeling, USA, 1997

◇ Distinguished Graduate of Sichuan Province, China, 1997

◇ Certificate of Software Engineer, Bureau of Computer Software Engineer Qualification Test, China, 1996

◇ Second Prize in the National Mathematical Contest in Modeling, China, 1995

◇ Distinguished Student, Chongqing University, China, 1993 - 1997

◇ Scholarships:
- BIRS/MSRI Scholarship, International Workshop on Self-stabilizing Distributed Systems, 2004
- SIEMENS Prize, SIEMENS Ltd., Germany, 1998
- IDG China Computer-World Scholarship, 1997
- Longfuhang Scholarship, Longfuhang Ltd., Taiwan, 1996
- Baoshan Scholarship for Distinguished Students, Shanghai Baoshan Ltd., China, 1995
- Highest-Rank Scholarship for Outstanding Students, Chongqing University, China, 1993 - 1997

◇ Honor/Professional Societies:
- Senior Member, Institute of Electrical and Electronics Engineers (IEEE), 2013
- Phi Kappa Phi, Upsilon Pi Epsilon
- Inclusion in *Mobius365 American Men and Women of Science*, 2015
- Inclusion in *Biltmore Who's Who Among Executives and Professionals*, 2011
- Inclusion in *Madison Who's Who Among Executives and Professionals*, 2010
- Inclusion in *Man of The Year in Education, American Biographical Institute*, 2009
- Inclusion in *Cambridge Who's Who*, 2008
- Inclusion in *AcademicKeys Who's Who in Sciences Higher Education*, 2008
- Inclusion in *Strathmore's Who's Who*, 2007
- Inclusion in *Marquis Who's Who in Science and Engineering*, 2006
- Inclusion in *Marquis Who's Who in America*, 2005
- Member of SIEMENS International Student Circle, SIEMENS Ltd., Germany, 1999

Funding

External Funding:

Summary statistics:
- Nine NSF awards (including serving as the PI for a CAREER award and five inter-disciplinary-project awards), three industry awards, and one foundation award
- Total funding: $4,202,703 Total funding as PI: $2,742,703

- ◇ PI, **NSF US Ignite** program, "Predictable Wireless Networking and Collaborative 3D Reconstruction for Real-Time Augmented Vision", 10/01/2016 - 09/30/2019; Co-PIs: Jing Hua, Jayanthi Rao, Anthony Holt; Funding: $600,000, Zhang's share: $300,000
- ◇ PI, **NSF CAREER/NeTS** program, "Taming Uncertainties in Reliable, Real-Time Messaging for Wireless Networked Sensing and Control", 09/01/2011 - 08/31/2018; Funding: $425,000
- ◇ WSU Site Lead, **NSF CRI** program, "CI-EN: ORBIT GEN 3 - Enhancing the ORBIT Testbed with LTE and Cloud Radio Processing", 07/02/2015 - 06/30/2018; PIs: Dipankar Raychaudhuri, Ivan Seskar, and Wade Trappe from Rutgers University; Zhang's share: three LTE base stations (∼$50,000 value)
- ◇ PI, **NSF CPS** program (medium size), "A Cross-Layer Approach to Taming Cyber-Physical Uncertainties in Vehicular Wireless Networking and Platoon Control", 09/01/2011 - 08/31/2015; Co-PIs: Le Yi Wang, George Yin; Funding: $900,000, Zhang's share: $370,016
- ◇ PI, **NSF GENI** program, "GENI-Enabled Vehicular Sensing and Control Networking: from Experiments to Applications", 10/01/2013 - 09/31/2015; Co-PIs: Jing Hua, Jayanthi Rao (Ford Research), Weidong Xiang (University of Michigan - Dearborn), Gorge Riley (Georgia Institute of Technology), Patrick Gossman, Anthony Holt; Funding: $266,388, Zhang's share: $192,568
- ◇ PI, **Ford Research**, "Reliable Inter-Vehicle Broadcast for Networked Fuel Economy Optimization", 09/01/2013 - 04/30/2014; Funding: $58,111
- ◇ PI, **NSF GOALI/NeTS** program, "Predictable, Real-Time Inter-Vehicle Wireless Communication for Fuel Economy and Emission Control", 05/01/2013 - 08/31/2013; Co-PIs: Jayanthi Rao (Ford Research), Hai Yu (Ford Research); Funding: $69,999, Zhang's share: $69,999
- ◇ PI, **NSF GENI** program, "WiMAX Prototyping in Metro Detroit: Integrating GENI Engineering with Wireless Network Applications and Science", 10/01/2011 - 09/31/2014; Co-PIs: TJ Giuli (Ford Research), Jayanthi Rao (Ford Research), Jing Zhu (Intel), Xiangying Yang (Intel), Patrick Gossman; Total funding: $298,890 + WiMAX base stations + in-kind from Ford, Intel, and CTN, Zhang's share: $298,890 + three WiMAX base stations (∼$50,000 value)
- ◇ WSU Site Lead, **NSF GENI** program, "Network-Agile Multi-Provisioned Infrastructure for GENI and ExoGENI", 10/01/2011 - 09/31/2014; PIs: Ilia Baldine (RENCI), Jeff Chase (Duke University); Zhang's share: one ExoGENI rack server (∼$100,000 value)
- ◇ PI, **GM Research**, "Heterogeneous Wireless Connectivity Module for Urban Telematics Systems", 08/01/2011 - 03/31/2012; Funding: $59,841
- ◇ Co-PI & WSU PI, **NSF GENI** program, "GENI-fying and Federating Autonomous Kansei Wireless Sensor Networks", 10/01/2008 - 09/31/2011; PI: Anish Arora, Co-PIs: Rajiv Ramnath, Vipul Gupta, Sami Ayyorgun; Total funding: $500,000, Zhang's share: $127,874
- ◇ PI, **Ford Research**, "Vehicular Networking for Connected Caravanning", 12/02/2010 - 05/18/2011; Funding: $14,474
- ◇ Senior Personnel, **Knight Foundation**, *Detroit Connected Community Initiative*, 12/01/2009 - 12/31/2011; Total funding: $810,000 for systems and service cost in establishing two Internet-connected wireless mesh communities in Detroit; Zhang's work is voluntary

Wayne State University Internal Funding:

- ◇ PI, **Research Equipment Program**, "Real-Time Networked 3D Urban Sensing Platform", 2015; Funding: $49,828
- ◇ PI, **Faculty GRA Competition**, "Real-Time Vehicular Wireless Networking for Fuel Economy and Emission Control", 2015; Funding: ∼$30,000
- ◇ PI, **Omnibus Education Fund**, "Software-Defined Radio Infrastructure for Hands-on Learning of Computer Networks, Distributed Systems and Embedded Systems", 2012; Funding: $19,600
- ◇ PI, **Omnibus Education Fund**, "Portable Wireless Platforms for Hands-on Learning of Computer Networks, Distributed Systems and Embedded Systems", 2011; Funding: $7,330
- ◇ PI, **Faculty GRA Competition**, "Intelligent Sensing and Wireless Networking for Smart Energy Grids with Alternative-Energy Sources", 2010; Co-PI: Caisheng Wang, Feng Lin; Funding: ∼$30,000
- ◇ PI, **Faculty Research Grant**, "Predictable Wireless Networking for Vehicular Cyber-Physical Systems", 2009; Funding: $10,000
- ◇ Co-PI, **Faculty GRA Competition**, "Hierarchical and Distributed Control for Alternative-Energy Cyber-Physical Systems", 2009; PI: Caisheng Wang, Co-PI: Feng Lin; Funding: ∼$30,000

Impact of Research (selected)

- ◇ Our research has laid a foundation for trustworthy wireless networking in mission-critical cyber-physical-human systems. For instance, our Physical-Ratio-K (PRK) wireless interference model and the PRK-based wireless transmission scheduling protocol PRKS ensure predictable interference control and high channel spatial reuse at the same time, which has been an open problem since early 1970s. Our multi-scale approach to real-time routing ensures probabilistic real-time guarantee in multi-hop data delivery in the presence of fast-varying, uncertain path delays and despite the NP-hardness of checking the delay distribution along any single path.
- ◇ Our findings on data-driven link estimation and routing in multi-hop wireless networks have been widely accepted and impacted systems practice; for instance, the default TinyOS routing protocol (i.e., Collection Tree Protocol) incorporates the idea of data-driven link estimation.
- ◇ Our transport protocol Reliable-Bursty-Convergecast (RBC) and our data-driven link estimation and routing protocol Learn-on-the-Fly (LOF) have served as foundational elements of the DARPA sensor network systems "A Line in the Sand" and "ExScal" which, with its 1,200-node mote network and 200-node 802.11b mesh network, was the world's largest wireless sensor network and mesh network deployed at its time.
- ◇ Our software-defined infrastructure *OpenCAV* is the first real-world infrastructure for cross-disciplinary innovation in connected and automated vehicles, and it is an important milestone in enabling collaborative, open innovation in traditionally-closed, safety-critical systems.
- ◇ Our *NetEye* wireless sensor network testbed has been used by researchers across the world.
- ◇ Citation of publications: 3,165+

Journal & Magazine Papers

- ◇ Hongwei Zhang, Xiaohui Liu, Chuan Li, Yu Chen, Xin Che, Feng Lin, Le Yi Wang, George Yin, "Scheduling with Predictable Link Reliability for Wireless Networked Control", *IEEE Transactions on Wireless Communications (TWC)*, accepted for publication

◇ Shengbo Eben Li, Yang Zheng, Keqiang Li, Feng Gao, Yujia Wu, Hongwei Zhang, J. Karl Hedrick, "Dynamical Modeling and Distributed Control of Connected and Automated Vehicles: Challenges and Opportunities", *IEEE Intelligent Transportation Systems*, 9(3):46-58, 2017

◇ Xiangmao Chang, Jun Huang, Shucheng Liu, Guoliang Xing, Hongwei Zhang, Jianping Wang, Liusheng Huang, Yi Zhuang, "Accuracy-aware Interference Modeling and Measurement in Wireless Sensor Networks", *IEEE Transactions on Mobile Computing (TMC)*, 15(2):278-291, 2016

◇ Yuehua Wang, Yu Chen, Chuan Li, Hongwei Zhang, Jayanthi Rao, TJ Giuli, Patrick Gossman, Xiangying Yang, Jing Zhu, "VInsight: Enabling Open Innovation in Networked Vehicle Sensing and Control", *IEEE Network*, July/August 2016

◇ Rajit Johri, Jayanthi Rao, Hai Yu, Hongwei Zhang, "A Multi-Scale Spatiotemporal Perspective of Connected and Automated Vehicles: Applications and Wireless Networking", *IEEE Intelligent Transportation Systems*, 8(2):65-73, 2016 (Authors in alphabetic order)

◇ Lijian Xu, Le Yi Wang, George Yin, Hongwei Zhang, "Impact of Communication Erasure Channels on Safety of Highway Vehicle Platoons", *IEEE Transactions on Intelligent Transportation Systems (TITS)*, 16(3):1456-1468, June 2015

◇ Zhixin Yang, George Yin, Le Yi Wang, Hongwei Zhang, "A Mean-Variance Control Framework for Platoon Control Problems: Weak Convergence Results and Applications on Reduction of Complexity", *Communications in Information and Systems*, special issue "Dedicated to Wing Shing Wong on the occasion of his 60th Birthday", 15(1), 2015

◇ Xiaohui Liu, Yu Chen, Hongwei Zhang, "A Maximal Concurrency and Low Latency Distributed Scheduling Protocol for Wireless Sensor Networks", *International Journal of Distributed Sensor Networks (Hindawi)*, 2015 (invited paper)

◇ Lijian Xu, Le Yi Wang, George Yin, Hongwei Zhang, "Communication Information Structures and Contents for Enhanced Safety of Highway Vehicle Platoons", *IEEE Transactions on Vehicular Technology (TVT)*, 63(9), November 2014

◇ Xin Che, Hongwei Zhang, Xi Ju, "The Case for Addressing the Ordering Effect in Interference-Limited Wireless Scheduling", *IEEE Transactions on Wireless Communications (TWireless)*, 13(9), September 2014 (A short version appeared in IEEE ICNP'11.)

◇ Le Yi Wang, Ali Syed, George Yin, Abhilash Pandya, Hongwei Zhang, "Control of Vehicle Platoons for Highway Safety and Efficient Utility: Consensus with Communications and Vehicle Dynamics", *Journal of Systems Science and Complexity (Springer)*, 27(4), 2014 (**Annual Best Paper Award**)

◇ Hongwei Zhang, Xin Che, Xiaohui Liu, Xi Ju, "Adaptive Instantiation of the Protocol Interference Model in Wireless Networked Sensing and Control", *ACM Transactions on Sensor Networks (TOSN)*, 10(2), January 2014 (A short version appeared in IEEE SECON'10.)

◇ Zhixin Yang, George Yin, Le Yi Wang, Hongwei Zhang, "Near-Optimal Mean-Variance Controls under Two-time-scale Formulations and Applications", *Stochastics*, 85(4), 2013

◇ Xiaohui Liu, Hongwei Zhang, Qiao Xiang, Xin Che, Xi Ju, "Taming Uncertainties in Real-Time Routing for Wireless Networked Sensing and Control", *IEEE Transactions on Smart Grid (TSG)*, special issue on "Smart Grid Communication Systems", 4(1), March 2013 (A short version appeared in ACM MobiHoc'12.)

◇ Wenfeng Du, Zhong Ming, Wei Nie, Hongwei Zhang, "A Remainder-Based Contention Avoidance Scheme for Saturated Wireless CSMA Networks", *IEEE Transactions on Vehicular*

Technology (TVT), 62(2), February 2013

- ◇ Xi Ju, Hongwei Zhang, Divya Sakamuri, "NetEye: A User-Centered Wireless Sensor Network Testbed for High-Fidelity, Robust Experimentation", *International Journal of Communication Systems (Wiley)*, 25(9), September 2012
- ◇ Junhui Zhao, Yi-Liang Chen, Zhong Chen, Feng Lin, Caisheng Wang, Hongwei Zhang, "Modeling and Control of Discrete Event Systems Using Finite State Machines with Variables and Their Applications in Power Grids", *Systems & Control Letters (Elsevier)*, 61(1), 2012
- ◇ Qiao Xiang, Hongwei Zhang, Jinhong Xu, Xiaohui Liu, Loren J. Rittle, "When In-Network Processing Meets Time: Complexity and Effects of Joint Optimization in Wireless Sensor Networks", *IEEE Transactions on Mobile Computing (TMC)*, 10(10), October 2011 (A short version appeared in IEEE RTSS'09.)
- ◇ Hongwei Zhang, "Experimental Analysis of Link Estimation Methods in Low Power Wireless Networks", *Tsinghua Science and Technology (Elsevier/Tsinghua)*, special issue on "Wireless Mobile Computing and Networking", 16(5), October 2011 (Invited paper; a short version appeared in WASA'11.)
- ◇ Hongwei Zhang, Lifeng Sang, Anish Arora, "Comparison of Data-driven Link Estimation Methods in Low-power Wireless Networks", *IEEE Transactions on Mobile Computing (TMC)*, 9(11), November 2010 (A short version appeared in IEEE SECON'09.) (**Spotlight Paper of the November 2010 issue of TMC**)
- ◇ Lifeng Sang, Anish Arora, Hongwei Zhang, "On Link Asymmetry and One-way Estimation in Wireless Sensor Networks", *ACM Transactions on Sensor Networks (TOSN)*, 6(2), February 2010 (A short version appeared in ACM MobiHoc'07.)
- ◇ Hongwei Zhang, Lifeng Sang, Anish Arora, "On the Convergence and Stability of Data-driven Link Estimation and Routing in Sensor Networks", *ACM Transactions on Autonomous and Adaptive Systems (TAAS)*, special issue on "Self-adaptive and Self-organizing Wireless Networking Systems", 4(3), July 2009 (Acceptance rate: $10\% = 4/40$; A short version appeared in WICON'08.)
- ◇ Hongwei Zhang, Anish Arora, Prasun Sinha, "Link Estimation and Routing in Sensor Network Backbones: Beacon-based or Data-driven?", *IEEE Transactions on Mobile Computing (TMC)*, 8(5), May 2009 (A short version appeared in IEEE INFOCOM'06.)
- ◇ Hongwei Zhang, Anish Arora, Young-ri Choi, Mohamed Gouda, "Reliable Bursty Convergecast in Wireless Sensor Networks", *Computer Communications (Elsevier)*, special issue on "Sensor-Actuator Networks", 30(13), September 2007 (Acceptance rate: $< 20\%$; A short version appeared in ACM MobiHoc'05.)
- ◇ Vinayak Naik, Anish Arora, Prasun Sinha, Hongwei Zhang, "Sprinkler: A Reliable and Energy Efficient Data Dissemination Service for Extreme Scale Wireless Networks of Embedded Devices", *IEEE Transactions on Mobile Computing (TMC)*, 6(7):762-776, July 2007 (A short version appeared in IEEE RTSS'05.)
- ◇ Hongwei Zhang, Anish Arora, "Guaranteed Fault Containment and Local Stabilization in Routing", *Computer Networks (Elsevier)*, 50(18):3585-3607, December 2006
- ◇ Anish Arora, Hongwei Zhang, "LSRP: Local Stabilization in Shortest Path Routing", *IEEE/ACM Transactions on Networking (TON)*, 14(3):520-531, June 2006 (Authors in alphabetic order; a short version appeared in IEEE-IFIP DSN'03.)

◇ Young-ri Choi, Mohamed Gouda, Hongwei Zhang, Anish Arora, "Stabilization of Grid Routing in Sensor Networks", *AIAA Journal of Aerospace Computing, Information, and Communication*, 3:214-233, May 2006

◇ A. Arora, P. Dutta, S. Bapat, V. Kulathumani, Hongwei Zhang, V. Naik, V. Mittal, H. Cao, M. Demirbas, M. Gouda, Y. R. Choi, T. Herman, S. Kulkarni, U. Arumugam, Mikhail Nesterenko, A. Vora, M. Miyashita, "A Line in the Sand: A Wireless Sensor Network for Target Detection, Classification, and Tracking", *Computer Networks (Elsevier)*, 46(5):605-634, December 2004 (**Second most downloaded paper of the year**)

◇ Hongwei Zhang, Anish Arora, "GS^3: Scalable Self-configuration and Self-healing in Wireless Sensor Networks", *Computer Networks (Elsevier)*, 43(4):459-480, November 2003 (Acceptance rate: 24% = 6/25; A short version appeared in ACM PODC'02.)

Conference Papers

◇ Yu Chen, Hongwei Zhang, "Optimal Request Clustering for Link Reliability Guarantee in Wireless Networked Control", *IEEE Wireless Communications and Networking Conference (WCNC)*, 2017

◇ Abhimanyu Gosain, Mark Berman, Marshall Brinn, Thomas Mitchell, Chuan Li, Yuehua Wang, Hai Jin, Jing Hua, Hongwei Zhang, "Enabling Campus Edge Computing using GENI Racks and Mobile Resources", *IEEE/ACM Symposium on Edge Computing (SEC)*, 2016

◇ Hongwei Zhang, Xiaohui Liu, Chuan Li, Yu Chen, Xin Che, Feng Lin, Le Yi Wang, George Yin, "Scheduling with Predictable Link Reliability for Wireless Networked Control", *IEEE/ACM International Symposium on Quality of Service (IWQoS)*, 2015 (Acceptance rate: 22.2% = 20/90)

◇ Qiao Xiang, Hongwei Zhang, Jianping Wang, Guoliang Xing, Shan Lin, Xue Liu, "On Optimal Diversity in Network-Coding-Based Routing in Wireless Networks", *34th IEEE International Conference on Computer Communications (INFOCOM)*, 2015 (Acceptance rate: 19% = 316/1640)

◇ Hongwei Zhang, Fan Bai, Xi Ju, "Heterogeneous Vehicular Wireless Networking: A Theoretical Perspective", *IEEE Wireless Communications and Networking Conference (WCNC)*, 2015

◇ Zhixin Yang, Le Yi Wang, George Yin, Qing Zhang, Hongwei Zhang, "Applications of Numerical Methods for Stochastic Controlled Switching Diffusions with A Hidden Markov Chain – Case Study on Distributed Power Management and Communication Resource Allocation", *6th Conference on Finite Difference Methods: Theory and Applications*, 2014

◇ George Yin, Le Yi Wang, Hongwei Zhang, "Stochastic Approximation - Powerful Tools for Simulation and Optimization: A Survey of Some Recent Work on Multi-Agent Systems and Cyber-Physical Systems", *ICNPAA Congress: Mathematical Problems in Engineering, Aerospace and Sciences*, 2014

◇ Lijian Xu, Le Yi Wang, George Yin, Hongwei Zhang, "Impact of Package Delivery Rate on the Safety of Highway Vehicle Platoons", *IEEE Intelligent Vehicles Symposium (IV)*, 2014

◇ Lijian Xu, Le Yi Wang, George Yin, Hongwei Zhang, "Coordinated Control and Communication for Enhanced Safety of Highway Vehicle Platoons", *International Conference on Connected Vehicles and Expo (ICCVE)*, 2013

◇ Xiaohui Liu, Hongwei Zhang, Qiao Xiang, Xin Che, Xi Ju, "Taming Uncertainties in Real-Time Routing for Wireless Networked Sensing and Control", *13th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, 2012 (Acceptance rate: 20% = 24/120)

- ◇ Le Yi Wang, Ali Syed, George Yin, Abhilash Pandya, Hongwei Zhang, "Coordinated Vehicle Platoon Control: Weighted and Constrained Consensus and Communication Network Topologies", *51st IEEE Conference on Decision and Control (CDC)*, 2012
- ◇ Feng Lin, Michael Polis, Caisheng Wang, Le Yi Wang, Hongwei Zhang, "Hierarchical Control and Management of Virtual Microgrids for Vehicle Electrification", *IEEE Transportation Electrification Conference and Expo (ITEC)*, 2012
- ◇ Xin Che, Xi Ju, Hongwei Zhang, "The Case for Addressing the Limiting Impact of Interference on Wireless Scheduling", *19th IEEE International Conference on Network Protocols (ICNP)*, 2011 (Acceptance rate: 16% = 31/189)
- ◇ Jun Huang, Shucheng Liu, Guoliang Xing, Hongwei Zhang, Jianping Wang, Liusheng Huang, "Accuracy-Aware Interference Modeling and Measurement in Wireless Sensor Networks", *31st IEEE International Conference on Distributed Computing Systems (ICDCS)*, 2011 (Acceptance rate: 15%)
- ◇ Hongwei Zhang, "Experimental Analysis of Link Estimation Methods in Low Power Wireless Networks", *6th International Conference on Wireless Algorithms, Systems, and Applications (WASA)*, 2011 (Review scores: 5, 5, 4 out of 5)
- ◇ Junhui Zhao, Zhong Chen, Feng Lin, Caisheng Wang, Hongwei Zhang, "Safety Control of PHEVs in Distribution Networks Using Finite State Machines with Variables", *North American Power Symposium (NAPS)*, 2011
- ◇ Shucheng Liu, Guoliang Xing, Hongwei Zhang, Jianping Wang, Jun Huang, Mo Sha, Liusheng Huang, "Passive Interference Measurement in Wireless Sensor Networks", *18th IEEE International Conference on Network Protocols (ICNP)*, 2010 (Acceptance rate: 18.2% = 31/170) (**Best Paper Candidate**, 6 out of 170 submissions)
- ◇ Xin Che, Xiaohui Liu, Xi Ju, Hongwei Zhang, "Adaptive Instantiation of the Protocol Interference Model in Mission-Critical Wireless Networks", *7th IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, 2010 (Acceptance rate: 21% = 63/300)
- ◇ Mukundan Sridharan, Wenjie Zeng, William Leal, Xi Ju, Rajiv Ramnath, Hongwei Zhang, Anish Arora, "From Kansei to KanseiGenie: Architecture of Federated, Programmable Wireless Sensor Fabrics", *6th International Conference on Testbeds and Infrastructures for the Development of Networks and Communities (TridentCom)*, 2010
- ◇ Qiao Xiang, Jinhong Xu, Xiaohui Liu, Hongwei Zhang, Loren J. Rittle, "When In-Network Processing Meets Time: Complexity and Effects of Joint Optimization in Wireless Sensor Networks", *30th IEEE Real-Time Systems Symposium (RTSS)*, 2009 (Acceptance rate: <20%)
- ◇ Hongwei Zhang, Lifeng Sang, Anish Arora, "Comparison of Data-driven Link Estimation Methods in Low-power Wireless Networks", *6th IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, 2009 (Review scores: 5, 5, 4 out of 5; Acceptance rate: 18.8% = 81/431)
- ◇ Hongwei Zhang, Lifeng Sang, Anish Arora, "On Biased Link Sampling in Data-driven Link Estimation and Routing in Low-power Wireless Networks", 4th International Wireless Internet Conference (WICON), 2008 (invited paper)
- ◇ Lifeng Sang, Anish Arora, Hongwei Zhang, "On Exploiting Asymmetric Wireless Links via One-way Estimation", *8th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, 2007 (Acceptance rate: 18% = 27/146)

- ◇ Hongwei Zhang, Anish Arora, Prasun Sinha, "Learn on the Fly: Data-driven Link Estimation and Routing in Sensor Network Backbones", *25th IEEE International Conference on Computer Communications (INFOCOM)*, 2006 (Acceptance rate: 18% = 252/1400)
- ◇ E. Ertin, A. Arora, R. Ramnath, M. Nesterenko, V. Naik, S. Bapat, V. Kulathumani, M. Sridharan, Hongwei Zhang, H. Cao, "Kansei: A Testbed for Sensing at Scale", *5th IEEE/ACM International Conference on Information Processing in Sensor Networks, Special Track on Platform Tools and Design Methods for Network Embedded Sensors (IPSN/SPOTS)*, 2006
- ◇ Hongwei Zhang, Anish Arora, Young-ri Choi, Mohamed Gouda, "Reliable Bursty Convergecast in Wireless Sensor Networks", *6th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, 2005 (Review scores: 4, 4, 4 out of 5; Acceptance rate: 14% = 40/281)
- ◇ Vinayak Naik, Anish Arora, Prasun Sinha, Hongwei Zhang, "Sprinkler: A Reliable Data Dissemination Service for Wireless Embedded Devices", *26th IEEE Real-Time Systems Symposium (RTSS)*, 2005
- ◇ A. Arora, R. Ramnath, E. Ertin, P. Sinha, S. Bapat, V. Naik, V. Kulathumani, Hongwei Zhang, H. Cao, M. Sridhara, S. Kumar, N. Seddon, C. Anderson, T. Herman, N. Trivedi, C. Zhang, M. Gouda, Y. R. Choi, M. Nesterenko, R. Shah, S. Kulkarni, M. Aramugam, L. Wang, D. Culler, P. Dutta, C. Sharp, G. Tolle, M. Grimmer, B. Ferriera, K. Parker, "ExScal: Elements of an Extreme Scale Wireless Sensor Networks", *11th IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA)*, 2005
- ◇ Hongwei Zhang, Anish Arora, Zhijun Liu, "A Stability-oriented Approach to Improving BGP Convergence", *23rd IEEE Symposium on Reliable Distributed Systems (SRDS)*, 2004 (Acceptance rate: 23%)
- ◇ Anish Arora, Hongwei Zhang, "LSRP: Local Stabilization in Shortest Path Routing", *IEEE-IFIP International Conference on Dependable Systems and Networks (DSN)*, 2003 (Review scores: 5, 4, 4 out of 5; Acceptance rate: 21%)
- ◇ Hongwei Zhang, Anish Arora, "GS^3: Scalable Self-configuration and Self-healing in Wireless Networks", *21st ACM Symposium on Principles of Distributed Computing (PODC)*, 2002 (Acceptance rate: 29%)
- ◇ Hongwei Zhang, Arjan Durresi, "Differentiated Multi-Layer Survivability in IP/WDM Networks", *8th IEEE-IFIP Network Operations and Management Symposium (NOMS)*, 2002 (Acceptance rate: 32%)

Workshop & Short Conference Papers

- ◇ Fengwei Zhang, Hongwei Zhang, "SoK: A Study of Using Hardware-assisted Isolated Execution Environments for Security", *International Workshop on Hardware and Architectural Support for Security and Privacy (HASP)*, 2016 (in conjunction with IEEE/ACM ISCA'16)
- ◇ Xi Ju, Hongwei Zhang, Wenjie Zeng, Mukundan Sridharan, Jing Li, Anish Arora, Rajiv Ramnath, Yufeng Xin, "LENS: Resource Specification for Wireless Sensor Network Experimentation Infrastructures", *6th ACM International Workshop on Wireless Network Testbeds, Experimental evaluation and Characterization (WiNTECH)*, 2011
- ◇ Xiaohui Liu, Hongwei Zhang, Qiao Xiang, "Towards Predictable Real-Time Routing for Wireless Networked Sensing and Control", *Cyber-Physical-Systems (CPS) Week Workshop on Real-Time Wireless for Industrial Applications (RealWin)*, 2011
- ◇ Vinayak Naik, Emre Ertin, Hongwei Zhang, Anish Arora, "Wireless Testbed Bonsai", *2nd International Workshop on Wireless Network Measurement (WiNMee)*, 2006

◇ Hongwei Zhang, Anish Arora, "Brief Announcement: Continuous Containment and Local Stabilization in Path-vector Routing", *24th ACM Symposium on Principles of Distributed Computing (PODC)*, 2005 (Acceptance rate: 22%)

Book

◇ Hongwei Zhang, "Dependable Messaging in Wireless Sensor Networks", VDM Publishing House Ltd., Germany, 2009.

Book Chapters

◇ Kai Liu, Victor Lee, Sang Son, Joseph Ng, Jiannong Cao, Hongwei Zhang, "Cooperative Data Scheduling via V2V/V2I Communications in Software Defined Vehicular Networks", *Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications: A Technical Approach*, in press

◇ Ling Wang, Hongwei Zhang, "Power Control for Reliable M2M Communication", *From Internet of Things to Smart Cities: Enabling Technologies*, Springer, 2017

◇ Hongwei Zhang, Le Yi Wang, George Yin, Shengbo Eben Li, Keqiang Li, Jing Hua, Yeuhua Wang, Chuan Li, Hai Jin, "Trustworthy Foundation for CAVs in an Uncertain World: From Wireless Networking, Sensing, and Control to Software-Defined Infrastructure", *Road Vehicle Automation*, Springer, 2016

◇ Qiao Xiang, Hongwei Zhang, "In-Network Processing in Wireless Sensor Networks", *Handbook of Sensor Networking: Advanced Technologies and Applications*, CRC Press, 2015

◇ Mukundan Sridharan, Wenjie Zeng, William Leal, Xi Ju, Rajiv Ramnath, Hongwei Zhang, Anish Arora, "KanseiGenie: Software Infrastructure for Resource Management and Programmability of Wireless Sensor Network Fabrics", *Next Generation Internet Architectures and Protocols*, Krishna Moorthy Sivalingam et at. (editors), Springer, 2011

◇ Hongwei Zhang, Vinayak Naik, "Data Transport Control in Wireless Sensor Networks", *Handbook of Wireless Ad Hoc and Sensor Networks*, Sudip Misra, Isaac Woungang, and Subhas C. Misra (editors), Springer, 2009

◇ Divya Sakamuri, Hongwei Zhang, "Elements of Sensornet Testbed Design", *Handbook of Sensor Networks*, Yang Xiao, Hui Chen, and Frank H. Li (editors), World Scientific Publishing Co, 2009

◇ Hongwei Zhang, Anish Arora, Prasun Sinha, Loren J. Rittle, "Messaging in Sensor Networks: Addressing Wireless Communications and Application Diversity", *Handbook of Real-Time and Embedded Systems*, Insup Lee, Joe Leung, and Sang Son (editors), CRC Press, 2007

Posters

◇ Hongwei Zhang, Chuan Li, Yu Chen, Pengfei Ren, Ling Wang, "Predictable Wireless Networking for Real-Time Cyber-Physical-Human Systems", *ACM/IEEE International Conference on Internet-of-Things Design and Implementation (IoTDI)*, 2017

◇ Hongwei Zhang, Le Yi Wang, George Yin, Jing Hua, Yuehua Wang, "Trustworthy Foundation for CAVs in an Uncertain World: From Wireless Networking, Sensing, and Control to Software-Defined Innovation Platforms", *AUVSI/TRB Automated Vehicles Symposium (AVS)*, 2015

◇ Hongwei Zhang, Xiaohui Liu, Chuan Li, Yu Chen, Xin Che, Feng Lin, Le Yi Wang, George Yin, "PRK-Based Scheduling for Predictable Link Reliability in Wireless Networked Sensing and Control", *ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, 2013

◇ Anish Arora, Rajiv Ramnath, Hongwei Zhang, Vipul Gupta, Sami Ayyorgun, Mukundan Sridharan, Wenjie Zeng, Xi Ju, "KanseiGenie: Federated Sensing Platforms", *3rd NSF GENI Engineering Conference*, 2008

◇ Hongwei Zhang, Lifeng Sang, Anish Arora, Unraveling the Subtleties of Link Estimation and Routing in Wireless Sensor Networks, *ACM SIGCOMM*, 2008

◇ Anish Arora, Prasun Sinha, Emre Ertin, Vinayak Naik, Hongwei Zhang, Mukundan Sridhara, Sandip Bapat, "ExScal Backbone Network Architecture", *3rd ACM/USENIX International Conference on Mobile Systems, Applications, and Services (MobiSys)*, 2005

◇ Anish Arora, Rajiv Ramnath, Emre Ertin, Prasun Sinha, Sandip Bapat, Vinayak Naik, Vinod Kulathumani, Hongwei Zhang, et al., "Project ExScal", *International Conference on Distributed Computing in Sensor Systems (DCOSS)*, 2005

◇ Anish Arora, Emre Ertin, Rajiv Ramnath, Vinayak Naik, Sandip Bapat, Hongwei Zhang, Chris Anderson, Gavin Fox, John Wieseman, "Kansei: Sensor Network Testbed for At-Scale Experiments", *2nd TinyOS Technology Exchange*, 2005

Other Publications

◇ Fu Xiao, Ruchuan Wang, Limin Sun, Qun Li, Hongwei Zhang, and Liusheng Huang, "Editorial: Selected Papers from the 6th China Conference of Wireless Sensor Networks", *International Journal of Distributed Sensor Networks*, 2013

◇ Hongwei Zhang, "Dependable Messaging in Wireless Sensor Networks", *Ph.D. dissertation, The Ohio State University, USA*, 2006

◇ Hongwei Zhang, "An Engineering Network Security Model", *Master thesis, Chongqing University, China*, 2000

◇ Hongwei Zhang, "Efficient Database Transactions in Large Scale Networked Systems", *Journal of Computer Applications, Chinese Computer Federation*, August 1999

Patents

◇ Hongwei Zhang, "Multiscale Approach to Predictable Wireless Networking", U.S. Provisional Application #62436905

◇ Hongwei Zhang, Xiaohui Liu, Chuan Li, "PRK-Based Scheduling for Predictable Link Reliability", U.S. Provisional Application #61788,445, International Application #PCT/US2014/27055 for US, China, and Europe

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Systems Developed

◇ *OpenCAV: Software-Defined Infrastructures for Open, Cross-Disciplinary Innovation in Connected and Automated Vehicles*
Wayne State University (lead), Ford Research, Georgia Institute of Technology, University of Michigan - Dearborn, 2013 - present

As a first step towards establishing safety-critical CPS experimental infrastructures and for enabling collaborative innovation and concerted progress across different disciplines of networked vehicle systems, we have developed the *software-defined innovation infrastructure OpenCAV* for networked vehicle systems using virtualization, software-defined-radio (SDR), and emulation. We have developed *virtualization* techniques that virtualize not only the computing resources but also the sensing and wireless communication resources of our vehicle platform; the virtualized platform enables concurrent, non-interfering access to the same platform by different users, thus allowing the same experimental infrastructure to be leveraged by different disciplinary communities (e.g., networking and transportation communities) at the same time to advance different aspects of the field. For infrastructure

evolvability, the SDR of our vehicle platform enables re-defining properties (e.g., networking protocols) of the wireless radios without any hardware replacement; together with virtualization, the SDR enables incremental deployment of new technologies and applications, since the platform enables non-interfering execution of older and newer technologies and applications at the same time. Towards opening up the traditionally-closed vehicle systems for *open innovation*, we have integrated into our vehicle platform the open-source OpenXC sensing of vehicle internal state (e.g., engine speed, fuel consumption, and brake pedal position) as well as our own publicly-released camera-based sensing of vehicle external state (e.g., positions of surrounding vehicles and pedestrians). For enabling infrastructure *flexibility* and *high-fidelity* at the same time, we have developed a multidimensional emulation system for networked vehicles; the emulation system integrates at-scale simulation of networked vehicle systems in cloud computing infrastructures (e.g., NSF GENI compute servers) with in-field vehicle channel measurements as well as high-fidelity sensing of vehicle internal and external state.

OpenCAV has been deployed in Wayne State University police patrol vehicles, and, through the GENI WiMAX/LTE network on Wayne State University campus, the deployed vehicles are networked with the GENI backbone infrastructures to enable high-fidelity, flexible emulation of networked vehicle systems using our emulation software. OpenCAV has already been supporting simultaneous execution of real-world applications (e.g., vehicle-assisted real-time 3D vision) and vehicular sensing and control networking experiments on the same set of deployed vehicles (see `https://youtu.be/y_QxXAOMJzI`). The long-lived deployment and operation of OpenCAV on Wayne State University police patrol vehicles are expected to serve as live examples and convincing evidence for other related communities to consider OpenCAV for their deployments, thus enabling the viral deployment of connected and automated vehicles for experimentation and real-world use.

◇ *GENI WiMAX/LTE Network for Wireless Networked Cyber-Physical Systems*
Wayne State University (lead), Ford Research, Intel Labs, Community Telecommunications Network, 2011 - present

WiMAX/LTE employee cutting-edge wireless communication techniques such as MIMO and OFDMA, and they serve as basic platforms for evaluating broadband wireless access in real-world settings. WiMAX/LTE is expected to play a major role in areas such as smart grid, smart transportation, vehicular infotainment, and community Internet access. Towards building an experimental infrastructure for research, education, and application exploration, we have deployed a three-sector/cell WiMAX/LTE network in Metro Detroit which supports handoff, virtualization, and scientific measurement. The WiMAX/LTE network is connected via VLAN to the GENI backbone network. We have also developed and deployed WiMAX/LTE mobile station platforms that support scientific measurement as well as application exploration. This GENI WiMAX/LTE network enables research, education, and application exploration in smart transportation, smart grid, wireless networked sensing and control, and community services.

◇ *ExoGENI: Network-Agile Multi-Provisioned Infrastructure for GENI*
RENCI/UNC Chapel Hill (lead), GPO/BBN Raytheon, Florida International University, University of Houston, Wayne State University, University of Massachusetts - Amherst, University of Florida, Texas A&M University, University of California - Davis, Columbia University, University of Alaska - Fairbanks, Oakland Scientific Facility, StarLight/Northwestern University, 2011 - present

ExoGENI is a GENI experimental infrastructure that links GENI to two advances in virtual infrastructure services outside of GENI: open cloud computing (OpenStack) and dynamic circuit fabrics. ExoGENI orchestrates a federation of independent cloud sites located across the US and circuit providers, like NLR and Internet2 through their native IaaS API interfaces, and links them to other GENI tools and resources.

Individual ExoGENI deployments consist of cloud site racks on host campuses, linked with national research networks through programmable exchange points. The ExoGENI sites and control software are enabled for flexible networking operations using traditional VLAN-based switching and OpenFlow. Using the ORCA (Open Resource Control Architecture) control framework software, ExoGENI offers a powerful unified hosting platform for deeply networked, multi-domain, multi-site cloud applications. We expect that ExoGENI will seed a larger, evolving platform linking other third-party cloud sites, transport networks, and other infrastructure services, and that it will enable real-world deployment of innovative distributed services and new visions of a Future Internet.

◇ *KanseiGenie: Federated Autonomous Wireless Sensor Networks*
Ohio State University (co-lead), Wayne State University (co-lead), LANL, SUN Microsystems, ETRI, 2008 - 2011

KanseiGenie provides researchers with programmability, virtualization, and slice-based experimentation on federated, autonomous wireless sensor network (WSN) infrastructures. The federated *Kansei* and *NetEye* testbeds have been operational for many years, and we also expect to federate with other testbeds from US, India, and China which have different sensing and wireless networking technologies.

These KanseiGenie experimentation infrastructures provide a rich set of features for researchers, including: (1) an integrated researcher portal that allows authenticated users to interact with a wide range of WSN fabrics such as XSM, TelosB, Stargate, and laptop arrays; (2) support for both web-based and programmatic interactions, such as experiment scheduling and results retrieval; (3) a scripting environment for composing long-running, complex, and/or phased experiments; and (4) the *KanseiGenie Doctor* which periodically measures the number of available nodes, their health, radio link quality, and other relevant networking metrics.

◇ *NetEye: Networked Embedded Sensing Testbed*
Wayne State University, Detroit, Michigan, USA, 2008 - present

NetEye consists of 130 TelosBs (with IEEE 802.15.4 radios), 46 eMotes (with IEEE 802.15.4 radios), 15 Dell Vostro laptops (with IEEE 802.11 b/g radios), and one compute server which are deployed in the Maccabees Building — the Computer Science building at Wayne State University. In addition to providing a local facility for supporting research and educational activities, NetEye is federated with Kansei as a part of the KanseiGenie consortium; KanseiGenie consortium is initiated to enable experimentation across shared, widely distributed sensornet testbeds at organizations such as Wayne State University, The Ohio State University, Los Alamos National Laboratory, and ETRI, Korea. NetEye and the KanseiGenie consortium are implemented to be interoperable with NSF GENI (i.e., Global Environment for Network Innovations), and have been incorporated into the national GENI facility. NetEye also provides live sensing data (e.g., environmental noise, temperature, and humidity) that can be used to drive experimentation and to provide useful information about occupational health in urban universities.

◇ *ExScal: Extreme Scale Wireless Sensor Networking*
DARPA Networked Embedded Systems Technology (NEST) field demonstration
Avon Park, Florida, USA, December 2004

This wireless sensor network deployment has demonstrated the scalability of our system software on the largest sensor network ever deployed at its time: 985 XSM motes, 203 MICA2 motes, and 203 Stargates were deployed in an area of 1,260 meters by 288 meters. We have successfully demonstrated target detection, classification, and tracking in this large-scale sensor network.

My major responsibilities in the project were twofold. Firstly, to provide real-time and reliable data transport over the IEEE 802.11b mesh network of the 203 Stargates, I have studied the IEEE 802.11b link properties (e.g., MAC transmission time and reliability) in the presence of bursty event traffic, and accordingly I have designed and implemented a data-driven link estimation and routing protocol *Learn On The Fly* (LOF). Instead of using beacon packets, LOF estimates link properties based on data traffic itself. Since it models the network state in the presence of data traffic, LOF chooses routes that incur shorter delay and less energy consumption than those chosen by beacon-based protocols (e.g., those using beacon-based ETX metric). The paradigm of data-driven link estimation has been incorporated into the default TinyOS routing protocol CTP (i.e., Collection Tree Protocol). Secondly, to reduce channel contention and to balance load at the XSM mote network, I assisted in designing the routing protocol *Logical Grid Routing* (LGR).

◇ *A Line in the Sand: A Wireless Sensor Network for Target Detection, Classification, and Tracking*
DARPA NEST field demonstration
MacDill Air Force base, Florida, USA, August 2003

This wireless sensor network deployment has demonstrated the potential of sensor networks for unattended ground sensing over a large, distributed region. More specifically, we have showcased how to detect, classify, and track various types of objects (such as persons and cars) using 90 MICA2 motes.

My major responsibility in the project was designing and implementing mechanisms to transport, reliably and in real-time, large bursts of data packets from different network locations to a base station (one major technical challenge of the project). With existing messaging services, only 50% data were successfully delivered and packet delivery was also significantly delayed, which was insufficient for supporting the target detection, classification, and tracking applications. To tackle this challenge, I have studied the limitations of existing transport control techniques, and I have designed a new protocol *Reliable Bursty Convergecast* (RBC): to alleviate retransmission-incurred channel contention, I have introduced differentiated contention control; to improve channel utilization and to reduce ack-loss, I have designed a window-less block acknowledgment scheme that guarantees continuous packet forwarding (regardless of packet as well as ack loss) and replicates the acknowledgment for a packet. Moreover, I have designed mechanisms to handle varying ack-delay and to reduce delay in timer-based retransmissions. With RBC, 96% data were successfully delivered in real-time such that the network goodput was close to optimal.

◇ *Kansei: Sensor Network Testbed for At-Scale Experiments*
The Ohio State University, USA, 2004 - present

Consisting of 210 XSM motes, 500 TelosB motes, and 210 Stargates, Kansei provides a

testbed infrastructure to conduct large scale experiments with both IEEE 802.11 and mote networks.

My involvement in building Kansei were 1) designing the 210-node 802.11 network such that link and network properties in Kansei mimic those outdoor, 2) designing the experiment scheduler to enable flexible and dependable experimentation, and 3) setting up the hardware and software platforms for Kansei. To facilitate high-fidelity wireless network experimentation, in particular, I have studied both indoor and outdoor wireless link properties, and have co-designed the network system (such as signal attenuators and small form-factor omni-directional antennae) to enable high-fidelity experimentation with reconfigurable network setups (e.g., node distribution density, wireless link reliability, etc.).

Invited Talks/Demos

- ◇ "Predictable, Ultra-High Reliability, Ultra-Low Latency Wireless: Algorithms, Innovation Infrastructures, and Applications", Sigma Xi Lecture, GM Research, June 2017
- ◇ "Real-Time Wireless-Networked 3D Vision for Public Safety (Demo)", US Ignite Application Summit, June 2017
- ◇ "Software-Defined Radios Outside Labs", 25th GENI Engineering Conference, March 2017
- ◇ "Wireless Networking and Software Defined Infrastructures: CAV and Beyond", Tsinghua University (China), July 2016
- ◇ "Predictable Wireless Networking for Real-Time Sensing and Control", Chongqing Chuanyi Automation Ltd. (China), July 2016
- ◇ "Trustworthy Wireless Networking for Connected and Automated Vehicles", China-US Automotive Forum, April 2016
- ◇ "Wireless Networking and Open Innovation: Connected and Automated Vehicles & 3D Vision", BOCOM Smart Network Technologies Inc. (China), May 2015
- ◇ "Wireless Networking and Open Innovation: Connected and Automated Vehicles and Beyond", Chongqing University (China), Henan University (China), May 2015
- ◇ "Connected and Automated Vehicles: Wireless Networking and Open Innovation",
  - Tongji University (China), Jiangsu University (China), May 2015
  - 34th Detroit Chinese Engineer Association (DCEA) Technology Conference and Annual Meeting, April 2015
- ◇ "Symbiotic Evolution of Applications and Networks of Connected and Automated Vehicles: A Case Study of Transportation and Public Safety (Demo)", 22nd NSF GENI Engineering Conference, March 2015 (Plenary VIP demo in the capstone meeting of the NSF GENI program)
- ◇ "Predictable Wireless Networking for Real-Time Sensing and Control: Smart Grid and Beyond", International Forum on Power Grid Monitoring, Yunnan, China, December 2014
- ◇ "Predictable Wireless Networking for Real-Time Sensing and Control",
  - Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, July 2014
  - Shenzhen University, Shenzhen, China, July 2014
  - University of Electronic Science and Technology of China, Chengdu, China, July 2014
  - Zhejiang University, Hangzhou, China, June 2014
  - Shanghai University, Shanghai, China, May 2014

◇ "Predictable Wireless Networking for Real-Time Sensing and Control: Connected and Automated Vehicles and Beyond",
- National Taiwan University, Taipei, Taiwan, July 2014
- Institute of Computing Technology, Chinese Academy of Sciences, Beijing, China, July 2014
- Shenzhen Hangsheng Electronics Co., Ltd, July 2014
- Chongqing University, Chongqing, China, June 2014
- Jiangsu University, Zhenjiang, China, June 2014
- Tongji University, Shanghai, China, May 2014

◇ "Connected and Automated Vehicles: Wireless Networking and Open Innovation", Asia-Pacific Economic Cooperation (APEC) Cooperative Forum on Internet of Vehicles and Its Worldwide Application Implementation, Shanghai, China, May 2014

◇ "Real-Time, Safety-Critical Wireless Networked Sensing and Control: Production Systems as Testbeds?", Second GENI/FIRE Collaboration Workshop, Cambridge, Massachusetts, May 2014

◇ "Predictable Wireless Networking for Real-Time Sensing and Control: Connected and Automated Vehicles and Beyond", University of Michigan - Ann Arbor, Ann Arbor, Michigan, April 2014

◇ "GENI Wireless for Safety-Critical, Traditionally-Closed Sensing and Control Systems", 19th NSF GENI Engineering Conference, Atlanta, Georgia, March 2014

◇ "Predictable, Real-Time Wireless Networking for Closed-Loop Sensing and Control",
- Institute of Information Engineering, Chinese Academy of Science, China, December 2012
- Chongqing University, China, December 2012

◇ "From Open-Loop Sensing to Closed-Loop Sensing and Control: Challenges to Embedded Wireless Networking",
- University of Michigan - Ann Arbor, Ann Arbor, Michigan, October 2011
- University of British Columbia, Vancouver, Canada, October 2011
- Kent State University, Kent, Ohio, October 2011
- University of Michigan - Dearborn, Dearborn, Michigan, September 2011
- Tsinghua University (Beijing), Institute of Software of the Chinese Academy of Science (Beijing), Chongqing University (Chongqing), China, August 2011

◇ "LENS: Language for Embedded Networked Sensing", 11th NSF GENI Engineering Conference, Denver, Colorado, July 2011

◇ "From Open-Loop Sensing to Closed-Loop, Real-Time Sensing and Control: Challenges to Wireless Networking", Merit Member Conference, Merit Networks, Ann Arbor, Michigan, June 2011

◇ "Broadband in Metro Detroit: Smart Grids, Smart Transportation and Smart Community", NSF/OSTP US Ignite Workshop, National Science Foundation, Arlington, Virginia, May 2011

◇ "Towards Predictable Messaging for Mission-Critical Wireless Networked Sensing and Control", Spring Conference of the IEEE Southeast Michigan, April 2010

◇ "Taming Uncertainty and Heterogeneity in Resource Specification for WSN Federations", 4th NSF GENI Engineering Conference, Raleigh, North Carolina, March 2010

◇ "Dependable Messaging in Wireless Cyber-Physical Systems", Department of Electrical and Computer Engineering, Wayne State University, January 2010

◇ "KanseiGenie: Architecture and ORCA Integration", 4th NSF GENI Engineering Conference, Miami, Florida, April 2009

◇ "Messaging in Wireless Cyber-physical Systems: Predictability in an Uncertain World", GM Research, Warren, MI, November 2008

◇ "Messaging in Wireless Cyber-physical Systems: Predictability in an Uncertain World", Bosch Research, Palo Alto, California, October 2008

◇ "Slice Control and Programmability in Wireless Sensor Networks", 3rd NSF GENI Engineering Conference, Palo Alto, California, October 2008

◇ "Federated, Autonomous Kansei Wireless Sensor Networks", 2^{nd} NSF GENI Engineering Conference, Arlington, Virginia, March 2008

◇ "Dependable Messaging in Wireless Sensor Networks", Merit Member Conference, Merit Networks, Ann Arbor, Michigan, June 2007

◇ "On Evolving An Integration Environment: the *Kansei* Consortium", Microsoft Research Sensor Networks Workshop, Woodinville, Washington, October 2005

◇ "Continuous Fault Containment and Local Stabilization in Path-vector Routing", BIRS/MSRI International Workshop on Self-stabilizing Distributed Systems, Banff, Alberta, Canada, October 2004

◇ "A Stability-oriented Approach to Improving BGP convergence", BIRS/MSRI International Workshop on Self-stabilizing Distributed Systems, Banff, Alberta, Canada, October 2004

Professional Activities

◇ Science and technology advising
- Technical reviewer to the IEEE Standards Association on "Smart Grid Vision for Vehicle Technology: 2030 and Beyond", 2013
- Advisory Board Member, Connected Vehicles Survey, IEEE/SAE/ACM/IFAC ICCVE, 2013
- Mentor to the NSF/OSTP/Mozilla US Ignite Apps Challenge, 2012
- Technical advisor for developing the WiMAX, wireless mesh, and sensor networks of the Detroit Connected Community Initiative (DCCI), 2010 - 2012

◇ Participation in federal program planning meetings
- NSF Workshop on Ultra-Low Latency Wireless Networks, 2016 (as a breakout lead)
- NSF US-Japan Trustworthy Networking Workshop, 2016
- NSF Future Wireless Cities Workshop, 2016
- NSF Workshop on GENI Future Plans, December 2015
- NSF Workshop on SDN in Large Enterprise Networks, November 2015
- NSF Workshop on Future Research Infrastructure for the Wireless Edge, November 2014 (as a breakout lead)
- Second NSF/EU GENI/FIRE Collaboration Workshop, May 2014
- NSF Workshop on Energy Cyber-Physical Systems, December 2013
- NIST/OSTP SmartAmerica Challenge Workshop, December 2013
- NSF Workshop on Future Directions in Wireless Networking, November 2013
- NIST Foundations for Innovation in Cyber-Physical Systems Workshop, March 2012
- NSF/OSTP US Ignite Gigabit Applications Workshop, May 2011

- NASA Workshop on Future Heterogeneous Networks, March 2011
- NSF Workshop on a Wireless National Test Bed, May 2010
- NITRD/NSF/AFRL/NSA Workshop on Research on Transportation Cyber-Physical Systems: Automotive, Aviation and Rail, November 2008
- NITRD/NIST/NSF/USCAR Workshop on High-Confidence Automotive Cyber-Physical Systems, April 2008

◇ Research Proposal Review Panel Member or Reviewer
- National Science Foundation (NSF)
- Department of Homeland Security (DHS)
- International reviewer: Ontario Research Fund (Canada), Research Grants Council of Hong Kong, Austrian Science Fund, Romania National Council for Research and Development, Nazarbayev University Research Council (Kazakhstan)

◇ Panelist
- Panel on " Opportunities and Challenges in Autonomous Vehicles", IEEE Transportation Electrification Conference and Expo (ITEC), 2016
- Panel on "Connected Vehicles and VANET", 27th IEEE Annual Computer Communications Workshop (CCW), 2013

◇ Symposium/Track Chair or Program Vice-Chair
- Co-Chair of the "Wireless Ad hoc and Sensor Networks" Symposium, IEEE International Conference on Computing, Networking and Communication (ICNC), 2017
- Co-Chair of the "Communication Architecture, Algorithms, Modeling and Evaluation" track, 24th IEEE International Conference on Computer Communications and Networks (ICCCN), 2015
- Chair of the "Cyber-Physical Systems and Internet of Things" track, Program Vice-Chair, 10th IEEE/IFIP International Conference on Embedded and Ubiquitous Computing (EUC), 2012

◇ Demo Co-Chair
- IEEE International Conference on Sensing, Communication, and Networking (SECON), 2017

◇ Ph.D. Forum Co-Chair
- IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS), 2016

◇ Publicity Chair
- ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS), 2013

◇ Local Arrangements Chair
- International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS), 2008

◇ Session Chair
- IEEE International Conference on Computer Communications (INFOCOM), 2015
- IEEE Wireless Communications and Networking Conference (WCNC), 2015
- ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS), 2013
- International Conference on Wireless Algorithms, Systems, and Applications (WASA), 2011
- IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), 2010

- International Workshop on Mobile Device and Urban Sensing (MODUS), 2008

◇ Program Committee Member

- IEEE International Conference on Computer Communications (INFOCOM), 2018
- IEEE International Conference on Communications (ICC): 2018, 2016, 2015, 2013, 2012, 2010
- IEEE/ACM International Symposium on Quality of Service (IWQoS): 2017 - 2014, 2012, 2011
- IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS): 2017 - 2012
- IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS): 2017, 2015 - 2013, 2007
- IEEE Global Communications Conference (GLOBECOM): 2017, 2016, 2013 - 2010, 2008
- IEEE Vehicular Networking Conference (VNC), 2017 - 2014
- International Workshop on Science of Smart City Operations and Platforms Engineering (SCOPE), 2017
- International Conference on Mobile Systems and Pervasive Computing (MobiSPC), 2017
- International Conference on Communication Systems and Networks (COMSNETS), 2017
- IEEE International Conference on Distributed Computing Systems (ICDCS), 2016
- IEEE International Conference on Sensing, Communication, and Networking (SECON), 2016
- IEEE Wireless Communications and Networking Conference (WCNC): 2016 - 2013
- Euromicro conference on Digital System Design (DSD), 2016, 2013
- IEEE International Performance Computing and Communications Conference (IPCCC), 2016
- The International Workshop on Computer and Networking Experimental Research Using Testbeds (CNERT), 2016
- IEEE Real-Time Systems Symposium (RTSS), 2015
- IEEE/ACM International Conference on Information Processing in Sensor Networks (IPSN), 2015
- IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS): 2015 - 2013, 2007
- IEEE International Conference on Connected Vehicles & Expo (ICCVE), 2015, 2012
- IEEE International Conference on Network Protocols (ICNP), 2014
- ACM International Conference on Modeling, Analysis, and Simulation of Wireless and Mobile Systems (MSWiM), 2014 - 2012
- 43rd IEEE International Conference on Parallel Processing (ICPP), 2014
- IEEE International Conference on Computer Communications and Networks (ICCCN): 2014 - 2007
- International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS): 2014, 2012
- International Conference on Communications and Networking in China (CHINACOM), 2014
- ICST International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness (QShine): 2014, 2010, 2009
- IEEE International Conference on Communications (ICC): 2013, 2012, 2010
- IEEE Symposium on Reliable Distributed Systems (SRDS), 2013

- IEEE International Conference on Networking, Architecture, and Storage (NAS): 2013 - 2011
- IEEE International Conference on Communications in China (ICCC), 2012
- International Workshop on Cyber-Physical Networking Systems (CPNS), 2012
- ACM International Workshop on Wireless Network Testbeds, Experimental Evaluation and Characterization (WiNTECH): 2011
- IEEE Sensor Applications Symposium (SAS): 2011, 2010
- ACM Symposium on Applied Computing (SAC): 2010
- ICST International Conference on Broadband Communications, Networks and Systems (BROADNETS): 2010
- International Conference on Future Computer and Communication (ICFCC): 2010
- International Conference on Multimedia and Ubiquitous Engineering (MUE): 2010, 2009
- International Conference on Wireless Access in Vehicular Environments (WAVE): 2009, 2008
- International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS): 2009
- IEEE International Conference on High Performance Computing (HiPC): 2009
- International Conference on Sensor Technologies and Applications (SENSORCOMM): 2009 - 2007
- IEEE International Conference on Advanced Information Networking and Applications (AINA): 2009
- International Symposium on Innovations and Real-time Applications of Distributed Sensor Networks (IRADSN): 2009
- IEEE First International Workshop on Generation C Wireless Networks (GenCWiNets): 2008
- ICST International Conference on Scalable Information Systems (INFOSCALE): 2008
- IEEE International Conference on Ubiquitous Intelligence and Computing (UIC): 2008
- International World Wide Web Conference (WWW): 2007
- International Workshop on Protocols and Algorithms for Reliable and Data Intensive Sensor Networks (PARIS): 2007

◇ Editorship
- Editor, Journal of Wireless Communications (Sanford), 2015 -
- Guest Editor, China Communications, Special Issue on "Vehicular Communications and Networking", 2016
- Guest Editor, International Journal of Distributed Sensor Networks (Hindawi), Special Issue on "Selected Papers from the 6th China Conference of Wireless Sensor Network", 2013

◇ Paper Referee
- *Journals and Magazines*: IEEE/ACM Transactions on Networking, ACM Transactions on Sensor Networks, IEEE Transactions on Wireless Communications, IEEE Internet of Things Journal, IEEE Transactions on Mobile Computing, IEEE Transactions on Dependable and Secure Computing, ACM Transactions on Autonomous and Adaptive Systems, IEEE Transactions on Parallel and Distributed Systems, IEEE Transactions on Computers, IEEE Transactions on Cloud Computing, IEEE Transactions on Vehicular Technology, IEEE Transactions on Information Forensics and Security, IEEE Network, IEEE Communications Surveys and Tutorials, IEEE Spectrum, Ad Hoc Networks (Else-

vier), Computer Networks (Elsevier), Wireless Communications and Mobile Computing (Wiley), Transportation Research (Elsevier), Information Processing Letters (Elsevier), Distributed Computing (Springer-Verlag), Journal of Parallel and Distributed Computing (Elsevier), Information Sciences (Elsevier), Theoretical Computer Science (Elsevier), Computer Journal (Oxford), AIAA Journal of Aerospace Computing, Information, and Communication (JACIC), International Journal of Ad Hoc and Ubiquitous Computing (Inderscience), Journal of High Speed Networks, International Journal of Distributed Sensor Networks (IJDSN), International Journal of Information and Computer Security (Inderscience), EURASIP Journal on Advances in Signal Processing, Concurrency and Computation: Practice and Experience, International Journal of Wireless Information Networks (Springer), Integrated Computer-Aided Engineering (ICAE), SCIENCE CHINA Information Sciences

- *Conferences*: ACM SenSys, ACM PODC, ACM WSNA, IEEE INFOCOM, IEEE ICNP, IEEE DSN, IEEE ICDCS, IEEE SRDS, IEEE RTSS, IEEE SECON, IEEE MASS, IEEE NOMS, IEEE AINA, SSS, WiNMee, OPODIS, FSTTCS, TRIDENTCOM, CODES+ISSS

◇ Member

- ACM, ACM SIGCOMM, ACM SIGMOBILE, ACM SIGBED, ACM SIGMETRICS
- IEEE (Senior Member), IEEE Communication Society, IEEE Computer Society
- USENIX, SAE

University Activities

◇ Member, Academic Technology Advisory Group, Wayne State University, 2011 - 2013, 2014 -

◇ Chair, Cyber-Physical Systems Graduate Program Committee, College of Engineering, 2015 -

◇ Member, Undergraduate Research Committee, College of Engineering, 2014 -

◇ Member, Technology Advisory Committee, College of Engineering, 2011 - 2013, 2014 -

◇ Member, Budget Advisory Committee, College of Engineering, 2016 -

◇ Member, Embedded Systems Curriculum Development Committee, College of Engineering, 2014-2015

◇ Chair, Distinguished Lectures Committee, Department of Computer Science, 2011 - 2013, 2014 -

◇ Member, Personnel and Salary Committee, Department of Computer Science, 2008 - 2010, 2011 - 2013, 2016-2018

◇ Member, Budget Advisory Committee, Department of Computer Science, 2016-2018

◇ Member, Promotion and Tenure Subcommittee, Department of Computer Science, 2015 -

◇ Member, Graduate Committee, Department of Computer Science, 2008 - 2013, 2014 -

◇ Member, Chair Search Committee, Department of Computer Science, 2016 - 2017

◇ Member, Faculty Search Committee, Department of Computer Science, 2015-2016

◇ Member, Bylaws Committee, Department of Computer Science, 2013 - 2014

◇ Member, Strategic Planning Committee, Department of Computer Science, 2012 - 2013

◇ Member, Networking Advisory Committee, Department of Computer Science, 2006 - 2011

◇ Member, Undergraduate Committee, Department of Computer Science, 2007

◇ Member, Equity and Excellence Advisory Committee, Wayne State University, 2007

◇ Member, Graduate Professional Scholarship Committee, Graduate School, 2007

◇ Member, Scholarship Awards Committee, Department of Computer Science, 2006, 2007

Educational Activities

◇ Undergraduate Teaching
- Introduction to Computer Networking

◇ Graduate Teaching
- Introduction to Cyber-Physical Systems
- Embedded Networks for Cyber-Physical Systems
- Wireless Networking and Cyber-Physical Systems
- Advanced Computer Networking
- Data Communication and Computer Networks

◇ Research Advising
- Current Ph.D. students: Yu Chen, Chuan Li, Pengfei Ren, Ling Wang (female)
- Graduated: Yuehua Wang (Ph.D., now at Texas A&M University - Commerce), Xiaohui Liu (Ph.D., now at Facebook), Xi Ju (Ph.D. & postdoc, now at GM Research), Qiao Xiang (Ph.D., now at Yale University as a postdoc), Xin Che (Ph.D., now at Marvell Semiconductor Inc.), Wen Xiao (female, Ph.D., now at Jiangsu University, China). Bo Mi (Ph.D., now at Chongqing Jiaotong University, China), Divya Sakamuri (Master, now at Ford Motor Company), Aparna Radhakrishnan (Master, now at NASA), Vineeth Rakesh Mohan (Master), Balaji Palaniswami (Master)

◇ Ph.D. Dissertation Committee
- Rui Chen, Sumukhi Chandrashekar, Chang Fu (ECE), Talal Alasmari (College of Education), Corey Tessler, Sarab AlRubeaai (University of Windsor, Canada), Youhuizi Li, Ruilong Deng (Zhejiang University, China), Kefei Xing (Zhejiang University, China), Khalid Kalbat (ECE), Masud Ahmed (ECE), Mochan Shrestha, Amal Alhosban (female), Guoxing Zhan, Sharrukh Zaman, Jiayu Gong (ECE), Musab Al-Hadrusi (ECE), Jianqiang Luo, Peng Quan (Mechanical Engineering), Eyad Hailat, Yong Xi, Safwan Al-Omari

◇ Ph.D. Qualifying Exam Committee
- Rui Chen, Sumukhi Chandrashekar, Younes Nejahi, Quan Zhang, Bing Luo, Hai Jin, Fayez Khazalah, Amal Alhosban (female), Shinnan Wang, Farhana Dewan (female), Masud Ahmed, Guoxing Zhan, Sharrukh Zaman, John Cavicchio, Jianqiang Luo, Mochan Shrestha, Eyad Hailat, Tom Carroll

◇ Master Thesis Committee
- Faria Mahnaz, Ruining Sun, Soumyasudharsan Srinivasaraghavan, Nirodha Abeywardana, Guoxing Zhan, Chenjia Wang, Santhi Movva (female), Brandon Szeliga, Mandeep Kaur (female), Deeksha Ganju (female)

◇ Undergraduate Research
- Marc Rush (UWB networks), Talia Selitsky (female; environmental monitoring sensornets)

◇ Education Outreach
- Wireless sensor network demonstrations (partly based on our NetEye sensor network testbed):
  - Prospective undergraduate students, weekly since January 2015
  - U.S.A. White House and NIST Presidential Innovation Fellows, February 20, 2014
  - College students from Shanghai University, China, July 19, 2013

- K-12 students from Metro Detroit, "GO-Computing: Gaining Options Through Computing" event, December 15, 2012
- 45 students from Cass Tech High School of Detroit, Michigan, January 18, 2012
- K-12 students from Metro Detroit, "GO-Computing: Gaining Options Through Computing" event, December 10, 2011
- College students from Shanghai University, China, July, 2011
- Minority students of the NSF BPC Information Management and Systems Engineering program at Wayne State University: January 22, 2011
- High-school female students of the "Go-girls Go cyber" event: November 6, 2010, March 27, 2010
- Avondale Meadows Upper Elementary (in Auburn Hills, MI) students, 2008; Water quality (e.g., pH, turbidity, temperature) monitoring along Clinton River, Auburn Hills, MI; media coverage by Detroit Public TV and Wayne Regional Education Service Agency.
- High-school students of International Academy, 2008
- Pre-major undergraduate students of Wayne State University, 2007
- High-school students of the Dearborn Center for Math, Science and Technology, 2006

- Wireless sensor network lectures:
  - Female college students from North Africa and Middle East, May 23, 2011
  - MBA students of Wayne State University, 2007
  - High-school students of the Dearborn Center for Math, Science and Technology (DCMST), 2006
- Faculty Judge for Wayne State University Graduate Exhibitions, March 28, 2010
- Wayne State University Graduate Open House, March 28, 2010
- Wayne State University Graduate Open House, 2009
- Wayne State University Scholars Day, 2007

Personal Data

◇ Permanent Resident of USA

Reference

Available on request.