Highlights of Dr. Weisong Shi's Contributions

2024

Dr. Weisong Shi, an IEEE Fellow, has significantly contributed to multiple domains in computer and networked systems and their applications in the last two decades, including edge computing, connected and autonomous vehicles, and connected health. He is an Alumni Distinguished Professor and Chair of the Department of Computer and Information Sciences at the University of Delaware (UD), leading the Connected and Autonomous Research Laboratory (CAR). Before joining UD, he was a faculty of Computer Science at Wayne State University. Dr. Shi has published more than 300 peer-reviewed conference papers and journal articles. He has been cited more than 23,000 times, with an H-index of 61. H's contributions have earned him several prestigious academic honors and awards, including the CCC Council member (2024-2027), NSF CISE Advisory Committee (2023-2026), Crain's Notable Leaders in EV (2022), AI 2000 Most Influential Scholar Award (2022), IEEE TCI Distinguished Service Award (2020), Most Downloaded Paper Award by IEEE Computer (2018), among others.

Edge Computing: Dr. Shi is recognized as a global leader in edge computing. His seminal paper, "Edge Computing: Vision and Challenges," has garnered over 7500 citations since 2016, indicating his pivotal role in shaping this field. In 2016, he served as the PI and co-chaired the NSF Workshop on Grand Challenges in Edge Computing with Prof. Mung Chiang from Princeton University. The report from the workshop has helped launch several edge computing-related programs, including the highlighted area of edge computing in the Computer Systems Research Core program, the NSF/VMware partnership on edge computing data infrastructure (ECDI). In 2016, with several colleagues from the ACM SIGMobile and IEEE Computer Society community, Weisong played an instrumental role in launching the ACM/IEEE Symposium on Edge Computing (SEC) and has served as the steering committee chair. Since then, SEC has been widely recognized as the top venue for publishing edge computing related work. Recommended by the editorial board of the Proceedings of the IEEE (PIEEE) in 2018, Weisong was asked to serve as the lead guest editor organizing a special issue on edge computing. The selection by the prestigious PIEEE is a testimony of his visibility in the community and demonstrates Weisong's leadership in the field. Weisong's contribution to edge computing has also extended to the general public education, in 2019, Weisong was approached by IEEE to develop an online five-lecture series on edge computing to educate professionals. To advocate edge computing in China, he published the first Chinese article on edge computing in 2017, which has been downloaded more than 20,000 times. He led a team that wrote the first Edge Computing book in Chinese in 2018, and the second edition was published in 2021. More than 5000 copies have been sold so far.

Since 2015, Weisong and his team have published more than 50 papers in the field of edge computing with a collective of 10,000+ citations. In his pioneer paper, "Edge Computing: Vision and Challenges," which was published in IEEE Internet of Things Journal in October 2016, they gave the first definition of edge computing, followed by several case studies, ranging from cloud offloading to smart home and city, as well as collaborative edge to materialize the concept of

edge computing. In addition, the paper presents several challenges and opportunities in the field of edge computing, which subsequently inspired a lot of follow-up research activities globally.

More specifically, Weisong and his team have proposed Firework, which is the first programming framework for collaborative data sharing and processing on edges. Firework allows developers to break down an application into subservices, thus distributing them in clouds and edges. In this case, Firework could speed up the development of edge-cloud environments with less response latency and network bandwidth cost and protect privacy. This work has attracted much attention in academia and industry and has been cited more than 189 times. In the last five years, Weisong has applied edge computing to connected and autonomous driving. His vision paper entitled "Edge Computing for Autonomous Driving: Opportunities and Challenges," published in the Proceedings of the IEEE, has opened the door for a whole new research area and has generated a significant impact on the community, as demonstrated by more than 590 citations. His work in this field has been funded by top-tier OEMs, including Toyota and GM.

Connected and Autonomous Vehicles: Dr. Shi's technical contributions are well demonstrated through his pioneering work in developing platforms and solutions that address the complex challenges in the connected and autonomous driving sector. Under his guidance, the CAR lab has established a solid reputation for constructing secure, real-time, and energy-efficient computing systems for autonomous driving. Among the many innovative projects from his CAR Lab, I want to highlight two hardware platforms, HydraOne and Equinox. HydraOne is an open-source experimental platform that has become instrumental in autonomous driving research and education. Several institutions in the US adopted this platform to support their research. Equinox is an innovative platform for the next generation of roadside units (RSU) that allows for the study of co-optimization of computing and communication on CAVs, a vital facet of efficient smart transportation. Moreover, his contribution to "4C: A Computation Communication and Control Co-Design Framework for CAVs" exemplifies his commitment to improving safety and fuel efficiency in connected and autonomous vehicles. His work on E2M, an Energy-Efficient Middleware for Computer Vision Applications on Autonomous Mobile Robots, and Prophet, a Predictable Real-time Perception Pipeline for Autonomous Vehicles, have spurred significant advances in optimizing energy efficiency and DNN inference time variations. In addition to the federal agencies, the research activities at his CAR lab have been supported by more than a dozen industry partners, including Toyota, GM, Tier-IV, and West Digital, to name a few, which is a great testimony to the big impact of his work in the field.

Dr. Shi envisions making connected and autonomous vehicles more accessible, particularly for people with disabilities. He now serves as the Center Director of eCAT, an NSF Industry-University Cooperative Research Center (IUCRC) to build a world-class industry-university research center for sustainable mobility technologies, and he is the chair of the IEEE STC on Autonomous Driving Technologies. Dr. Shi's visionary work on OpenVDAP, an open Vehicular Data Analytics Platform (OpenVDAP), serves as the core data sharing and accessing middleware for autonomous vehicles. In OpenVDAP, each application offers multiple execution pipelines in response to various network and computational constraints and an elastic management model to choose an optimal pipeline by hardware-software co-optimizing

automatically. In addition, a library/API called Vehicle Programming Interface (VPI) is provided for developers, enabling all data access with a secure method, which deals with developing a third-party application in connected and autonomous vehicles. The work has been cited 107 times and followed up by companies/organizations like IBM, Intel, arm, Nvidia, Denso, and the Autoware Foundation.

Smart Health and Energy Efficiency: Additionally, Dr. Shi has significantly contributed to smart and connected health, leading the Wireless Health Initiative at Wayne State University and serving as the inaugural Editor-In-Chief of the Smart Health Journal. His work in this field intersects with his expertise in edge computing, creating possibilities for advancements in healthcare. In addition, Dr. Shi's expertise also extends to energy-efficient computing systems. His work includes studying battery management for mobile systems and energy-efficient data center design. His work, especially on Taobao Hadoop workload analysis, has won awards and has been adopted by industry giants like Baidu, Alibaba, and Intel.

Community Leadership: Dr. Shi's leadership contributions are as profound as his technical contributions. As the chairs of IEEE Computer Society Technical Committee on the Internet (TCI) and the IEEE STC on Autonomous Driving Technologies, he has profoundly influenced the trajectory of this rapidly evolving field, and won the 2020 IEEE TCI Distinguished Service Award. His leadership role at the NSF IUCRC on electric, connected, and autonomous technology for mobility (eCAT) and his Autoware Strategy Planning Committee service display his dedication and commitment to propelling these technologies forward. His entrepreneurial endeavors are manifest in his co-founding of the IEEE International Conference on Mobility: Operations, Services, and Technologies (MOST), which builds upon the successful Connected and Autonomous Driving workshop (MetroCAD). Since 2022, he has also served as the Autoware Center of Excellence Director at the University of Delaware, further amplifying his global impact on autonomous mobility. Serviced as the funding steering committee chair, Dr. Shi founded the ACM/IEEE Symposium on Edge Computing (SEC) in 2016, the first and premier conference on Edge Computing. In 2016, he founded the IEEE/ACM International Conference on Connected Health (CHASE), a top venue for computer scientists and engineers to publish their work on smart and connected health.

Education: Beyond his research activities, Dr. Shi is deeply committed to advancing robotics and autonomous systems education. Dr. Shi introduced a Vertically Integrated Projects (VIP) course on autonomous vehicles, encouraging students from diverse backgrounds to engage with cutting-edge technologies and methodologies within vehicle computing. Furthermore, Dr. Shi has proposed the CAR Lab Summer Visiting Program (CSVP), which provides mentorship and support for high school and undergraduate students interested in researching this rapidly growing field. These commitments were also showcased when Dr. Shi's group conducted a workshop on autonomous driving technology at HenHacks 2022. In terms of graduate student success, Dr. Shi has advised three female Ph.D. students to completion in the past three years. These alumni have proceeded to distinguished positions, with Lanyu Xu joining Oakland University as an assistant professor in 2021 and Sidi Lu joining William and Mary as an assistant professor in August 2023.

Conclusion: To conclude, Dr. Weisong Shi's pioneering research and invaluable contributions, particularly in edge computing and connected and autonomous vehicles, have profoundly impacted the scientific community and society. His revolutionary vision of vehicle computing stands as a guiding light, steering academia and industry towards unprecedented frontiers in research and technological advancements. In addition to his research, Dr. Shi's enduring influence on education and his exceptional community leadership propel the advancement of current scientific technologies and nurture an environment where technology emerges as a potent instrument for societal progress. His unique blend of visionary leadership, pioneering technical contributions, and unwavering dedication to nurturing future leaders in autonomous technologies make him an exemplary candidate.