Sean O'Connor

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Research Interests

My research focuses on advancing human-robot interaction through improved experimental methodologies and accessible research tools. I am particularly interested in Wizard-of-Oz experimental frameworks, reproducibility in HRI studies, and developing platforms that democratize access to HRI research across disciplines. My work with HRIStudio addresses critical challenges in experimental reproducibility and cross-platform robot control, enabling researchers without specialized programming expertise to conduct rigorous HRI studies. I am passionate about exploring how we can make robot behaviors more trustworthy and explainable, particularly through transparent experimental design and comprehensive data logging. Looking forward, I aim to investigate how standardized experimental frameworks can advance our understanding of human-robot trust, collaboration dynamics, and the design of intuitive robot interfaces across diverse application domains.

Education

Boston University **Boston, MA**
Master of Science in Computer Engineering **Expected May 2027**

Bucknell University **Lewisburg, PA**
Bachelor of Science in Computer Science and Engineering, Honors **May 2026**
Engineering GPA: 3.92/4.0 • Overall GPA: 3.71/4.0 • Magna Cum Laude • Dean's List: Seven Semesters
James M. Pommersheim Research & Innovation in Engineering Award — awarded to the engineering student who has achieved through creative effort outstanding work of scholarship or invention

Publications

[1] Sean O'Connor. A web-based wizard-of-oz platform for collaborative and reproducible human-robot interaction research. Bachelor's honors thesis, Bucknell University, Lewisburg, PA, 2026.

[2] Sean O'Connor and L. Felipe Perrone. HRIStudio: A Framework for Wizard-of-Oz Experiments in Human-Robot Interaction Studies (Late Breaking Report). In *2024 33rd IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)*, 2024.

[3] Sean O'Connor and L. Felipe Perrone. A Web-Based Wizard-of-Oz Platform for Collaborative and Reproducible Human-Robot Interaction Research. In *2025 34th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)*, Eindhoven, The Netherlands, 2025.

Research Experience

Human-Robot Interaction Research **Bucknell University**
Lead Researcher - HRIStudio Platform Development **Jan 2023 – Present**
Advisor: Dr. L. Felipe Perrone, Computer Science Department
Research Commitment: 3.5 credits of individual study (CSCI 278/378) across 6 semesters

- Developing HRIStudio, a novel web-based platform addressing reproducibility challenges in Wizard-of-Oz HRI studies, with two first-author publications at IEEE RO-MAN 2024 and 2025
- Architected modular plugin system enabling cross-platform robot control (NAO, Pepper, custom platforms) through JSON-defined interfaces, eliminating need for specialized programming knowledge
- Implemented WebSocket-based bidirectional communication protocols for low-latency robot teleoperation with real-time state synchronization
- Designed comprehensive data logging system capturing interaction timelines, robot states, and experimental conditions with microsecond precision for reproducibility analysis
- Developed RESTful API leveraging Robot Operating System (ROS) for extensible robot integration across multiple platforms
- Currently developing honors thesis evaluating platform effectiveness through user studies and analyzing impact on interdisciplinary HRI research accessibility
- Conducted systematic literature review identifying key challenges in WoZ methodology reproducibility, informing platform design decisions and feature prioritization

Interdisciplinary Research Collaboration **Bucknell University**
Computer Science Research Assistant - Chemical Engineering Department **Aug 2023 – May 2025**
Collaborating with Chemical Engineering Department on Environmental Monitoring

- Developed automated data collection and analysis tools for environmental research, processing real-time sensor data streams for atmospheric and water quality monitoring

- Built custom Python pipelines integrating multiple data sources, enabling researchers to identify patterns in environmental data that informed conference presentations
- Bridged computer science expertise with domain-specific research needs, demonstrating ability to collaborate across disciplines

RoboLab@Bucknell **Bucknell University**
Founding Member and Research Participant **Sep 2023 - Present**
Interdisciplinary lab bridging Computer Science and Psychology perspectives on HRI

- Participate in weekly research seminars exploring human-robot trust, automation bias, and ethical implications of autonomous systems
- Contribute to discussions on experimental design for HRI studies, bringing technical perspective to psychological research questions

Teaching Experience

Computer Science Department **Bucknell University**
Teaching Assistant - Software Engineering & Design **Jan 2024 - Present**

- Mentor 150+ students in software engineering principles, design patterns, and collaborative development practices
- Developed automated testing frameworks with personalized feedback, improving learning outcomes while streamlining assessment processes
- Created supplementary materials connecting theoretical concepts to real-world applications, drawing from industry experience
- Hold regular office hours and code review sessions, fostering deep understanding of software architecture principles

Computer Science Tutor - Engineering Study Spot **Aug 2024 - Dec 2024**

- Provided one-on-one tutoring across the entire computer science curriculum, from introductory programming to advanced algorithms
- Developed personalized learning strategies for students with diverse backgrounds and learning styles

Engineering Department **Bucknell University**
Teaching Assistant - Engineering Design Experience **Aug 2023 - Dec 2023**

- Guided 40+ engineering students through Arduino programming and breadboard circuit design
- Supervised hands-on laboratory sessions involving microcontroller programming and sensor integration
- Facilitated discussions on engineering ethics and the societal implications of embedded system design

Physics Department **Bucknell University**
Teaching Assistant - Experimental Physics Laboratory **Aug 2023 - May 2024**

- Instructed 100+ students in experimental design, data analysis, and scientific writing
- Emphasized connection between theoretical physics principles and experimental validation
- Guided students through error analysis and uncertainty quantification in experimental measurements

Selected Projects

Computer System from Scratch - Nand2Tetris (ECEG 431) **HDL/Assembly/Java**

- Built complete computer system from NAND gates through operating system, demonstrating comprehensive understanding of computer architecture
- Designed and simulated all hardware components including logic gates, ALU, RAM, and CPU using hardware description language
- Developed complete software stack: assembler for machine code translation, virtual machine translator for intermediate code, and compiler for high-level object-oriented language
- Implemented functional operating system with memory management, I/O handling, and graphics capabilities
- Technologies: Hardware Description Language (HDL), Assembly, Jack (object-oriented language), Java

HRIStudio - Web-Based Wizard-of-Oz Platform **TypeScript/React/WebRTC**

- Architected full-stack web application for managing HRI experiments with real-time robot control interfaces
- Implemented WebSocket-based bidirectional communication protocols for low-latency robot teleoperation
- Designed RESTful API leveraging Robot Operating System with JSON-defined plugins for extensibility across multiple robot platforms
- Created comprehensive logging system capturing interaction data, timestamps, and experimental conditions for reproducibility
- Technologies: Next.js, React, TypeScript, Node.js, WebSockets, PostgreSQL, Docker

Autonomous Vehicle Control System - Chem-E-Car Competition **C++/Arduino**

- Designed embedded control system for autonomous hydrogen fuel cell-powered vehicle using finite state machine architecture
- Implemented real-time sensor fusion combining spectrometer readings and power monitoring with calculated stopping algorithms

- Developed PlatformIO-based build system with hardware abstraction layer for testing and simulation
- Achieved precise distance control (±10cm) through chemical reaction timing at AIChE National Competition
- Technologies: C++, Arduino, PlatformIO, I2C/SPI protocols, finite state machines

Formula One Performance Prediction Using Machine Learning **Python/ML**

- Developed ensemble machine learning models (LightGBM, XGBoost, Random Forest) to predict F1 lap times with high accuracy
- Engineered features from weather data, track characteristics, and historical performance using domain knowledge
- Implemented cross-validation and hyperparameter optimization for model evaluation across multiple racing circuits
- Analyzed feature importance to understand factors influencing racing performance
- Technologies: Python, LightGBM, XGBoost, Random Forest, pandas, scikit-learn, FastF1 API

Real-time Racing Statistics Platform **TypeScript/Next.js**

- Built production system serving 1500+ concurrent users and 250k+ monthly visitors
- Implemented WebSocket-based real-time data streaming with automatic reconnection and state synchronization
- Designed responsive UI with accessibility features meeting WCAG 2.1 AA standards
- Optimized database queries reducing page load times by 60% through intelligent caching and indexing
- Technologies: Next.js, TypeScript, PostgreSQL, Docker, DigitalOcean

Professional Experience

Riverhead Raceway **Riverhead, NY**
Software Developer **Oct 2020 – Present**

- Architected and deployed production systems handling 250k+ monthly users and $100,000+ in payment processing
- Led digital transformation initiative, replacing legacy paper-based systems with modern web applications
- Implemented CI/CD pipelines, containerization, and infrastructure as code using Docker and GitHub Actions
- Developed RESTful APIs and microservices architecture for scalable, maintainable systems

IT Administrator **Oct 2020 - Apr 2024**

- Modernized IT infrastructure from consumer to enterprise-grade systems, improving uptime to 99.9%
- Implemented comprehensive backup and disaster recovery protocols protecting critical business data
- Automated system administration tasks using PowerShell and Bash scripting

Miller Place School District **Miller Place, NY**
Information Technology Intern **Sep 2020 - May 2022**

- Supported 1000+ students and faculty during COVID-19 transition to remote learning
- Deployed and maintained educational technology platforms and troubleshooted hardware/software issues

Leadership & Activities

AIChE Chem-E-Car Competition Team **Bucknell University**
President, Electrical/Mechanical Team Lead **Jan 2023 – Present**

- Led 15-member interdisciplinary team in designing autonomous chemical-powered vehicles for national competition
- Introduced agile development methodologies and version control practices to hardware development process
- Mentored junior members in embedded systems programming and control theory

Bucknell Coffee Society **Bucknell University**
Co-Founder and Treasurer **Oct 2023 – Present**

- Co-established campus organization promoting coffee education and community building
- Manage $5,000+ annual budget, coordinate events, and maintain vendor relationships
- Organized educational workshops on coffee science, brewing techniques, and sustainability

Conferences & Presentations

IEEE RO-MAN 2025 **Eindhoven, The Netherlands**
34th International Conference on Robot and Human Interactive Communication **Aug 2025**

- Presented: "A Web-Based Wizard-of-Oz Platform for Collaborative and Reproducible Human-Robot Interaction Research"

IEEE RO-MAN 2024 **Pasadena, CA**
33rd International Conference on Robot and Human Interactive Communication **Aug 2024**

- Presented: "HRIStudio: A Framework for Wizard-of-Oz Experiments in HRI Studies" (Late Breaking Report)

AIChE Annual Student Conference **San Diego, CA**
Chem-E-Car Performance Competition **Oct 2024**

- Competed in National Chem-E-Car Performance Competition with autonomous hydrogen fuel cell vehicle
- Presented poster on safety-critical embedded systems design

AIChE Mid-Atlantic Regional Conference **UMBC, Baltimore, MD**
Chem-E-Car Performance Competition **Apr 2024**

- Placed 2nd overall in regional Chem-E-Car Competition

Relevant Coursework

Robotics & Human-Robot Interaction: Human-Robot Interaction, Individual Study in HRI (3.5 credits)
Artificial Intelligence & Machine Learning: Artificial Intelligence with Neural Nets (in progress), Data Mining, Image Processing & Analysis (in progress)
Systems & Embedded: Operating Systems Design, Computer Systems, Embedded Computer Systems, Real-time Control Systems
Software Engineering: Software Engineering & Design, Algorithm Design & Analysis, Programming Language Design
Research Methods: Research Methods in Computer Science, Probability & Statistics, Experimental Design

Technical Skills

Robotics & HRI: ROS/ROS2, Gazebo, NAO/Pepper SDK, WebSockets, Wizard-of-Oz Methodology, Robot Teleoperation, Computer Vision
Embedded Systems & Hardware: Arduino, Raspberry Pi, I2C/SPI Protocols, Sensor Integration, Real-time Control, Finite State Machines
Machine Learning & AI: PyTorch, TensorFlow, scikit-learn, LightGBM, XGBoost, OpenCV, pandas, numpy, Jupyter
MLOps & AI Deployment: Weights & Biases (W&B), HuggingFace Transformers, Experiment Tracking, Model Versioning, Transfer Learning
Programming Languages: Python, C/C++, JavaScript/TypeScript, Java, MATLAB, SQL, Bash, LaTeX
Research & Development: Git/GitHub, Docker, Experimental Design, Statistical Analysis (R), Data Visualization, Technical Writing
Web & Systems: React, Node.js, Next.js, REST APIs, PostgreSQL, Linux, Cloud Computing, Distributed Systems

Honors & Awards

- James M. Pommersheim Research and Innovation in Engineering Award — Bucknell University College of Engineering (2026)
- Dean's List (7 semesters): Fall 2022, Fall 2023, Spring 2024, Fall 2024, Spring 2025, Fall 2025, Spring 2026
- GPA: 3.71/4.0 • Engineering GPA: 3.92/4.0 • Magna Cum Laude
- AIChE Mid-Atlantic Chem-E-Car Competition - 2nd Place (2024)