

Paul J Bonczek

Robotics and Autonomous Systems Researcher

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EDUCATION

Ph.D. in Electrical Engineering

Expected Fall 2022

University of Virginia, Charlottesville, VA

Topic: *Randomness-based Behavior Monitoring for Resilient Autonomous Systems Operations*

Advisor: Nicola Bezzo (bezzorobotics.com)

M.E. in Electrical Engineering

May 2021

University of Virginia, Charlottesville, VA

Focus: Robust Automatic Control

B.S. in Electrical & Computer Engineering and Applied Mathematics (Dual 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

RESEARCH EXPERIENCE

Graduate Research Assistant

January 2018 – Present

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

- ♦ Cyber-Physical System Security ♦ Runtime Monitoring and Detection ♦ Resilient Multi-agent Systems
♦ Adaptive Systems ♦ Robotic Swarms ♦ Secure Control and Autonomy ♦ Artificial Intelligence

PUBLICATIONS

- [1] **P.J. Bonczek**, 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**. (To be presented in Kyoto, Japan in October)
- [2] **P.J. Bonczek**, R. Peddi, S. Gao, 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)
- [3] **P.J. Bonczek**, 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)
- [4] **P.J. Bonczek**, 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)
- [5] **P.J. Bonczek**, 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)
- [6] **P.J. Bonczek**, S. Gao, 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)

In Preparation

- [P1] **P.J. Bonczek**, N. Bezzo, “*A Cooperative Recovery Framework for Safe Multi-robot Operations: Exploiting Randomness*,” in preparation for submission to IEEE Robotics and Automation Letters (RA-L).
- [P2] **P.J. Bonczek**, N. Bezzo, “*Resilient Multi-agent Formation Control via RSSI-based Localization*,” to be submitted to the 2023 IEEE American Control Conference (ACC). (*Manuscript is complete*)
- [P3] **P.J. Bonczek**, N. Bezzo, “*Cooperative Robot Teams for Defending Against Malicious Intruders*,” in preparation for submission to the 2023 IEEE International Conference on Robotics and Automation (ICRA).

TEACHING EXPERIENCE

Graduate Teaching Assistant

University of Virginia, Charlottesville, VA

ECE Capstone (Advisement, Discussion, and Grading)

Fall 2016, Fall 2017

- Advised (~50 students) undergraduate students with senior capstone projects.

Fundamentals II (Grading)

Spring 2017

Fundamentals III (Grading)

Spring 2017

Electromagnetic Energy Conversion (Grading and Lab Instructor)

Spring 2020

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

Griffiss Institute at the Air Force Research Laboratory (AFRL), Rome, NY

- Worked with a team of interns to set up and test a photonic-based neuromorphic computer.
- Learned to wire-bond.

Engineering Intern

Summer 2015

Griffiss Institute at the Air Force Research Laboratory (AFRL), Rome, NY

- Designed and built an analog PID controller for an inverted pendulum as a test case for adaptive abilities using memristors.

Engineering Intern

Summer 2014

Griffiss Institute at the Air Force Research Laboratory (AFRL), Rome, NY

- Hardware testing to observe switching resistive properties of memristor devices.

Engineering Intern

July 2013 – May 2014

IR Cameras, LLC, Utica, NY

- Quality control testing for the packaging assembly of Infrared (IR) cameras.

PROFESSIONAL ACTIVITIES

Scientific Paper Reviewer

IEEE American Control Conference (ACC)	2019, 2020, 2022
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)	2021, 2022
IEEE Transactions on Robotics (T-RO)	2021
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
Learning for Dynamics and Control Conference (L4DC)	2022

Memberships

Institute of Electrical and Electronics Engineers (IEEE), <i>Student member</i>	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

SKILLS & INTERESTS

Programming: Proficient in MATLAB. Familiarity with Python, C++, R, ROS, Arduino
Tools: LaTeX, Simulink, Microsoft Office, GitHub, iMovie
Interests: Pickleball, cooking, scuba diving, hiking, WWII history