

## Background

I am a research fellow awarded the 2023 [EPSRC Doctoral Prize Research Fellowship](#) for the topic “Reliable AI-Enabled Design of Cyber-Physical Systems”. My research focus is the provision of rigorous mathematical guarantees over the behaviour of cyber-physical systems particularly for safety-critical domains. Lately, my research has involved designing software tools to implement both abstraction and barrier certificate approaches, as well as theoretically providing guarantees over systems where the underlying model is (partially) unknown but we have access to some data.

I have contributed to the international academic community with published works, program committee memberships, paper reviews, and conference presentations. I was also a website chair for the VARS2021 Workshop, a part of [CPS-IoT week](#). I have been invited to give multiple (in-person) talks on my research, including internationally (TU Eindhoven, UC Louvain, and Vanderbilt University). I was a guest speaker at the [PARTNERS24](#) ‘Ask the Experts’ event (2024) and the Open Research Conference (2025), both hosted by Newcastle University.

Previously, I was a PhD student in the [School of Computing](#) at [Newcastle University](#), United Kingdom, supervised by [Dr Sadeqh Soudjani](#) - I was awarded an EPSRC Studentship in October 2019. I graduated November 2023. My research focused on the intersection of formal methods in computer science and control theory applied to power system frequency regulation. I considered both model-based and data-driven approaches. In 2019, I completed an integrated Masters in Computing (MComp) in Computer Science (Security and Resilience) with 1st Class Honours also at [Newcastle University](#). For the project and dissertation I received a score of 92%.

At [Newcastle University](#), between 2019 and 2023 I was the Group Seminar Chair of [AMBER](#), organising seminars and other group activities. I have given multiple internal research presentations, and assisted widely by teaching as a demonstrator and marking. I have experience with supervising BSc, MSc and PhD student projects. Alongside these I was the co-lead of research communication and dissemination in the [HyCoDeV Lab](#).

---

## Academic Degrees

Oct.19-Nov.23 **PhD** in Formal Methods for Cyber-Physical Systems, School of Computing, **Newcastle University, UK**  
Thesis title: *Model-Based and Data-Driven Formal Synthesis of Power Systems*

Oct.15-Sep.19 **M.Comp (Hons.)** in Computer Science (Security and Resilience), **Newcastle University, UK**  
Dissertations: (i) *Using Formal Methods and Proof to Verify a CANDO Epilepsy Medical Device (2019)*  
(ii) *Modelling Computer Security Principles as a Strategy Game (2018)*

## Research Interests

*Trustworthy Autonomy & AI, Cyber-Physical Systems, Formal Learning & Control, Data-Driven Methods, Abstraction Techniques, Control Barrier Certificates*

## Honours and Awards

June.25 Selected as Newcastle University applicant for [Royal Academy of Engineers Fellowship](#) [**16.67% Acceptance**]  
June.25 2<sup>nd</sup> place - ARCH 2025 Best Result Award  
Nov.23-Nov.25 EPSRC Doctoral Prize Research Fellowship (£93,000) [**7% Acceptance**]  
Oct.19-Mar.23 EPSRC PhD Studentship (£68,362)  
Oct.15-Sep.20 Newcastle University Sports Scholarship

## Invited Talks and Panels

[Aug. 25] *upcoming*, **Max Planck Institute**, DE.  
[Jun. 25] *Open-Source Software Tools for Research*, Open Research Conference, **Newcastle University**, UK.  
[Jun. 25] *IMPACT: Abstraction and Control Design for Large-Scale Stochastic Systems using Interval MDPs*, **UCLouvain**, BE.  
[May. 25] *Safety Barrier Certificates and Data-Driven k-Inductive Safety Control Barrier Certificates for Nonlinear Systems*, **Vanderbilt University**, US.  
[Feb. 25] *Data-Driven k-Inductive Safety Control Barrier Certificates for Nonlinear Systems*, **TU Eindhoven**, NL.  
[Dec. 24] *Safety Barrier Certificates for Nonlinear Systems*, School of Computing and Communications, **Lancaster University**, UK.  
[Nov. 24] *IMPACT: A software tool for controller synthesis of stochastic systems using interval Markov decision processes*, Software Systems Group (SSY) Seminar, **Kings College London**, UK.  
[Nov. 24] *Safety Barrier Certificates for Nonlinear Polynomial Systems*, Institute of Perception, Action and Behaviour (IPAB) Seminar, **Edinburgh University**, UK.  
[Nov. 24] *IMPACT: A software tool for controller synthesis of stochastic systems using interval Markov decision processes*, Scientific Computing (SciComp) Seminar, **Durham University**, UK.  
[Jul. 24] “Ask the Experts” Session, **PARTNERS24**, **Newcastle University**, UK.

[The PARTNERS program intends to inspire and support young people who may have barriers that make it less likely they would attend university.]

## Publications: Journal

- [J5] **B. Wooding**, O. Schön, “Formal Learning for Uncertainty-Aware Embodied AI”, *Philosophical Transactions of the Royal Society A*, 2025 [**Invited Submission for Theme Issue on “Safe, Secure and Robust AI for Safety-Critical Systems”**] (due August 2025)
- [J4] **B. Wooding**, A. Lavaei, “Learning k-Inductive Control Barrier Certificates for Unknown Nonlinear Dynamics Beyond Polynomials”, *under revise and resubmit in Automatica*, 2024
- [J3] A.S. Laino, **B. Wooding**, S. Soudjani, R. Davenport, “Logic-Based Robustness for Resilience of Water Resource Recovery Facilities (WRRFs)”, *Environmental Science: Water Research & Technology*, 2024 [**1 of 20 papers (8.5% of eligible papers) chosen for the themed collection — Highlights from Environmental Science: Water Research & Technology in 2024**]
- [J2] **B. Wooding**, S. Soudjani, “Leveraging Robust Simulation Functions for Interconnected Systems under Large Disturbances”, *pending*, 2023
- [J1] M. Kazemi\*, R. Majumdar, M. Salamaty\*, S. Soudjani, **B. Wooding\***, “Data-Driven Abstraction-Based Controller Synthesis”, *Nonlinear Analysis: Hybrid Systems (NAHS)*, 2024 (\***contributed equally**)

## Publications: Conference

- [C11] L. Freitas, **B. Wooding**, B.Scott, A. Pollitt, P. Degenaar “Proving the Correctness of CANDOS Optrode Command Interface VDM model in Isabelle/HOL”, *23rd Overture Workshop and 3rd INTO-CPS Association Brainstorm*, 2025
- [C10] A. Abate, O. Akbarzadeh, H.A.P. Blom, S. Haesaert, S. Hassani, A. Lavaei, F.B. Mathiesen, R. Misra, A. Nejati, M. Niehage, F. Ørum, A. Remke, B. Samari, R. Wang, R. Wisniewski, **B. Wooding**, and M. Zaker “ARCH-COMP25 Category Report: Stochastic Models”, *9th International Workshop on Applied Verification of Continuous and Hybrid Systems (ARCH25)*, 2025 (**authors alphabetical**)
- [C9] **B. Wooding**, A. Lavaei. “k-Inductive Neural Barrier Certificates for Unknown Nonlinear Dynamics”, *under review*, 2025
- [C8] J.Gardner\*, **B. Wooding\***, A. Nejati, A. Lavaei. “TRUST: Stability and Safety Controller Synthesis for Unknown Dynamical Models Using a Single Trajectory”, *Hybrid Systems: Computation and Control (HSCC)*, 2025 (\***contributed equally**)
- [C7] **B. Wooding**, A. Lavaei. “PRoTECT: Parallelized Construction of Safety Barrier Certificates for Nonlinear Polynomial Systems”, *under review*, 2024
- [C6] **B. Wooding**, A. Lavaei. “IMPACT: Interval MDP Parallel Construction for Controller Synthesis of Large-Scale Stochastic Systems”, *Quantitative Evaluation of Systems and Formal Modeling and Analysis of Timed Systems (QEST+FORMATS)*, 2024
- [C5] O. Schön, S. Naseer, **B. Wooding**, S. Soudjani, “Data-Driven Abstractions via Binary-Tree Gaussian Processes for Formal Verification”, *Analysis and Design of Hybrid Systems (ADHS)*, 2024
- [C4] **B. Wooding**, A. Lavaei, V. Vahidinisab, and S. Soudjani, “Robust Simulation Functions with Disturbance Refinement”, *European Control Conference (ECC)*, 2023
- [C3] S. Bogomolov, J. Fitzgerald, FF. Foldager, C. Gamble, PG. Larsen, K. Pierce, P. Stankaitis, **B. Wooding**, “Tuning Robotti: the machine-assisted exploration of parameter spaces in multi-models of a cyber-physical system”, *18th International Overture Workshop*, 2021 (**authors alphabetical**)
- [C2] A. Abate, H. Blom, N. Cauchi, J. Delicaris, A. Hartmanns, M. Khaled, A. Lavaei, C. Pilch, A. Remke, S. Schupp, F. Shmarov, S. Soudjani, A. Vinod, **B. Wooding**, M. Zamani, and P. Zuliani, “ARCH-COMP20 Category Report: Stochastic Models”, *7th International Workshop on Applied Verification of Continuous and Hybrid Systems (ARCH20)*, 2020 (**authors alphabetical**)
- [C1] **B. Wooding**, V. Vahidinisab, S. Soudjani, “Formal Controller Synthesis for Frequency Regulation Utilising Electric Vehicles”, *Smart Energy Systems and Technologies (SEST)*, 2020

## Publications: Book Chapter

- [B3] **B. Wooding**, V. Vahidinisab, and S. Soudjani, “Cyber-Physical Smart Homes/Buildings”, *Cyber-Physical Structures of Power Applications* (**expected December 2025**)
- [B2] **B. Wooding**, V. Vahidinisab, S. Soudjani, “Operation and control of a population of active buildings at network level”, *Active Building Energy Systems: Operation and Control*, 2021
- [B1] **B. Wooding**, V. Vahidinisab, M. Kazemi, S. Soudjani, “Control and management of active buildings”, *Active Building Energy Systems: Operation and Control*, 2021

## Publications: Poster

- [P2] **B. Wooding**, V. Horbanov, A. Lavaei, “Poster Abstract: PRoTECT: Parallel Construction of Barrier Certificates for Safety Verification of Polynomial Systems”, *International Conference on Cyber-Physical Systems (ICCPs)*, 2025
- [P1] **B. Wooding**, A. Lavaei, “Poster Abstract: IMPACT: A Parallelized Software Tool for IMPDP Construction and Controller Synthesis with Convergence Guarantees”, *Hybrid Systems: Computation and Control (HSCC)*, 2024

## Academic Services: Program Committees (PCs)

- **Artifact Evaluation PC** for Foundations of Software Engineering (FSE) 2024
- **Artifact Evaluation PC** for Formal Modeling and Analysis of Timed Systems (FORMATS) 2023

- **Repeatability PC** for Hybrid Systems: Computation and Control (HSCC) 2020, 2021, 2022
- **Repeatability PC** for IFAC Conference on Analysis and Design of Hybrid Systems (ADHS) 2021
- **Website Chair** for Verification of Autonomous & Robotic Systems (VARS) Workshop at CPS-IoT Week 2022

## Academic Services: Membership

[2024-Present] IEEE Member

[2023] IEEE Student Membership

## Academic Services: Reviewing Activities

**[7 journals, 14 conferences, 1 book]**

- **Journals:** IEEE Transactions on Automatic Control (TAC), IEEE Transactions on Control Systems Technology (TCST), IEEE Access, Elsevier European Journal of Control (EJCON), IFAC Automatica, Elsevier Performance Evaluation (PEVA), Royal Society of Chemistry Environmental Science: Processes & Impacts
- **Conferences:** ACM Hybrid Systems Control Conference (HSCC), IEEE European Control Conference (ECC), IEEE Conference on Control Technology and Applications (CCTA), IFAC Conference on Analysis and Design of Hybrid Systems (ADHS), International Symposium on Automated Technology for Verification and Analysis (ATVA), ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS), International Conference on Computer Aided Verification (CAV), Computation-Aware Algorithmic Design for Cyber-Physical Systems (CAADCPS), International Symposium On Leveraging Applications of Formal Methods, Verification and Validation (ISoLA), Learning for Decision and Control (L4DC), IEEE International Conference on Intelligent Transportation Systems (ITSC), IFAC American Control Conference (ACC), IEEE Conference on Design and Control (CDC), International Conference on Quantitative Evaluation of Systems and Formal Modeling and Analysis of Timed Systems (QEST+FORMATS)
- **Book Chapters:** Active Building Energy Systems: Operation and Control

## Conference Presentations

[June. 25] Open Research Conference, Newcastle-upon-Tyne, UK.

[June. 25] 9th International Workshop on Applied Verification of Continuous and Hybrid Systems (ARCH25), Virtual Workshop. **[on behalf of Stochastic Models category]**

[May. 25] International Conference on Hybrid Systems: Computation and Control (HSCC), Irvine, California.

[May. 25] International Conference on Cyber-Physical Systems (ICCPS), Irvine, California.

[Sep. 24] International Conference on Quantitative Evaluation of Systems and Formal Modeling and Analysis of Timed Systems (QEST+FORMATS), Calgary, Canada. **[Regular, Work-in-Progress, and Demo Sessions]**

[Jun. 23] 21st European Control Conference (ECC), Bucharest, Romania.

[Sep. 20] 3rd International Conference on Smart Energy Systems and Technologies (SEST), Istanbul, Turkey. **[Virtual]**

## Teaching Experiences (Demonstrating and Marking)

*Cloud Computing; Engineering for AI; Research Methods; Computer Architecture; Software Engineering; Software Verification; Algorithm Design and Analysis; Building Systems for People; Understanding Programming Languages; Group Project in Data Science; Development and Operation of Systems.*

## Supervision/Mentoring Experiences

- **8 BSc Projects, 5 MSc Projects, 2 PhD Projects**

Related work to mentorships include [J3],[C5],[C7],[C8]

## Relevant Courses Taken

**Career Development:** I have attended the following workshops and training courses:

- Developing Your Good Leadership Identity and Practice - [Prof. Geraldine Fitzgerald](#)
- Building an Impactful Presentation: A Step-by-Step Guide
- Leading and Managing Research Teams
- [Certified Peer Review Course](#)
- Getting Those Grants: Early Career Fellowships: The Foundation
- Public Engagement Training

**Required Skills:** (I) An Introduction to the Prevent Duty in Higher Education, (II) Basic Online Fire Safety, (III) Basic Online Health & Safety, (IV) Equality & Diversity Essentials, (V) Information Security (previously GDPR), (VI) Initiations and Dangerous Behaviour at Student Events, (VII) Mental Health and Wellbeing Awareness, (VIII) Modern Slavery, (IX) The Bribery Act 2010, (X) Zero Suicide Alliance - Suicide - Let's Talk

**EECI M17 (2024):** The scenario approach: data science for systems, control, and machine learning

**During PhD:** (I) Smart Grids and Applications of Computational Intelligence; (II) Applied Probability; (III) Differential Equations; (IV) Systems and Control; (V) Signals and Communication

**During MComp:** (I) Machine Learning; (II) Big Data Analytics; (III) Distributed Algorithms; (IV) System Evaluation; (V) System Validation; (VI) System Verification Technologies; (VII) System and Network Security; (VIII) Cryptography; (IX) Reliability and Fault Tolerance; (X) High Integrity Software Development; (XI) The Challenge of Dependable Systems.

## Miscellaneous

**Leadership:** I held a sports scholarship for Volleyball at Newcastle University for 4 seasons. In my last season (my first PhD year) I also played semi-professionally in the Men's Super League, the highest division of Volleyball in the UK. During this time I had many leadership opportunities as the Men's Team Captain, Club Secretary and Club President. I was Chairman of JPCFC, a football team, playing in an FA registered league during the 2024-25 season.

**Global Perspective:** I spent 10 years of my childhood living in Uganda in East Africa, including attending an international school which had over 70 different nations represented. These opportunities have given me an important global perspective of different countries, different cultures, and different worldviews.

## References

**PhD Supervisor:** Sadegh Soudjani, Max Planck Institute: [sadegh@mpi-sws.org](mailto:sadegh@mpi-sws.org)

**Fellowship Collaborator:** Abolfazl Lavaei, Newcastle University: [abolfazl.lavaei@ncl.ac.uk](mailto:abolfazl.lavaei@ncl.ac.uk)