

Paul J Bonczek

Robotics and Autonomous Systems Researcher

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AMR Lab Webpage: bezzorobotics.com/paul-bonczek

EDUCATION

Ph.D. in Electrical Engineering

December 2022

University of Virginia, Charlottesville, VA

Advisor: Nicola Bezzo (bezzorobotics.com)

Dissertation Title: Randomness-based Detection and Recovery for Resilient Autonomous Robot Operations

M.E. in Electrical Engineering

May 2021

University of Virginia, Charlottesville, VA

Focus: Robust Automatic Control

B.S. in Electrical Engineering and Applied Mathematics (Double Major)

May 2016

State University of New York (SUNY) Polytechnic Institute, Utica, NY

A.A.S. in Electrical Technology

May 2013

SUNY Onondaga Community College, Syracuse, NY

WORK EXPERIENCE

Senior Professional Staff

January 2023 – Present

Johns Hopkins University Applied Physics Laboratory, Laurel, MD

- Sensor data fusion and tracking systems research engineer to support the United States Navy's Cooperative Engagement Capability (CEC) and Marine Corps sensor systems.

RESEARCH EXPERIENCE

Graduate Research Assistant

January 2018 – December 2022

University of Virginia, Charlottesville, VA

- Designed multiple randomness-based monitors to detect stealthy sensor attacks on cyber-physical systems with modeled measurement and process uncertainties.
- Compared detection results of randomness-based monitors to traditional magnitude-based attack detectors in discovering stealthy sensor cyber-attacks hidden within system noise profiles.
- Developed a multi-agent system simulator in MATLAB to study the effects of stealthy cyber attacks to sensors and communication broadcast information on proximity-based formations.
- Examined randomness-based detection capabilities in multi-robot swarms to resiliently maintain operations under stealthy sensor and communication attacks.
- Characterized a multi-agent system framework that can covertly relay safety-critical information through hidden motion signatures while maintaining operations during malicious communication attacks.
- Investigated cooperative behaviors in multi-agent systems to aid in recovery/re-localization of vehicles subject to sensor attacks/faults that compromise localization capabilities and formation control performance.
- Formalized a detection and recovery framework to enable resilient navigation capabilities for mobile robots during cyber attacks and faults to on-board controllers.

RESEARCH INTERESTS

Resilient Multi-agent Systems ♦ Runtime Monitoring and Detection ♦ Robust Control and Autonomy
Adaptive Systems ♦ Robotic Swarms ♦ Resilient State Estimation ♦ Artificial Intelligence

PUBLICATIONS

- [1] **P.J. Bonczek** and N. Bezzo, "RSSI-based Localization with Adaptive Noise Covariance Estimation for Resilient Multi-Agent Formations," IEEE American Control Conference (ACC), pp. 4215-4222, **2023**. DOI: [10.23919/ACC55779.2023.10156301](https://doi.org/10.23919/ACC55779.2023.10156301)
- [2] **P.J. Bonczek** and N. Bezzo, "*Resilient Detection and Recovery of Autonomous Systems Operating under On-board Controller Cyber Attacks*," accepted for publication to the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), **2022**. DOI: [10.1109/IROS47612.2022.9981844](https://doi.org/10.1109/IROS47612.2022.9981844)
- [3] **P.J. Bonczek**, R. Peddi, S. Gao, and N. Bezzo, "*Detection of Non-random Sign-based Behavior for Resilient Coordination of Robotic Swarms*", in IEEE Transactions on Robotics (T-RO) Special Issue on Resilience in Networked Robotic Systems, vol. 38, no. 1, pp. 92-109, Feb. **2022**. DOI: [10.1109/TRO.2021.3139592](https://doi.org/10.1109/TRO.2021.3139592)
- [4] **P.J. Bonczek** and N. Bezzo, "*Detection and Inference of Randomness-based Behavior for Resilient Multi-vehicle Coordinated Operations*," IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 5844-5850, **2021**. DOI: [10.1109/IROS51168.2021.9635899](https://doi.org/10.1109/IROS51168.2021.9635899)
- [5] **P.J. Bonczek** and N. Bezzo, "*Detection of Hidden Attacks on Cyber-Physical Systems from Serial Magnitude and Sign Randomness Inconsistencies*," IEEE American Control Conference (ACC), pp. 3281-3287, **2021**. DOI: [10.23919/ACC50511.2021.9482962](https://doi.org/10.23919/ACC50511.2021.9482962)
- [6] **P.J. Bonczek** and N. Bezzo, "*Memoryless Cumulative Sign Detector for Stealthy CPS Sensor Attacks*," 21st International Federation of Automatic Control (IFAC) World Congress, vol. 53, no. 2, pp. 838-844, **2020**. DOI: [10.1016/j.ifacol.2020.12.840](https://doi.org/10.1016/j.ifacol.2020.12.840)
- [7] **P.J. Bonczek**, S. Gao, and N. Bezzo, "*Model-based Randomness Monitor for Stealthy Sensor Attacks*," IEEE American Control Conference (ACC), pp. 2036-2042, **2020**. DOI: [10.23919/ACC45564.2020.9147412](https://doi.org/10.23919/ACC45564.2020.9147412)

Under Review

- [U1] **P.J. Bonczek** and N. Bezzo, "*A Cooperative Recovery Framework for Multi-robot Operations under Loss of Localization*," submitted to the IEEE Robotics and Automation Letters (RA-L)

In Preparation

- [P1] **P.J. Bonczek** and N. Bezzo, "*Cooperative Robot Teams for Defending Against Malicious Intruders*", in preparation for submission to the IEEE Transactions on Robotics (T-RO).
- [P2] **P.J. Bonczek**, "*Randomness-based Anomaly Detector for Stealthy Sensor Attacks on Cyber-Physical Systems via Asymptotic Wald-Wolfowitz Runs Test*", in preparation for submission to the IEEE Control Systems Letters.

SKILLS

Programming: Proficient in MATLAB. Familiarity with Python, C++, R, ROS
Tools: LaTeX, ADVISER, Simulink, Microsoft Office, GitHub, GitLab, iMovie, Arduino, Raspberry Pi

TEACHING EXPERIENCE

Graduate Teaching Assistant

University of Virginia, Charlottesville, VA

Electromagnetic Energy Conversion (Grading and Lab Instructor)	Spring 2020
ECE Capstone (Advisement, Discussion, and Grading)	Fall 2017
• <i>Advised (approximately 25) undergraduate students with senior capstones projects.</i>	
Fundamentals II (Grading)	Spring 2017
Fundamentals III (Grading)	Spring 2017
ECE Capstone (Advisement, Discussion, and Grading)	Fall 2016
• <i>Advised (approximately 25) undergraduate students with senior capstones projects.</i>	

PRESENTATIONS

UVA Link Lab Student Flash Talks	2020
University of Virginia Engineering Research Symposium (UVERS) Finalist	2020
UVA Link Lab Student Research Poster and Talk	2019
UVA ECE Student Research Poster Session	2018

PROFESSIONAL EXPERIENCE

Engineering Intern	Summer 2016
<i>Griffiss Institute at the Air Force Research Laboratory (AFRL), Rome, NY</i>	
<ul style="list-style-type: none">• Worked with a team of interns to set up and test a photonic-based neuromorphic computer.• Learned to wire-bond.	
Engineering Intern	Summer 2015
<i>Griffiss Institute at the Air Force Research Laboratory (AFRL), Rome, NY</i>	
<ul style="list-style-type: none">• Designed and built an analog PID controller for an inverted pendulum as a test case for adaptive abilities using memristors.	
Engineering Intern	Summer 2014
<i>Griffiss Institute at the Air Force Research Laboratory (AFRL), Rome, NY</i>	
<ul style="list-style-type: none">• Hardware testing to observe switching resistive properties of memristor devices.	
Engineering Intern	July 2013 – May 2014
<i>IR Cameras, LLC, Utica, NY</i>	
<ul style="list-style-type: none">• Quality control testing for the packaging assembly of Infrared (IR) cameras.	

PROFESSIONAL ACTIVITIES

Scientific Paper Reviewer

IEEE American Control Conference (ACC)	2019, 2020, 2022, 2023
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)	2021, 2022
IEEE Transactions on Robotics (T-RO)	2021, 2022
International Conference on Cyber-Physical Systems (ICCPs)	2021
IEEE International Conference on Robotics and Automation (ICRA)	2021
International Federation of Automatic Control (IFAC) World Congress	2020
IEEE Conference on Decision and Control (CDC)	2019, 2022
IEEE Robotics and Automation Letters (RA-L)	2019
IEEE Mediterranean Conference on Control and Automation (MED)	2022

MembershipsInstitute of Electrical and Electronics Engineers (IEEE), *Student member*

2019 – Present

IEEE Societies: Young Professionals (YP), Robotics and Automation (RAS),

Control Systems (CSS), Aerospace and Electronic Systems (AESS),

Information Theory (ITSOC), Intelligent Transportation Systems (ITSS),

Systems, Man, and Cybernetics (SMC)

AWARDS & CERTIFICATES**Coursera Deep Learning Specialization**

2020

ID: 58HLTKUBXRR2

Academic Achievement Award

2016

SUNY Polytechnic Institute, Utica, NY

- Highest GPA for Applied Mathematics courses upon graduation (4.0/4.0)

President's Honor List

Fall 2014, Spring 2015, Fall 2015, Spring 2016

SUNY Polytechnic Institute, Utica, NY

RELEVANT COURSEWORK

- Autonomous Mobile Robotics
- Multivariable Robust Control Theory
- Digital Control Theory
- Adaptive Control Theory
- Linear Control Systems
- Nonlinear Control Theory
- Probability and Stochastic Processes
- Reinforcement Learning
- Machine Learning

PERSONAL INTERESTS

Pickleball ♦ Cooking ♦ Scuba diving ♦ Hiking ♦ WWII history