Murtadha Alsayegh

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Research Summary

My research advances privacy-preserving computation and secure coordination for autonomous multi-robot systems, with applications in agriculture, information gathering, and critical infrastructure. I develop novel algorithms integrating secure multi-party computation (MPC), Shamir's Secret Sharing, and reinforcement learning to enable decentralized decision-making without compromising sensitive data. My work addresses fundamental challenges in scalable task allocation, resilient planning under uncertainty, and efficient communication for heterogeneous robot teams. With publications in premier venues (IEEE RA-L, IROS, CDC, CASE, ECC) and recognition as a Best Paper Finalist at CASE 2025 and ECC 2022, my research bridges theoretical foundations with real-world deployments in agricultural robotics and secure cyber-physical systems.

Education

Ph.D. Computer Science, Florida International University, Miami, FL — Aug 2024
Dissertation: *Privacy-Preserving Multi-Agent Coordination in Autonomous Systems*
M.S. Software Engineering, University of Michigan, Dearborn, MI — Apr 2013
B.S. Computer Science, Lawrence Technological University, Southfield, MI — Dec 2010

Academic Appointments

Postdoctoral Researcher, University of Central Florida, Orlando, FL — 2024 – Present

- Lead researcher on NSF-funded agricultural robotics project developing privacy-preserving frameworks for decentralized cooperative harvesting systems.
- Pioneered integration of reinforcement learning with secure task allocation algorithms (LDARA/NNDARA), achieving 30% efficiency improvements in heterogeneous robot teams.
- Mentor Ph.D. and M.S. students on research design, experimental methodology, and manuscript preparation; co-author on manuscripts under review at ICRA 2026.
- Collaborate on grant proposals for USDA and NSF programs addressing autonomous agriculture and secure robotics.
- Best Paper Finalist recognition at IEEE CASE 2025 for contributions to secure multi-robot coordination.

Graduate Research Assistant, Florida International University, Miami, FL — 2020 – 2024

- Conducted doctoral research on privacy-preserving algorithms for multi-robot task allocation and information.
- Developed oblivious Markov Decision Process (MDP) execution protocols enabling secure planning without revealing state information.
- Published co-author papers in IEEE RA-L (IF: 4.6) and multiple conference proceedings (IROS, CDC, ECC).
- Designed lightweight communication protocols reducing bandwidth requirements by 40% in distributed robot networks.

Research Interests

Core Areas: Privacy-preserving robotics, secure multi-party computation, distributed coordination, heterogeneous multi-robot systems, reinforcement learning for autonomous systems.

Application Domains: Agricultural automation, environmental monitoring and information gathering, search and rescue, warehouse logistics, cybersecurity for cyber-physical systems, SCADA and industrial control systems, smart manufacturing, disaster response, autonomous transportation, healthcare and assistive robotics.

Methodological Expertise: Shamir's Secret Sharing, oblivious computation, decentralized planning, scalable task allocation, uncertainty-aware motion control, multi-robot communication protocols.

Teaching Experience & Philosophy

Teaching Philosophy: I am committed to inclusive, research-driven pedagogy that engages students as active contributors to knowledge creation. My approach emphasizes hands-on learning, collaborative problem-solving, and connections between foundational concepts and cutting-edge research. I prioritize creating supportive environments where diverse students can thrive, particularly in STEM fields where representation matters.

Instructor of Record, Florida International University, Miami, FL 2021 – 2023

- Designed and delivered undergraduate courses in artificial intelligence, robotics fundamentals, and cybersecurity for cyber-physical systems.
- Developed lab-based curriculum integrating Python programming, robot simulation (ROS/Gazebo), and secure communication protocols.
- Adapted course materials for diverse student backgrounds, including first-generation college students and non-traditional learners.

Graduate Research Mentor, FIU IT^2 REU/RET Program 2021 – 2022

- Supervised undergraduate research teams (6–8 students annually) on projects in multi-robot coordination and secure computation.
- Guided students from project conception through publication submission; mentored students produced 3 peer-reviewed conference papers.
- Developed structured mentoring curriculum covering literature review, experimental design, scientific writing, and presentation skills.
- Facilitated K–12 outreach activities connecting research to broader STEM education goals.

Courses Prepared to Teach: Introduction to Computer Science (CS1/CS2), Data Structures and Algorithms, Artificial Intelligence, Machine Learning, Cybersecurity, Robotics and Autonomous Systems, Distributed Computing, Reinforcement Learning, Privacy-Preserving Computation.

Selected Publications

5 peer-reviewed publications in top-tier venues; 2 Best Paper Finalist recognitions; 4 first-authored works.

- **Alsayegh, M.**, Xu, Y., *A Secure MPC Framework for Decentralized Row Allocation in Cooperative Strawberry Harvesting*, IEEE International Conference on Automation Science and Engineering (CASE), 2025. **Best Paper Finalist.** [IEEE Xplore]
- Newaz, A., **Alsayegh, M.**, Alam, T., Bobadilla, L., *Decentralized Multi-Robot Information Gathering from Unknown Spatial Fields*, IEEE Robotics and Automation Letters (RA-L), vol. 8, no. 5, pp. 3070–3077, 2023. [IEEE Xplore]
- **Alsayegh, M.**, et al., *Oblivious Markov Decision Processes for Robust Robotic Policy Execution*, IEEE Conference on Decision and Control (CDC), 2023. [IEEE Xplore]
- **Alsayegh, M.**, et al., *Privacy-Preserving Multi-Robot Task Allocation via Secure Multi-Party Computation*, European Control Conference (ECC), 2022. **Best Paper Finalist.** [IEEE Xplore]
- **Alsayegh, M.**, et al., *Lightweight Multi-Robot Communication Protocols for Information Synchronization*, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020. [IEEE Xplore]

Invited Talks & Scholarly Presentations

- *Privacy-preserving methods in agricultural robotics with a focus on harvesting systems*, Expanding AI/AgAAID Symposium, University of Central Florida, Orlando, FL, September 2025.
- *Secure Multi-Robot Computation for Heterogeneous Teams: Foundations and Applications*, FIU Knight Foundation School of Computing and Information Sciences Lecture Series, Miami, FL, April 2024.
- Multiple conference presentations at IEEE IROS, CDC, ECC, and CASE (2020–2025), disseminating research to international audiences.

Honors & Awards

- Best Paper Finalist, IEEE Conference on Automation Science and Engineering (CASE), 2025
- Best Paper Finalist, European Control Conference (ECC), 2022
- FIU Excellence in Mentorship Award, 2022

Research Funding & Grant Activity

- Contributing researcher on USDA-funded project: Privacy-Preserving Frameworks for Agricultural Robotics (2024–Present, PI: Prof. Y. Xu).
- Co-author on pending NSF CAREER proposal: Secure Coordination for Heterogeneous Multi-Robot Systems (submitted 2025).
- Graduate research supported by FIU Presidential Fellowship and departmental assistantships (2020–2024).

Professional Service & Leadership

Peer Review:

- Reviewer for IEEE International Conference on Robotics and Automation (ICRA) 2025
- Reviewer for IEEE Robotics and Automation Letters (RA-L), IEEE/RSJ IROS, IEEE CDC, ECC, IEEE CASE
- Completed 10+ reviews for top-tier conferences and journals (2022–Present)

Outreach & Engagement:

- Panelist for K–12 STEM outreach events at FIU and UCF, engaging students annually in robotics demonstrations and career discussions.
- Volunteer mentor for underrepresented students in computing through FIU STARS Alliance and similar programs.

Professional Memberships:

- IEEE Robotics and Automation Society (Member, 2019–Present)
- IEEE Computer Society (Member, 2020–Present)
- ACM Special Interest Group on Artificial Intelligence (SIGAI, Member, 2021–Present)

Industry & Applied Experience

Automation Engineer, Schneider Electric, Saudi Arabia 2013 – 2018

- Led implementation of IEC-62443-compliant cybersecurity measures for SCADA and industrial control systems (ICS) serving energy and water infrastructure.
- Designed fault-tolerant automation architectures reducing system downtime by 25% for critical operations.
- Conducted comprehensive vulnerability assessments across 15+ facilities, mitigating cyber risks by 40% through protocol hardening and network segmentation.
- Bridged academic research and real-world deployment, informing later doctoral work on secure cyber-physical systems.

Technical Skills & Research Tools

Programming & Frameworks: Python, C++, ROS/ROS2, Gazebo, TensorFlow, PyTorch, OpenMP, MPI.
Research Methods: Secure multi-party computation protocols, Shamir's Secret Sharing, reinforcement learning (Q-learning, DQN), distributed optimization, graph-based task allocation, simulation-based validation, field robotics experimentation.
Cybersecurity & Infrastructure: SCADA/ICS security (IEC-62443), network protocol analysis, vulnerability assessment, penetration testing, secure communication design.