PhD Candidate
Computer Science
North Carolina State University

SHAOHU ZHANG

: (605) 592-0499
: szhang42@ncsu.edu
: zhangshaohu.github.io

RESEARCH INTERESTS

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

EDUCATION

North Carolina State University (NCSU), Raleigh, NC 7/2023
- Ph.D. Computer Science
- Dissertation: *Towards Context-aware and Trustworthy Voice Assistants.*
- Committee: Dr. Anupam Das (Chair), Dr. Chau-Wai Wong, Dr. William Enck, Dr. Muhammad Shahzad

South Dakota State University (SDSU), Brookings, SD 2017
- MS. Computer Science (non-degree)
- MS. Civil Engineering
- Thesis: *Identification, Calculation, and Warning of Horizontal Curves for Low-volume Two-lane Roadways Using Smartphone Sensors.*
- Committee: Dr. Jonathan Wood (Chair), Dr. Suzette Burckhard, Dr. Rouzbeh Ghabchi

Shanghai Maritime University (SMU), Shanghai, China 2012
- M.S. Supply Chain Management

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

UNDER SUBMISSION

1. Analyzing the Efficacy of the Vetting Process and Prevalence of Ads in Emerging Voice Applications.**CCS'23** (Under Review).

2. VoicePM: A Robust Privacy Measurement on Voice Anonymity. **WiSec'23** (Under Review).

3. IPPV: Instance-level Privacy-Preserving Video Transformation for Vehicular Camera Videos. **PerCom'23** (Under Review)

4. Speaker Orientation-Aware Security and Privacy Control for Voice Assistants. **DSN'23** (Under Rebuttal).

PEER-REVIEWED PUBLICATIONS

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

1. **(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%** .

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

3. **(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%**.

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

5. **(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%**

6. **(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%**.

7. **(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.*

8. **(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.*

9. **(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**, 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**.

2. **Shaohu Zhang**, Myounggyu Won, Sang H. Son. WiTraffic: Non-intrusive Vehicle Classification Using WiFi. *In Proceedings of the 14th ACM Conference on Embedded Network Sensor Systems CD-ROM, pp. 358-359. 2016.* **SenSys'16**

3. 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. 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).

2. 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).

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

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

5. 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.*

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

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

8. 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

Instructor, North Carolina State University, Raleigh, NC

- CSC773 Advanced Internet Protocol, Spring 2023, co-instructor with Dr. Khaled Harfoush

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

- CSC573/591 Internet Protocol, Fall 2022, Instructor: Dr. Khaled Harfoush
- CSC433 Privacy in the Digital Age, Spring 2021, Instructor: Dr. Anupam Das
- CSC533 Privacy in the Digital Age, Fall 2020, Instructor: Dr. Anupam Das
- CSC591/791,ECE591/791 Internet of Things, Spring 2020, Instructor: Dr. Muhammad Shahzad
- CSC573/591 Internet Protocol, Spring 2020, Instructor: Dr. Muhammad Shahzad
- CSC456 Internet of Things, Spring 2019, Instructor: Dr. Muhammad Shahzad

Instructor, Shanghai Maritime University, Institute of Advanced Technology, Shanghai, China

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

Students/Mentoring

North Carolina State University, Raleigh, NC
- **Current PhD student**: Zhouyu Li
- **Past PhD students (IoT course research project)**: Haoze Du, Xiao Ling, Kewen Peng
- **Past Master Student (independent study):** 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.

- **CoE Graduate Research Award**, College of Engineering, North Carolina State University, 2018.
- **Student Travel Grant:** HotMobile'23, RAID'21, MASS'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 ten journal manuscripts and >30 conference papers in top-tier conferences/journals.

Artifact Review 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

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

Conference Review/sub-reivew
- Annual Transportation Research Board meeting (TRB): 2023.
- 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
- Security and Privacy in Wireless and Mobile Networks (WiSec): 2021.
- Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT): 2019, 2021.
- ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (BuildSys): 2019.

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

PROPOSALS

I am 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

Work Experience

Wolfpack Security and Privacy Research (WSPR) Lab, NCSU, Raleigh, NC 1/2020–present

- Graduate Research Assistant
- Advisor: Dr. Anupam Das
- **VoicePM:** Developed a robust Voice Privacy Measurement framework to study the feasibility of applying different state-of-the-art voice anonymization solutions to achieve the optimum tradeoff between privacy and utility.
- **HeadTalk:** Collected speaker's orientation data from VA and used it to develop a speaker orientation-aware privacy control for voice assistants.
- **HandLock:** Proposed and developed the concept of a gesture-based 2-FA system for VAs.

Wolfpack Interactive, Sensing and Networking Lab (WiSN) Lab, NCSU, Raleigh, NC 8/2017–12/2019

- Graduate Research 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 1/2017–7/2017

- 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 8/2015–12/2016

- 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 6/2012 – 8/2013

Instructor, Shanghai Maritime University, Shanghai, China 9/2011 – 7/2012

Reference

- **Dr. Anupam Das**, Assistant Professor
  Department of Computer Science, North Carolina State University, Raleigh, NC, USA.
  Email: anupam.das@ncsu.edu
- **Dr. Jonathan Wood**, Assistant Professor
  Department of Civil, Construction, and Environmental Engineering, Iowa State University, Ames, IA, USA.
  Email: jwood2@iastate.edu
- **Dr. Muhammad Shahzad**, Associate Professor
  Department of Computer Science, North Carolina State University, Raleigh, NC, USA.
  Email: mshahza@ncsu.edu