Xiaochan Xue

Doctoral Student in Electrical and Computer Engineering

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SUMMARY

I am a Ph.D. candidate in Computer Engineering under the supervision of Prof. Shucheng Yu. My research focuses on wireless integrated sensing and communication (ISAC) using 5G, Sub-6GHz, Next-G, and Open Radio Access Network (O-RAN) technologies to enable secure, ultra-reliable connectivity and real-time, high-precision sensing by leveraging applied artificial intelligence (AI). I address critical challenges in privacy-preserving security for distributed devices while advancing the development of secure and adaptive cyber-physical systems (CPS) for applications in healthcare, smart cities, and beyond. I have published several high-impact research papers, including five international conference papers (four accepted, one submitted) and one scholarly journal article, all in top-ranked venues within wireless communication. Recognized for my academic and professional achievements, I was awarded the Excellence Doctoral Fellowship for the 2023-2024 academic year at Stevens and have been selected as the 2025 NSF CPS Rising Star. As a researcher at the Analytics and Information Security for Complex Systems Lab (AISecLab), I am deeply committed to developing innovative security solutions for wireless systems, driven by a passion for advancing secure, efficient, and intelligent communication technologies through both theoretical insights and practical implementations.

EDUCATION

Doctoral Degree: Stevens Institute of Technology (SIT) Major: Computer Engineering

- GPA: 4.0
- Advisor: Prof. Shucheng Yu
- Research:

<u>Dissertation Topic</u>: Harnessing Physical-Layer signals for distributed Security and Confidential Computation in NextG Wireless Systems

Master's Degree: Stevens Institute of Technology (SIT) Major: MS of Electrical Engineering

- GPA: 4.0
- **Research**: Spectrum optimization, Secrecy performance for hybrid satellite-terrestrial relay systems

Bachelor's Degree: Jilin University (JLU) Major: B.E. in Communication Engineering

• Cumulative GPA: 80.36/100, Major GPA 82/100

HONORS/AWARDS	
• 2025 NSF CPS (Cyber-Physical System) Rising Star, Vanderbilt University (Nashville, TN)	02/2025
Excellence Doctoral Fellowship, Stevens Institute of Technology	2023-2024
Graduate Conference Fund, Stevens Institute of Technology	2023-2024
Research Assistantship during Master degree, Stevens Institute of Technology	2019-2020
Third Class Scholarship, Jilin University	10/2016
Outstanding Student Leader, Jilin University	10/2016
Excellent Student Award in College, Jilin University	10/2015

Hoboken, United States start from 01/2020

01/2018-12/2019

Changchun, China

09/2013-06/2017

Hoboken, United States

TEACHING EXPERIENCE

Stevens Institute of Technology (SIT) (During Doctoral Degree)

• Position: Instructor

<u>Course: Information System Security (Graduate Level) (On-site & WebCampus)</u>
Designed and delivered course content covering cybersecurity fundamentals, network security, cryptography, and system vulnerabilities. Developed hands-on assignments and projects to help students understand secure communication protocols, authentication mechanisms, and emerging threats.

• Position: Graduate Teaching Assistant

Course: Applied Machine Learning (Graduate Level)

Supported course instruction by designing assignments, and mentoring students in applying efficient office hours to solve their problems in supervised and unsupervised learning, neural network techniques. Provided guidance for students to compromise insights about course projects.

> <u>Course: Engineering Design IV (Undergraduate Level)</u>

Instructed this senior design laboratory course for undergraduates to develop design skills and engineering judgment, based upon previous and current courses and laboratory experience, which is accomplished by participation in a design project. Projects are selected in areas of current interest such as communication and control systems, signal processing, and simulation design with MATLAB.

Stevens Institute of Technology (SIT) (During Master's Degree)

• Position: Grader

- Course: Applied Machine Learning (Graduate Level)
- > <u>Course: Linear System Theory (Graduate Level)</u>

RESEARCH EXPERIENCE

Stevens Institute of Technology (SIT) (During Doctoral Degree)

- Position: Graduate Research Assistant
 - Advisor: Prof. Shucheng Yu
 - Research Lab: AISecLab

Project.1 Physical Layer Security (PLS) in Wireless Networks for Distributed Devices

- Developed a novel trust bootstrapping protocol among devices to mitigate collaborative RF signal modification attacks without requiring additional hardware. Theoretical security analysis and experimental validation demonstrated its feasibility.
- Designed lightweight, scalable PLS-based confidential computing techniques for federated learning (FL) and multi-device collaboration. Proposed a pairwise cancellable random artificial noise (PCR-AN) scheme for AirComp-based FL to enhance model privacy against directional antenna-based eavesdropping. Theoretically analyzed secrecy capacity and FL convergence rate, ensuring privacy.

Project.2 mmWave Sensing & Integrated Sensing and Communication (ISAC)

- Developed a realistic, AI-driven sensing system for contactless breathing pattern detection using narrow sweep-band mmWave FMCW radar, achieving high detection accuracy in real-world settings.
- Implemented a contactless breathing pattern detection using mmWave OFDM signals and experimentally demonstrated its feasibility. Now working on the integration with Machine Learning, especially neural networks for data processing and pattern detection.

Project.3 Wireless Sensing in Open RAN (O-RAN) Integrated with Security & AI (Ongoing)

- Designing wireless sensing applications for distributed learning under the O-RAN framework is being designed.
- o Developing a Generative AI integrated ISAC in AI-RAN/O-RAN to build up the cyber-physical systems.

Stevens Institute of Technology (SIT) (During Master's Degree)

- Position: Research Assistant
 - Advisor: Prof. Min Song
 - Project.1 Spectrum (Channel) Utilization Optimization

08/2024-Present

01/2020-12/2023

01/2022-Present

05/2018-05/2019

05/2019-12/2019

 Designed and implemented K-RCH, an efficient channel hopping protocol for rendezvous in Cognitive Radio Networks (CRNs), enabling secondary users to dynamically access available spectrum. It is a group-based random channel hopping mechanism to improve rendezvous efficiency, improve spectral efficiency in dynamic environments, reduce time-to-rendezvous (TTR), and improve network throughput.

06/2018-08/2018

Nanjing University of Posts and Telecommunications (NJUPT) (During Master's Degree)

• Position: Visiting Researcher

Advisor: Prof. Yulong Zou

Project.1 Secrecy Performance of Hybrid Satellite-Terrestrial Relay Systems with Hardware Impairments

 Investigated the secrecy performance of hybrid satellite-terrestrial relay (HTR) systems, considering the impact of hardware impairments (HIs) on secure communications. Derived closed-form expressions for secrecy outage probability and analyzed the influence of key parameters such as relay location, eavesdropper position, and transceiver impairments.

PUBLICATIONS

International Conference Publications:

- C.1 X. Xue, S. R. Parkar, R. Li, and S. Yu, "Breathing Pattern Detection Using Narrow Sweep Band mmWave FMCW Radar," submitted.
- C.2 X. Xue, S. Yu and M. Song, "Secure Device Trust Bootstrapping Against Collaborative Signal Modification Attacks," IEEE INFOCOM 2023 - IEEE Conference on Computer Communications, New York City, NY, USA, 2023, pp. 1-10, doi: 10.1109/INFOCOM53939.2023.10229007. (19.2% acceptance rate)
- C.3 X. Xue, M. K. Hasan, S. Yu, L. N. Kandel and M. Song, "Over-the-Air Federated Learning with Enhanced Privacy," ICC 2023 - IEEE International Conference on Communications, Rome, Italy, 2023, pp. 4546-4551, doi: 10.1109/ICC45041.2023.10278765.
- C.4 X. Xue, S. Yu, M. Song and C. Xin, "K-Group Random Channel Hopping (K-RCH) Rendezvous for Cognitive Radio Networks," ICC 2021 - IEEE International Conference on Communications, Montreal, QC, Canada, 2021, pp. 1-6, doi: 10.1109/ICC42927.2021.9500643.
- C.5 H. Wu, Y. Zou, J. Zhu, X. Xue and T. Tsiftsis, "Secrecy Performance of Hybrid Satellite-Terrestrial Relay Systems with Hardware Impairments," ICC 2019 - 2019 IEEE International Conference on Communications (ICC), Shanghai, China, 2019, pp. 1-6, doi: 10.1109/ICC.2019.8761231.

Referred Journal Publications:

J.1 M. K. Hasan, X. Xue, S. Yu, and M. Song, "Cooperative NOMA-Based Spectrum Leasing With Multiple Secondary Users," in IEEE Transactions on Vehicular Technology, vol. 72, no. 11, pp. 14543-14558, Nov. 2023, doi: 10.1109/TVT.2023.3287230. (Journal Impact Factor: 6.8)

PRESENTATIONS/SEMINARS

Presentations:

- P.1 **X. Xue**, S. Yu, M. Song and C. Xin, "K-Group Random Channel Hopping (K-RCH) Rendezvous for Cognitive Radio Networks", virtual due to covid, June 15, 2021. (*Invited oral presentation on conference paper*)
- P.2 X. Xue, M. K. Hasan, S. Yu, L. N. Kandel, and M. Song, "Over-the-Air Federated Learning with Enhanced Privacy", Rome, Italy, May 29, 2023. (*Invited oral presentation on conference paper*)
- P.3 **X. Xue**, S. Yu and M. Song, "Secure Device Trust Bootstrapping Against Collaborative Signal Modification Attacks," New York area, USA, May 20, 2023. (*Invited oral presentation on conference paper*)
- P.4 X. Xue, S. Yu and M. Song, "Secure Device Trust Bootstrapping Against Collaborative Signal Modification Attacks," 1st Symposium on Emerging Topics in Networks, Systems, and Cybersecurity, Stevens Institute of Technology, NJ, USA, August 13, 2024. (*Presented the poster*)
- P.5 **X. Xue**, S. Yu, "AI-Driven Integrated Sensing and Communication (ISAC) in AI-RAN/O-RAN: Scalability, Privacy, and Security", NSF CPS Rising Star Workshop 2025 (Nashville, TN, USA) (*Poster*) (17% acceptance rate)
- P.6 **X. Xue**, S. Yu, "AI-Driven Integrated Sensing and Communication (ISAC) in AI-RAN/O-RAN: Scalability, Privacy, and Security", Stevens Institute of Technology ECE Department Research Expo, April 9, 2025. (*Poster*)

Seminar:

S.1 X. Xue, "Enhancing Security and Privacy in Distributed Wireless Networks Through Physical Layer Techniques", Stevens Institute of Technology, NJ, USA, February 26, 2025. (*Invited oral seminar*)

PROFESSIONAL DEVELOPMENT

Graduate Mentor, Department of ECE, Stevens Institute of Technology 2021-Present

- Mentored.1stJiapeng Xiao, a master student in Professor Shucheng Yu's groupHelped him design projects for his one-semester master research scholarship; taught him to operate the USRPSDR to get familiar with the operation between software and hardware.
- Mentored.2ndZhifan Jiang, a master student in Professor Shucheng Yu's groupDesigned his one-year master research scholarship topic; taught him to implement projects on LabVIEW to
operate TMYTEK mmWave antennas; instructed him to form research ideas and the academic report step by step.
He got the Excellent Research Award from the department.
- Mentored.3rd Beula Jose, a master student in Professor Shucheng Yu's groupDesigned her one-semester ongoing master project; taught her to operate the USRP SDR to implement an adversary experiment setup during the wireless communication process. She achieved good performance and built up her research sense after this periodic project training.

Mentored.4th Saurabh Raman Parkar, a master student in Professor Shucheng Yu's group

- a. Guided his projects for his one-semester master research scholarship; trained him to learn the O-RAN structure and implement data collection based on the POWDER platform and open source srsRAN with USRP SDR front ends; helped him to give an oral presentation and generate a research report. <u>He got the 1st-rank scholarship from the department</u>.
- b. Led him to form the idea to implement the TMYTEK mmWave antennas on open-source GNURadio to collect breathing signals with FMCW signals; instructed him to identify scientific problems, conceive solutions, and write a research paper to submit to a conference. <u>Paper submitted</u>.
- c. Led him to form the idea using 5G NR mmWave OFDM communication method to achieve breathing patterns detection. (Both b and c will be his Master Degree Dissertation content)

Mentored.5th Ruoxi Li, a master student in Professor Shucheng Yu's group

Guided her to familiarize herself with the communication field step by step; taught her to use the TMYTEK mmWave antennas on Labview for OFDM transmission; helped her design breathing signal collection based on CSI analysis; instructed her how to analyze and present data professionally. <u>She has already received a Ph.D. offer</u>.

2024-2025 AFRL Software Design Radio (SDR) Challenge Mentor 2024-Present Mentored a group of high school and undergraduate students to form a wireless project based on USRP SDR; taught them the implementation of MIMO setting with USRP on the MATLAB platform.

COLLABORATORS

Dr. Shucheng Yu (Stevens Institute of Technology, USA), **Dr. Min Song** (Stevens Institute of Technology, USA), **Dr. Laxima Niure Kandel** (Embry-Riddle Aeronautical University, USA), **Dr. Chunsheng Xin** (Old Dominion University, USA), **Dr. Yao Zheng** (University of Hawai'i at Mānoa, USA), **Dr. Yulong Zou** (Nanjing University of Posts and Telecommunications, CHINA)

SERVICE

Worked as a student member in several Conferences:

- IEEE International Conference on Communications
- IEEE International Conference on Computer Communications

Served as a reviewer in the International Conferences:

- International Conference on Cloud Networking
- IEEE Transactions on Vehicular Technology

SKILLS

Research:

- MATLAB, LabVIEW, GNU Radio
- Python, Visual Studio, C/C++
- O-RAN platform: POWDER, COSMOS, open source srsRAN
- Software-Defined Radios (SDRs): USRP B/N series, NI USRP 2974
- Antennas: mmWave (beamforming), low frequency (directional, omni-directional)
- Keysight, Rohde & Schwarz

Others:

- Unity
- Final Cut Pro
- Studio One
- OBS

COURSEWORK

Wireless Communications, Communication Theory, Information Systems Security, Applied Machine Learning, Special Problems in Electrical Engineering, Introduction to Control Theory, Computing Principles for Embedded Systems, Computer Architecture, Analytical Methods in Electrical Engineering, Linear System Theory, Data Acquisition, Computing Principles for Mobile and Embedded Systems, Python, C++, Advanced Math, Prob. Theory & Stat, Complex Analysis & Integral Transformation Digital Signal Processing, Random Signal Analysis, Computer Network, Information & Coding Theory, Algorithms & Data Structures, Digital Circuit & Logic Design, Analog Elect Circuits, Signals & System, High-Speed Circuit Signal Integrity Analysis & Design