YINGYING (JENNIFER) CHEN

By Chonggang Wang, Editor-in-Chief, IEEE Network

As the Editor-in-Chief of *IEEE Network*, I am pleased to announce the new column, "Women in Networks". Computer communications and networking have made tremendous advancements in the past 20 years. They have become the backbone for many mobile, edge, and IoT devices that we interact with and utilize in our work and throughout our daily lives. This great technology's convenience in today's life is all owed to the researchers and engineers who diligently work in the networking community. Among them, women who work in the computer communications and networking areas have made invaluable contributions to technology advancements. This new column, "Women in Networks", aims to introduce distinguished female researchers, engineers, and educators who have been actively working and dedicating themselves in the research and development of computer communications and networking domain. I hope their stories will make people more aware of the unique contributions coming from these dedicated female researchers and engineers. I also hope young female students and researchers will be intrigued to work in the exciting information technology domain and contribute to reshaping future technology. In this inaugural issue of the new column, I would like to introduce Dr. Yingying (Jennifer) Chen. Dr. Chen will serve as the Editor of this new column. She will collect and tell you the stories of many distinguished female scientists and engineers in this exciting area.

Yingying (Jennifer) Chen is a professor of electrical and computer engineering (ECE) and Peter Cherasia Endowed Faculty Scholar at Rutgers University. She is the Associate Director of the Wireless Information Network Laboratory (WINLAB). She also leads the Data Analysis and Information Security (DAISY) Lab. She currently serves as the Graduate Director of ECE. She is an IEEE Fellow. Her research interests include mobile sensing and computing, cyber security and privacy, Internet of Things, and smart healthcare. Her background is a combination of computer science, computer engineering and physics. She had a great passion for physics in high school and chose to study condensed matter physics during her undergraduate study at Nanjing University. She was fortunate to receive early admission to the Gifted Young Program at Nanjing University, exempted from the National College Admission Examinations. She then becaime fascinated by the Unix programming environment when pursuing her Ph.D. study in physics in U.S. and decided to switch to computer science. This was one of the most important decision in her career, which led to the start of her career working on networking management systems at Nokia (previously Lucent Technologies as shown in Fig. 1). The product-driven networking related projects at Nokia have broadened her knowledge and vision in computer networks and equipped her with hands-on experience in both research and development of Nokia's optical networking backbone products and the critical aspects in the networking management systems. Eventually, she decided to make the second most important decision in her career and switched from industry to academia. Ever since then, she feels she started an amazing journey in conveying her knowledge to many young students with eagerly learning minds and exploring the power of fundamental research, which demonstrated great impact on the general public in our society.

FIGURE 1. Dr. Chen worked at the previous Bell Labs at Holmdel, NJ. In 1947, physicists at Bell Laboratories created the first working transistor, the basis of all digital computer technology and a world-changing invention. This large monument to this piece of engineering history is located on the grounds of the previous Bell Labs.

Dr. Chen is recognized as a pioneer and technical leader in the areas of mobile computing and mobile security. She envisioned that with the ubiquitous usage of wireless technologies and mobile devices, mobile computing combines communications among people, context-aware mobile sensing and continuous access to networked services, providing unprecedented opportunities to build a broad array of emerging mobile systems and applications. She was among the first to integrate the computing, sensing, communication capabilities, and software-hardware architecture co-design for low-power heterogeneous mobile edge devices to build mobile safety systems, mobile healthcare systems, and localization systems. Her computing algorithms in mobile safety systems demonstrate that the mobile devices that we carry and wear can provide effective safety services by sensing our activities and surroundings and identifying dangerous situations. This line of work has resulted in recognizable mobile and wearable device-based systems for driver phone use detection as illustrated in Fig. 2 [1, 2], dangerous driving behavior detection [3], pedestrian safety services, and massive road data acquisition for dependable self-driving. It has also been recognized with the Best Paper Award from the prestigious ACM MobiCom 2011. Furthermore, Dr. Chen is one of the pioneers to tackle the activity identification and vital signs monitoring problems in home environments, which can support mobile healthcare applications including well-being management, elder care, and latchkey child safety. She takes a unique viewpoint of activity identification at home through reusing the commodity Wi-Fi and smart devices (e.g., voice assistant system, refrigerator, and smart TV). Her low-cost system extracts fine-grained channel features and can uniquely identify various kinds of human activities as shown in Fig. 3 [4] and further accurately monitor vital signs (including both breathing rate and heartbeat) during sleep without requiring a user to wear any devices [5]. This line of work represents a significant advancement in device-free activity identification and monitoring by reusing prevalent WiFi for long-term wellbeing monitoring and home safety. She is also among the pioneers to develop fundamental theories and key techniques for wireless localization systems, which is a critical enabler in a broad range of location-based services.

Dr. Chen is also the first to propose using peer phones and acoustic ranging to significantly improve the accuracy of WiFi localization with minimum auxiliary COTS sound hardware on smartphones [6]. It is among the first works to combine multiple complementary techniques to improve indoor localization for smartphones. This project discovers the root cause of large errors in WiFi-based localization systems and devises a novel peer-assisted localization algorithm that leverages acoustic ranging and locates peer phones jointly to achieve improved accuracy. The results of the project advance wireless localization techniques by providing high accuracy and robustness for emerging location-based applications, which demand high location accuracy. The proposed localization system for smartphones is critical to enable novel features in facilitating the widespread deployment of pervasive location-aware applications as the accurate location is a critical input to those high-level applications.

With the wide adoption and deployment of mobile computing, mobile security becomes increasingly important. Dr. Chen proposes that location-oriented information can be built into any mobile wireless network stack and serve as a promising new dimension across different layers from the physical layer to the application layer to complement conventional security solutions and enhance mobile security. In particular, her research team is one of the first to devise techniques for practical secret key generation, detecting the presence of identity-based

attacks and localizing malicious adversaries in mobile wireless environments. Her work in exploiting physical layer information for secret key establishment in mobile environments has drawn much attention as it solved the problems of lacking key management infrastructures and frequent changing of neighboring devices due to high mobility. Furthermore, she has developed a family of innovative techniques grounded on machine learning to detect identity-based attacks conducted by malicious mobile agents, which have a detrimental impact on the successful deployment of mobile pervasive applications. This line of work has been widely cited. Moreover, mobile user authentication, both for access to the device itself and as a platform for verifying access to mobile services (e.g., mobile payment), is critical in building secure mobile computing systems [7]. Dr. Chen presents a unique vision trying to turn any solid surface (e.g., door panel, desk surface, and vehicle door) into a touch-sensing surface and enable low-cost user authentication leveraging physical vibration. The ground-breaking results along this direction have been published in the top security conference ACM CCS 2017 [8] and won the Best Paper Award at IEEE SECON 2017 [9] for mobile sensing and computing. Additionally, performing security analysis is of particular importance in building trustworthy mobile computing. Dr. Chen's research demonstrates that a user's sensitive information could be leaked through their wearable devices and obtained by adversaries including the user's PIN sequence when accessing an ATM machine or using debit cards for payments. This line of work has drawn great public attention and received the Best Paper Award from ACM AsiaCCS 2016 [10], a highly regarded conference on computer and communications security.

In summary, Dr. Chen has co-authored three books: *Securing Emerging Wireless Systems* (Springer 2009); *Pervasive Wireless Environments: Detecting and Localizing User Spoofing* (Springer 2014); and *Sensing Vehicle Conditions for Detecting Driving Behaviors* (Springer 2018). She has published 200+ journal articles and refereed conference papers and obtained eight patents. Her research has been licensed by multiple companies and reported in numerous media outlets including the Wall Street Journal, MIT Technology Review, CNN, Fox News Channel, IEEE Spectrum, Fortune, Inside Science, NPR, the Tonight Show with Jay Leno and Voice of America TV. She is one of the pioneers to use machine learning techniques and data mining methods to classify and model the healthcare, security, system, network related problems since its infancy. Besides the algorithm development, her work has a strong emphasis on system implementation and validation in real-world scenarios. Her interdisciplinary research and education have been sponsored by multiple grants from various funding agencies. She is serving and served on prestigious journal editorial boards including *IEEE/ACM Transactions on Networking* (IEEE/ACM ToN), *IEEE Transactions on Mobile Computing* (IEEE TMC), *IEEE Transactions on Wireless Communications* (IEEE TWireless), *ACM Transactions on Privacy and Security* (ACM TOPS), *IEEE Network Magazine*, *EURASIP Journal on Information Security*, and the *International Journal of Parallel, Emergent and Distributed Systems* (IJPEDS). She is also actively involved in community service. She is the Technical Program Co-chair of IEEE INFOCOM 2022, a flagship networking and communications conference sponsored by the IEEE Communications Societ Society. She served as the Technical Program Co-chair and General Co-chair of ACM MobiCom 2018 and 2016, respectively, a high-profile conference in ACM SigMobile. She also regularly serves on the technical program committees of many other ACM and IEEE top-tier conferences.

We are happy to launch this new column to showcase distinguished female engineers, researchers, and scientists in networking areas. I hope you enjoyed reading the first column article about Dr. Yingying Chen. *IEEE Network* is always on the lookout for new "Women in Networks" stories that will inspire and inform our readers. If you have any suggestions or feedback, please contact the column editor, Dr. Yingying Chen or me.

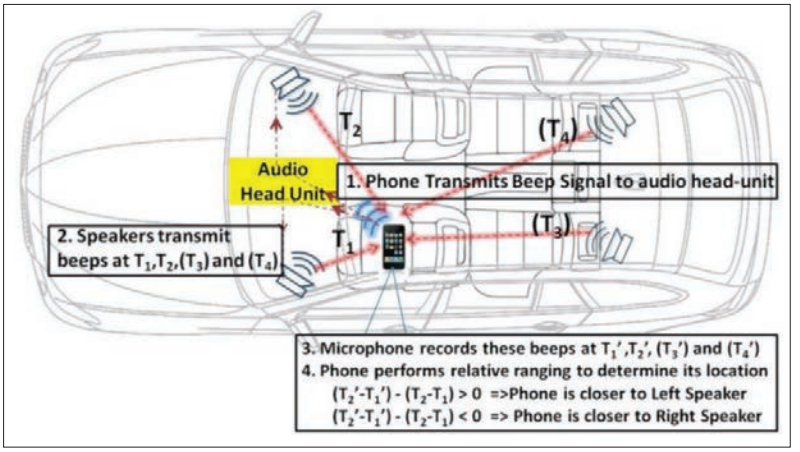

FIGURE 2. Illustration of the driver phone use detection system leveraging car speakers [1].

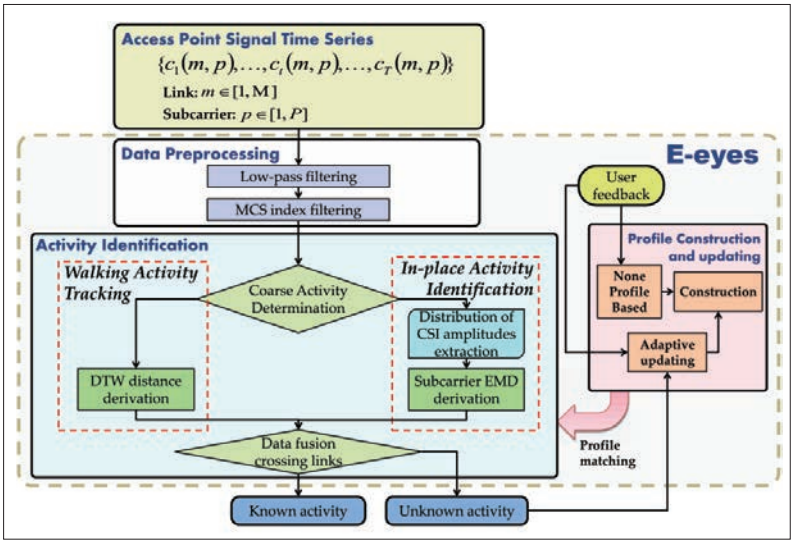

FIGURE 3. System flow of E-eyes [4], a low-cost device-free activity recognition system using WiFi signals.

REFERENCES

[1] J. Yang *et al.*, "Detecting driver phone use leveraging car speakers," in *Proc. 17th Annual International Conference on Mobile Computing and Networking (ACM MobiCom)*, 2011, pp. 97–108 (Best Paper Award).
[2] Y. Wang *et al.*, "Sensing Vehicle Dynamics for Determining Driver Phone Use," in *Proc. 11th Annual International Conference on Mobile Systems, Applications, and Services (ACM MobiSys)*, 2013, pp. 41–54.
[3] J. Yu *et al.*, "Fine-grained Abnormal Driving Behaviors Detection and Identification with Smartphones," *IEEE Trans. Mobile Computing*, vol 16, no. 8, 2016, pp. 2198–2212.
[4] Y. Wang *et al.*, "E-eyes: Device-free Location-oriented Activity Identification Using Fine-grained WiFi Signatures," in *Proc. 20th Annual International Conference on Mobile Computing and Networking (ACM MobiCom)*, 2014, pp. 617–28.
[5] Y. Ren *et al.*, "Noninvasive Fine-grained Sleep Monitoring Leveraging Smartphones," *IEEE Internet of Things J.*, vol 6, no. 5, 2019, pp. 8248–61.
[6] H. Liu *et al.*, "Push the Limit of WiFi based Localization for Smartphones," in *Proc. 18th Annual International Conference on Mobile Computing and Networking (ACM MobiCom)*, pp. 305-316, 2012.
[7] L. Lu *et al.*, "Lip Reading-based User Authentication through Acoustic Sensing on Smartphones," *IEEE/ACM Tran. Networking*, vol 27, no. 1, 2019, pp. 447–60.
[8] J. Liu *et al.* "VibWrite: Towards Finger-input Authentication on Ubiquitous Surfaces via Physical Vibration," in *Proc. 2017 ACM SIGSAC Conference on Computer and Communications Security (ACM CCS)*, 2017, pp. 73–87.
[9] J. Liu *et al.*, "Vibsense: Sensing Touches on Ubiquitous Surfaces through Vibration," in *Proc. 2017 14th Annual IEEE International Conference on Sensing, Communication, and Networking (IEEE SECON)*, 2017, pp. 1–9 (Best Paper Award).
[10] C. Wang *et al.*, "Friend or Foe? Your Wearable Devices Reveal Your Personal PIN," in *Proc. 11th ACM on Asia Conference on Computer and Communications Security (ACM Asia CCS)*, 2016, pp. 189–200 (Best Paper Award).