Assistant Professor
UNC Pembroke

# Shaohu Zhang, Ph.D.

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## Research Interests

- **Security and Privacy in IoT**: Fingerprinting and human biometric security and privacy with a special focus on embedded sensors in IoT devices.
- **Mobile Computing/Sensing Systems**: sensing with ubiquitous modalities, such as WiFi, camera, IMU, and sound in intelligent transportation and smart homes.
- **Human Computer Interaction**: Context-aware IoT systems relating to bridging Cyber-Physical Systems and ML.
- **LLM and NLP**: Speech privacy, speech translation, and its LLM applications.

## Education

**North Carolina State University (NCSU)**, Raleigh, NC 2023
- Ph.D. Computer Science

**South Dakota State University (SDSU)**, Brookings, SD 2017
- MS. Computer Science (non-degree)
- MS. Civil Engineering

**Zhejiang Ocean University (ZJOU)**, Zhoushan, China 2010
- B.A. Marine Fishery Science and Technology

## Work Experience

**Tenure Track Assistant Professor in Computer Science**, University of North Carolina at Pembroke 08/2023-Present

**Wolfpack Security and Privacy Research (WSPR) Lab**, NCSU, Raleigh, NC 01/2020–05/2023
- Graduate Research/Teaching Assistant
- Advisor: Dr. Anupam Das
- Worked on IoT security and privacy.

**Wolfpack Interactive, Sensing and Networking Lab (WiSN) Lab**, NCSU, Raleigh, NC 08/2017–12/2019
- Graduate Research/Teaching Assistant
- Advisor: Dr. Muhammad Shahzad
- Mobile Computing/Sensing Systems: collected data and designed the system for WiFi sensing on gesture recognition, authentication, and home human events.

**Civil Lab for Operations and Safety Engineering in Transportation**, SDSU, Brookings, SD 01/2017–07/2017
- Graduate Research Assistant
- Advisor: Dr. Jonathan Wood
- Main investigator to evaluate causal relationships between perception-reaction times, emergency deceleration rates, and crash outcomes by mining the Naturalistic Driving Data.

**Wireless Embedded and Networked Systems (WENS) Lab**, SDSU, Brookings, SD 08/2015–12/2016
- Graduate Research Assistant
- Advisor: Dr. Myounggyu Won
- designed and implemented a WiFi-based traffic monitoring system to classify vehicles, measure vehicle speed and perform vehicle lane detection using WiFi signals.

**Logistics Engineer, China Railway Materials Commercial Corp**, Shanghai, China 06/2012 – 08/2013

**Instructor, Shanghai Maritime University**, Shanghai, China 09/2011 – 07/2012

## Under Preparation/Submission

1. ChatChat: Enhancing Speech-to-Speech Translation using LLM. (Under Preparation).
2. SoK: Speech-to-Speech Translation in the Context of Chinese-English Daily Use. (Under Preparation)
3. Analyzing the Efficacy of the Vetting Process and Prevalence of Ads in Emerging Voice Applications. (Under Review).

## Peer-reviewed Publications

**J** Journal, **C** Conference, * indicates the first author is my advisor while I am the main student contributor.

1. **(C)** Zhouyu Li, Ruozhou Yu, Anupam Das, **Shaohu Zhang**, Huayue Gu, Xiaojian Wang, Fangtong Zhou, Aafaq Sabir, Dilawer Ahmed, and Ahsan Zafar. INSPIRE: Instance-level Privacy-preserving Transformation for Vehicular Camera Videos. Proceedings of the 32nd International Conference on Computer Communications and Networks. **IEEE ICCCN'23, acceptance rate: 55/181=30%**.

2. **(C) Shaohu Zhang**, Zhouyu Li, Anupam Das. VoicePM: A Robust Privacy Measurement on Voice Anonymity, *16th ACM Conference on Security and Privacy in Wireless and Mobile Networks.* **ACM WiSec 2023, acceptance rate: 34/134 =25%** .

3. **(C) Shaohu Zhang**, Aafaq Sabir, Anupam Das. Speaker Orientation-Aware Privacy Control to Thwart Misactivation of Voice Assistants, *The 53rd Annual IEEE/IFIP International Conference on Dependable Systems and Network.* **IEEE IFIP DSN 2023, acceptance rate: 47/235=20%** .

4. **(C) Shaohu Zhang**, Anupam Das. Enabling 2-FA for Smart Home Voice Assistants using Inaudible Acoustic Signal, *In 24th International Symposium on Research in Attacks, Intrusions and Defenses, pp. 251-265. 2021.* **(RAID'21), acceptance rate: 33/138=23.9%** .

5. **(J)** Jonathan Wood *, **Shaohu Zhang**. Evaluating Relationships Between Perception-Reaction Times, Emergency Deceleration Rates, and Crash Outcomes using Naturalistic Driving Data. *Journal of Transportation research record 2675, no. 1 (2021): 213-223.* **TRR'21, acceptance rate: 20%** .

6. **(C) Shaohu Zhang**, Raghav Venkatnarayan, Muhammad Shahzad. A WiFi-based Home Security System. *In 2020 IEEE 17th International Conference on Mobile Ad Hoc and Sensor Systems (MASS), pp. 129-137*. **IEEE MASS'20, acceptance rate:28%**.

7. **(J)** Jonathan Wood *, **Shaohu Zhang**. Identification and Calculation of Horizontal Curves for Low-Volume Roadways using Smartphone Sensors. *Journal of Transportation Research Record, 2672(39), 1-10. 2018.* **TRR'18, acceptance rate: 20%** .

8. **(C+J)** Muhammad Shahzad *, **Shaohu Zhang**. Augmenting User Identification with WiFi Based Gesture Recognition. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 2(3), pp.1-27, 2018.* **IMWUT/Ubicomp'18, acceptance rate:18%**

9. **(C) Shaohu Zhang**, Myounggyu Won, Sang H. Son. Low-cost and Non-intrusive Traffic Monitoring System Using WiFi. *In 2017 26th International Conference on Computer Communication and Networks (ICCCN), pp. 1-9. IEEE, 2017.* **ICCCN'17, acceptance rate:28.6%**.

10. **(C)** Myounggyu Won *, **Shaohu Zhang**, Appala Chekuri, Sang H. Son. Enabling Energy-Efficient Driving Route Detection Using a Built-in Smartphone Barometer Sensor, *In 2016 IEEE 19th International Conference on Intelligent Transportation Systems (ITSC), pp. 2378-2385. IEEE, 2016.*

11. **(C) Shaohu Zhang**, Myounggyu Won, Sang H. Son. Low-cost Realtime Horizontal Curve Detection Using Inertial Sensors of a Smartphone. *In 2016 IEEE 84th Vehicular Technology Conference (VTC-Fall), pp. 1-5. IEEE, 2016.*

12. **(C)** Xiao Qin *, **Shaohu Zhang**, Wei Wang. Advanced Curve-speed Warning System Using an In-Vehicle Head-Up Display. *Proceedings of 94th Transportation Research Board Meeting, Washington, D.C, 2015.*

**POSTER & ABSTRACT**

1. **Shaohu Zhang**, Aafaq Sabir, Anupam Das. POSTER: Enhancing Security and Privacy Control for Voice Assistants Using Speaker Orientation, *16th ACM Conference on Security and Privacy in Wireless and Mobile Networks.* **ACM WiSec 2023**.

2. **Shaohu Zhang**, Anupam Das. A 2-FA for home voice assistants using inaudible acoustic signal. *In Proceedings of the 27th Annual International Conference on Mobile Computing and Networking, pp. 834-836. 2021.* **MobiCom'21**.

3. **Shaohu Zhang**, Myounggyu Won, Sang H. Son. WiTraffic: Non-intrusive Vehicle Classification Using WiFi. *In Proceed-*

*ings of the 14th ACM Conference on Embedded Network Sensor Systems CD-ROM, pp. 358-359. 2016.* **SenSys'16**

4. Xiao Qin *, **Shaohu Zhang**, Wei Wang. Advanced Curve-speed Warning System Using an In-Vehicle Head-Up Display. *Proceedings of 94th Transportation Research Board Meeting, Washington, D.C, 2015.*

### Technical Report

1. Jonathan Wood *, **Shaohu Zhang**. Evaluating Relationships Between Perception-Reaction Times, Emergency Deceleration Rates, and Crash Outcomes Using Naturalistic Driving Data. *MPC-17-338, North Dakota State University - Upper Great Plains Transportation Institute, Fargo: Mountain-Plains Consortium, 2017.*

### Thesis

1. Towards Context-aware and Trustworthy Voice Assistants. *Committee members: Dr. Anupam Das (Chair), Dr. William Enck, Dr. Muhammad Shahzad, Dr. Chau-Wai Wong. North Carolina State University, 2023.*

2. Identification, Calculation and Warning of Horizontal Curves for Low-volume Two-lane Roadways Using Smartphone Sensors. *Committee members: Dr. Jonathan Wood (Chair), Dr. Suzette Burckhard, Dr. Rouzbeh Ghabchi. South Dakota State University, 2017.*

### Talks & Presentation

1. VoicePM: A Robust Privacy Measurement on Voice Anonymity, *16th ACM Conference on Security and Privacy in Wireless and Mobile Networks.* WiSec 2023 virtual.

2. Web Privacy in the Digital World. University of North Carolina, Pembroke, March 2023.

3. Enabling 2-FA for Smart Home Voice Assistants using Inaudible Acoustic Signal. *The 24th International Symposium on Research in Attacks, Intrusions and Defenses.* (RAID'21 virtual).

4. 2-FA for Smart Home Voice Assistants using Inaudible Acoustic Signal. *In Proceedings of the 27th Annual International Conference on Mobile Computing and Networking.* (Mobicom'21 virtual).

5. Security on Android Devices. *NCSU Data Privacy Month 2021.*

6. A WiFi-based Home Security System. *The 17th IEEE International Conference on Mobile Ad Hoc and Sensor Systems.* (MASS'20 virtual).

7. Identification and Calculation of Horizontal Curves for Low-Volume Roadways using Smartphone Sensors. *In the 97th Transportation Research Board Annual Meeting (TRB'18), Washington D.C.*

8. WiTraffic: Non-intrusive Vehicle Classification Using WiFi. *In the 14th ACM Conference on Embedded Networked Sensor Systems (SenSys'16), Stanford University.*

9. Horizontal Curve Detection Using Inertial Sensors of a Smartphone. *Sigma Xi Chapter, South Dakota State University, 2016*

10. Avoiding Roadway Departure Crashes with an In-Vehicle Head-Up Display. *In the TRB 94th Transportation Research Board Annual Meeting (TRB'15) Washington D.C.*

### Teaching Experience

**University of North Carolina at Pembroke,** Pembroke, NC

- CSC 2920 Software Engineering, Spring 2024
- CYB 4030 Introduction to Digital Forensics, Spring 2024
- CSC 1750 Introduction to Algorithms (23 undergrads), Fall 2023
- CSC 1760 Introduction to Programming (30 undergrads), Fall 2023

- CSC 1850 Object-oriented Programming (58 undergrads), Fall 2023

**North Carolina State University,** Raleigh, NC

- CSC/ECE 773 Advanced Internet Protocol (14 graduates), Spring 2023, co-instructor with Dr. Khaled Harfoush

**Teaching Assistant/Lab Instructor, North Carolina State University,** Raleigh, NC

- CSC/ECE 573/591 Internet Protocol, Fall 2022, Instructor: Dr. Khaled Harfoush
- CSC 433 Privacy in the Digital Age, Spring 2021, Instructor: Dr. Anupam Das
- CSC 533 Privacy in the Digital Age, Fall 2020, Instructor: Dr. Anupam Das
- CSC/ECE 591/791, Internet of Things, Spring 2020, Instructor: Dr. Muhammad Shahzad
- CSC/ECE 573/591 Internet Protocol, Spring 2020, Instructor: Dr. Muhammad Shahzad
- CSC 453 Internet of Things, Spring 2019, Instructor: Dr. Muhammad Shahzad

**Lecturer, Shanghai Maritime University**, Institute of Advanced Technology, Shanghai, China

- International Multimodal Transportation, Spring 2012 (72 undergraduate students).
- Customs Declaration, Fall 2011 (48 undergraduate students).

## STUDENTS/MENTORING

- **Current master student**: Ruoyu Zhao (Co-advising with Dr. Xiantao Jiang from Shanghai Maritime University)
- **Current undergraduate student**: Najmul Hasan (University of North Carolina at Pembroke)
- **Previous PhD student**: Zhouyu Li (North Carolina State University), Chao Chen (University of Memphis)
- **Past PhD students (IoT course research project in Spring 2020) at NCSU**: Haoze Du, Xiao Ling, Kewen Peng
- **Past Master Student (independent study) at NCSU:** Lee Shyu (Fall 2021)

## HONORS & AWARDS

- **2023 CoE Mentored Teaching Fellowship**, College of Engineering, North Carolina State University, 2023.
- **2022 Summer Graduate Fellowship**, College of Engineering, North Carolina State University, 2022.
- **CoE Enhancement Fee Travel Award**, College of Engineering, North Carolina State University, 2020, 2023.
- **CoE Graduate Research Award**, College of Engineering, North Carolina State University, 2018.
- **Student Travel Grant:** HotMobile'23, RAID'21, CCS'21, MobiCom'21, MobiCom'17, and SenSys'16.
- **Sigma Xi Graduate Research Award**, South Dakota State University, 2016.
- **Outstanding Undergraduate Thesis Award**, Zhejiang Ocean University, China, 2010.

## PROFESSIONAL ACTIVITIES

I have reviewed more than twenty journal manuscripts and >40 papers in top-tier conferences.

**Technical Program Committees:**

- 2nd ACM Workshop on Smart Wearable Systems and Applications (SmartWear2023) In Conjunction with MobiCom 2023. October, 6, 2023, Madrid, Spain
- The 2023 IEEE 98th Vehicular Technology Conference (VTC2023-Fall Hong Kong).

- PhD Forum, The 53rd Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN'23).

**Artifact Review Program Committees:**
- USENIX Security Symposium: 2023
- Privacy Enhancing Technologies Symposium (PoPETs): 2023
- ACM ASIA Conference on Computer and Communications Security (AsiaCCS): 2023
- Annual Computer Security Applications Conference (ACSAC): 2023
- ACM Conference on Security and Privacy in Wireless and Mobile Networks (ACM WiSec): 2022-2023

**Workshop**
- Co-chair, Privacy Check-up Sessions, NCSU Data Privacy Month 2021. North Carolina State University. Feb 2021.

**Conference Review/sub-reivew**
- ACM Conference on Computer and Communications Security (CCS): 2021-2023.
- Symposium on Security and Privacy (IEEE S&P): 2021.
- ISOC Networked and Distributed System Security Symposium (NDSS): 2021-2023.
- Annual Computer Security Applications Conference (ACSAC): 2022-2023.
- Security and Privacy in Wireless and Mobile Networks (WiSec): 2021-2022.
- ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (BuildSys): 2019.

**Journal Review:**
- Journal of Transportation Research Record (TRR): 2023
- ACM Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT): 2019, 2021, 2022.
- IEEE Internet of Things Journal: 2021-2023.
- ACM Transactions on Interactive Intelligent Systems: 2021.
- IEEE Transactions on Mobile Computing: 2021-2023.

## PROPOSAL/FUNDING

- **Lie to Lies: Leveraging LLMs for AI-Generated Misinformation Attack and Defense** (PI, in preparation).

- **Bridging the Gap: Empowering Underrepresented Students through AI-Driven Education in Rural Areas of Southern NC** (Co-PI, in preparation).

- Title: **Neighborhood Microscope: Leveraging Big Data Sources to Examine Health and Well-being in Urban and Rural NC Neighborhoods**.
  PI: Dr. Shaohu Zhang, Co-PI: Dr. Melanie Escue, University of North Carolina at Pembroke
  Total Award: $86,000
  Sponsor: North Carolina Collaboratory.

I was the main student contributor, together with my advisor, to the design, experiments, and writing of the following grant proposals.
- Title: **Physical Context-aware Voice Assistant for Smart Homes.**
  Lead PI: Dr. Anupam Das, North Carolina State University
  Total Award: $75,000
  Sponsor: Proposals for 2022 Towards Trustworthy Products in AR, VR, and Smart Devices, Meta Company
- Title: **Preventing Misactivation of Voice Assistant Using Head Orientation**
  PI: Dr. Anupam Das, North Carolina State University
  Finalist of 2021 Towards Trustworthy Products in AR, VR, and Smart Devices, Meta Company.
- Title: **A Roadway Departure Warning System with an In-Vehicle Head-Up Display**
  PI: Dr. Qin Xiao, South Dakota State University
  National Cooperative Highway Research Program (NCHRP IDEA 2016) (unfunded)

## PROJECTS

During the past 8 years of master's and Ph.D. study, I have been grateful for the support from the following funded projects, other resources from SDSU and NCSU, and travel grants from NSF.
- Title: **CRII: SaTC: Analyzing Information Leak in Smart Homes**
  Sponsor: National Science Foundation (NSF)
  PI: Dr. Anumpam Das North Carolina State University

Total Award: $174,995 Duration: 3 years (June 01, 2019 – May 31, 2022)
Responsibility: main investigator on the security and privacy of voice assistant.

- Title: **WiFi based Indoor Mapping and Human Discovery**
  PI: Muhammad Shahzad North Carolina State University
  Total Award: $384,583 Duration: 2018-2021
  Sponsor: Army Research Office, USA
  Responsibility: WiFi sensing projects.
- Title: **CRII: CSR: Pervasive Gesture Recognition Using Ambient Light.**
  Sponsor: National Science Foundation (NSF)
  PI: Dr. Muhammad Shahzad North Carolina State University
  Total Award: $174,878 Duration: 3 years (2016 – 2020)
  Responsibility: investigated non-LOS VLC.
- Title: **Evaluating Relationships between Perception-Reaction Times, Emergency Deceleration Rates, and Crash Outcomes using Naturalistic Driving Data.**
  Sponsor: North Dakota State University - Upper Great Plains Transportation Institute
  PI: Dr. Jonathon Wood South Dakota State University
  Total Award: $180,258 Duration: 2016 – 2017
  Responsibility: main investigator to the data analysis and report writing.
- Title: **Developing a Pavement Management System for Small Communities.**
  Sponsor: jointly funded by the city of Madison, SD and Mountain Plain Consortium
  PI: Dr. Qin Xiao South Dakota State University
  Total Award: $91,040 Duration: 01/2014-12/2016
  Responsibility: Data collection and mapping