Ebuka Philip Oguchi Ph.D. Candidate

CONTACT INFORMATION

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RESEARCH INTERESTS

My research focuses on cybersecurity across the agricultural, vehicular, machine learning, and molecular sectors. I specialize in ensuring message integrity and authentication for commercial off-the-shelf (COTS) wireless devices, utilizing expertise in machine learning, cryptography, and security protocols for secure communication.

EDUCATION

- **University of Nebraska, Lincoln**

  Ph.D. in Computer Science and Engineering, expected 2025
  Advisor: Prof. Nirnimesh Ghose
  CGPA: 4.0/4.0
  Research Project: Message Integrity and Authentication for COTS wireless devices

- **Changchun University of Science and Technology, China**

  Masters in Computer Applied Technology, 2020
  Advisor: Prof. Fang Ming
  CGPA: 3.87/4.0
  Research Project: Smoke Recognition Algorithm Based on ResNet and GoogleNet Networks

- **Nnamdi Azikiwe University, Awka, Nigeria**

  Bachelor of Engineering, Electronic and Computer Engineering, 2016
  Advisor: Prof. Akpado K. Aghaegbunam
  Final Project: Biometric Course Register Using Fingerprint Authentication

PUBLICATIONS

Manuscripts under Preparation

1. **Oguchi, Ebuka**; Anderson, Malcolm I; Duong, Truc Thien; Wisniewska, Anna; Ghose, Nirnimesh "Molecular Communication security - A Survey."
2. **Oguchi, Ebuka**; Lado, Hakim; Ghose, Nirnimesh; Can Vuran, Mehmet; "Channel Fingerprinting For Underground Internet-of-Things,"

Manuscripts under Review

1. **Oguchi, Ebuka**; Ghose, Nirnimesh; Can Vuran, Mehmet; "Soil Assisted Trust-Establishment For Underground Internet-of-Things," submitted to *ACM Transaction on Internet of Things (TIOT).*

Peer-Reviewed Conference Papers

1. **Oguchi, Ebuka**; Ghose, Nirnimesh; Can Vuran, Mehmet, "STUN: Secret-Free Trust-Establishment for Underground Wireless Networks," in *Proc. of 41st IEEE International Conference on Computer Communication Wrkshp (IEEE INFOCOM 2022), Virtual, Event*, pp. 1 - 6, 2nd May. 2022.
2. **Oguchi, Ebuka**; Ghose, Nirnimesh; Can Vuran, Mehmet; "VET: Autonomous Vehicular Credential Verification using Trajectory and Motion Vectors," in *Proc. of 19th EAI International Conference on Security and Privacy in Communication Networks (EAI SecureComm 2023), Hong Kong SAR, Hong Kong*, pp. 1529 - 1537, 19-21 Oct. 2023. (Acceptance rate: **28.9%**).

Poster

1. **Oguchi, Ebuka**; Ghose, Nirnimesh; Can Vuran, Mehmet, "STUN: Secret-Free Trust-Establishment for Underground Wireless Networks," in Nebraska Research Days, March 2023.

Thesis

1. **Oguchi, Ebuka**, "Smoke Recognition Algorithm Based on ResNet and GoogleNet Networks," MS thes., Changchun University of Science and Technology, 2020.

Research Projects

• **The University of Nebraska, Lincoln** January 2021 - Present

Research Assistant, Advisor: Dr. Nirnimesh Ghose

- **Agricultural IoT Security:** Tackling the essential issue of building trust within the framework of developing agricultural IoT network applications. Strategies integrate physical layer features with cryptographic primitives. In a contemporary farm environment, this research creates novel methods that allow secure operations for wirelessly equipped, scalable, and interoperable equipment. This will help reduce significant damage to farm production due to corruption of the sensitive real-time data transmitted and received by Ag-IoT sensors underground to the Over-the-Air actuator during the smart agricultural process. Thereby increasing crop yield by efficiently using human labor and natural resources. Funded by NSF under grants (CNS-2331191, CNS-2225161, CNS-1619285, ECCS-2030272).
- **Autonomous Vehicle Security:** The development of autonomous vehicles has advanced significantly; unmanned aerial aircraft, driverless cars, and many more are enhancing and securing our way of life. But this also creates a new avenue for attack: an enemy can now seize control of these self-governing devices and create potentially fatal situations. We use trajectory and motion vector data and the Doppler effect to ensure message integrity and authentication of autonomous vehicles. We formally analyze the correctness and robustness of VET using matching conversations. Our experimental tests and evaluations show that our protocol detected and removed adversaries well. Funded by Nebraska Center for Energy Sciences Research (NCESR).
- **Radio Frequency Fingerprinting - On-going:** Research on fingerprinting in underground networks for message integrity verification. This offers the cryptographic identities a sort of second-factor authentication. We identify wireless physical layer characteristics for devices and locations using machine learning methods to solve this issue. Funded by NSF under grants (CNS-2331191, CNS-2225161).

- **Molecular Communication Security - On-going:** Research on molecular communication to guarantee message integrity verification. We tackle the challenge of securing nanodevices and sensors that operate in biological environments that are different from conventional electromagnetic environments. To solve this issue, we investigate a lightweight approach to securing the communication between absorbing Alice and Bob nanodevices in the presence of an attacker, Eve, whose main goal is to bootstrap into the molecular channel to cause various harm. We study the various attacks Eve can perform and propose possible ways to secure the molecular channel. This will facilitate efficient drug delivery and nanomedicine and help to prevent bioterrorism from causing harm to the water and environment. Funded by NSF under grants (CNS-2331191, CNS-2225161).

• **Changchun University of Science and Technology, China** January 2019 - May 2020

Research Assistant, Advisor: Dr. Fang Ming

- Project Details: We implemented these neural network architectures to handle image classification tasks, focusing on optimizing the networks for smoke detection and achieving high accuracy rates. We collected real and synthetic smoke datasets and cleaned and fine-tuned the dataset for our experiment. We trained and tested our experimental data using large models like GoogleNet and ResNet models.

• **Changchun University of Science and Technology, China** June 2020 - August 2020

Research Assistant, Advisor: Dr. Chen Chunyi

- Project Details: We developed and implemented a system for processing omnidirectional images and videos, focusing on capturing, stitching, and rendering 360-degree visual content. The project involved optimizing the stitching algorithms to ensure seamless transitions between different camera feeds, enabling the creation of high-quality panoramic images and videos. This system was designed to be robust for various applications, including virtual reality environments and immersive video experiences.

• **Nnamdi Azikiwe University, Awka, Nigeria** May 2015 - June 2016

Undergrad Research Assistant, Advisor: Dr. Akpado K. Aghaegbunam

- Project Details: We implemented a biometric course register designed to register students for Electronic and Computer Engineering courses. The system authenticates students using their fingerprints to grant them access to the exam hall. This ensures that only registered students are allowed to take their exams, enhancing the security and integrity of the examination process.

Teaching Experience

- **Teaching Assistant, Cryptography & Security, CSCE 477/877:** Fall 2022
  Organized experiments, graded homework and labs, and supported students in mastering complex topics.
- **Teaching Assistant, Introduction to Computer Architecture, D.S. Adegbenro ICT Polytechnic:** Jan 2018 - May 2018
  Taught the syllabus, organized experiments, graded homework and labs, and super-

vised exams.

- **Teaching Assistant, Introduction to Computer Software, D.S. Adegbenro ICT Polytechnic:** Jan 2018 - May 2018
  Taught the syllabus, organized experiments, graded homework and labs, and supervised exams.

Industry Experience

- **Internship at Electronic Development Institute, Awka:** Oct. 2015
  Engaged in developing projects for remote control of home appliances using infrared sensors. The project involved designing and implementing systems allowing users to remotely control various home appliances through infrared communication, enhancing convenience and automation in household environments.

Professional Services and Activities

- **Conference Reviewer:**
  - EAI SecureComm, 2024

Mentorship

Mentorship Programs:

- Google CS Research Mentorship Program (CSRMP) - Class B Sept. 2023
- The Institute for African American Mentoring in Computing Sciences (iAAMCS) July. 2024

Mentees at the University of Nebraska Lincoln:

- Graduate Student: Mr. Hakim Lado - Ph.D. (Fall 2023)
- Undergraduate Student: Ms. Arielle Monson, Senior (Fall 2022)

Awards and Honors

- **Mary E. and Elmer H. Dohrmann Fellowship:** Fall 2023
- **Chinese Government Scholarship:** Oct. 2018

Certifications

- Machine Learning Summer School, University of Oxford, Aug. 2022
- CS 50AI, Harvard University via edX, Jan. 2021
- Microsoft Azure ML Scholar, Microsoft, Sept. 2020
- Stanford Code-in-Place (CS 106A), Stanford University, May 2020
- Biomedical Responsible Conduct of Research, CITI Program, Sept. 2023
- Verified International Academic Qualifications, Sept. 2020
- Machine Learning Summer School MLSS-Indo 2020, Indonesia, Aug. 2020
- AWS Machine Learning Foundations, Udacity, July 2020

Skills

Technical Proficiency:

- **Machine Learning/Artificial Intelligence:** Proficient in utilizing TensorFlow (Certified Aug. 2022) and designing and implementing machine learning models for cybersecurity and data integrity applications.
- **Software Development:** Advanced proficiency in Python for machine learning (Certified Jan. 2021), C programming for system development, and MATLAB for data analysis and algorithm development.
- **Security Protocols:** Deep understanding of cryptography and network security practices, including developing secure communication protocols using Proverif for protocol verification (Jan. 2021 to date).

Tools and Technologies:

- **Software Defined Radios (SDR):** Skilled in using Gnu-radio and USRP 2922/ B210 mini for complex wireless communications and signal processing projects (Jan. 2021 to date).
- **Data Analysis and Visualization:** Experienced in using advanced data analytics tools and methodologies to interpret and present data effectively (Jan. 2021 to date).
- **Cloud Technologies:** Proficient with Microsoft Azure (Certified Sept. 2020) and AWS Machine Learning Foundations (Certified July 2020), capable of deploying scalable and secure cloud-based applications.

Hardware and Networking:

- **Embedded Systems:** Design and implement microcontroller-based projects, including sensor data gathering systems and automation prototypes (Fall 2021).
- **Network Configuration and Security:** Practical experience in setting up and securing wireless networks, including detailed knowledge of WEP and WPA2 security (Jan. 2021 to date). protocols.
- **Hardware Design and Diagnostics:** Competent in circuit design, soldering, and hardware diagnostics essential for creating and testing electronic devices (Fall 2021).

Communication and Teaching:

- **Mentorship and Leadership:** Active in mentoring roles within academic and project settings, guiding undergraduate and graduate students in their academic and research pursuits (Fall 2022, Fall 2023).
- **Public Speaking and Presentation:** Proficient in delivering clear and effective presentations on complex technical topics in academic and professional settings (May & Dec. 2022, Oct. 2023, June & Aug. 2024).