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.

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

[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

[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](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

[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](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).

[P4] **P.J. Bonczek**, N. Bezzo, "*A Characterization of a Run Randomness Detector for Stealthy Sensor Attacks on Cyber-Physical Systems*," in preparation for submission to IEEE Control Systems Letters (L-CSS).

RESEARCH INTERESTS

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

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*

- *Advised (approximately 25) undergraduate students with senior capstones projects.*

Fundamentals II (Grading)	*Spring 2017*
Fundamentals III (Grading)	*Spring 2017*
ECE Capstone (Advisement, Discussion, and Grading)	*Fall 2016*

- *Advised (approximately 25) undergraduate students with senior capstones projects.*

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), *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

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

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