

SASWATA PAUL

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CAREER GOALS

To apply my expertise in formal methods, distributed protocols, cyber-physical systems, and avionics systems to investigate and propose innovative solutions to challenging problems in the domain of safety-critical systems.

EDUCATION

Ph.D. in Computer Science May 2022
Rensselaer Polytechnic Institute, Troy, NY, USA

M.S. in Computer Science Dec. 2018
Rensselaer Polytechnic Institute, Troy, NY, USA

B.Tech. in Computer Science & Engineering May 2015
National Institute of Technology, Agartala, Tripura, India

EXPERIENCE

Graduate Research Assistant May 2017 - Present
Rensselaer Polytechnic Institute Troy, NY

- Developed the first machine-checked proof of eventual progress for the Synod consensus protocol.
- Developed a failure-aware actor model for formal reasoning about distributed communication in airborne networks.
- Developed a formal library in Athena tailored towards reasoning about distributed coordination protocols.
- Developed a formally verified protocol for ensuring situational awareness in autonomous aircraft.
- Designed a data-driven approach for the runtime verification of distributed systems using formal proofs.
- Designed a provably-correct decentralized and autonomous air traffic management technique for Urban Air Mobility.
- Developed a formally verified strategic conflict-aware flight planning algorithm.
- Developed a data-driven approach for generating high-fidelity emergency trajectories for fixed-wing aircraft.

Research Intern Jun. 2020 - Aug. 2020, May 2021 - Jul. 2021
General Electric Global Research Niskayuna, NY

- Worked on DARPA and NASA-funded programs with the High-Assurance Systems team.
- Developed a formal data model for constructing Operational Risk Assessment artifacts (NASA V&V).
- Developed an approach for auto-generating assurance case fragments from the VERDICT toolchain (DARPA CASE).
- Proposed an approach to generate certification reports from the curated RACK database (DARPA ARCOS).
- Developed an SMT-based approach for strategic detection and elimination of aircraft conflicts for Urban Air Mobility.

Graduate Teaching Assistant Aug. 2016 - May 2017, Aug. 2020 - Dec. 2020
Rensselaer Polytechnic Institute Troy, NY

- Conducted practical labs, held office hours, proctored exams, and graded assignments and exams for courses such as Computer Science I, Principles of Software, and Programming Languages.

Summer Intern May 2014 - Jul. 2014
Society for Natural Language Technology & Research Kolkata, India

- Developed an Android application for generating the shortest/cheapest bus route between two given destinations.

SKILLS

Computer Languages : over 5000 lines - JAVA, C, Python; over 1000 lines - C++, PHP, Prolog, SALSA, R; familiar with: JavaScript, Erlang, Pict, Haskell, Oz, Scheme, Lisp, Dot

Formal Methods : Athena, TLA⁺ Toolbox, SADL-AT, dReal, SMT-Lib, VERDICT

Other Tools : L^AT_EX, AADL, SPARQL, JavaFx, GraphViz, Maven, Docker, Github, MS Office, RACK

RELEVANT GRADUATE COURSEWORK

Systems : Programming Languages, Distributed Computing over the Internet, Operating Systems

Theory : Design & Analysis of Algorithms, Distributed Systems & Algorithms, Software Verification

ML/Data : Machine Learning from Data, Xinformatics, Data Analytics, Data Science

HONORS AND DISTINCTIONS

- *Best Paper Award*, Software Development track, at the 40th AIAA/IEEE DASC, San Antonio, TX, Oct. 2021.
- Received the *GE Impact Award* as a summer intern at GE Research, Niskayuna, NY, Aug. 2020 & Jul. 2021.
- Finalist for *Best Student Paper Award* at the 38th AIAA/IEEE DASC, San Diego, CA, Sep. 2019.
- Topper of the CS department at NIT Agartala in the 8th semester of B.Tech., May 2015.
- Secured 1st position in inter-college coding competition at NIT Agartala, 2013.
- Secured 2nd position at Holy Cross School Agartala in Indian School Certificate examination, 2011.
- Secured 4th position at Holy Cross School Agartala in Indian Certificate of Secondary Education examination, 2009.

PROFESSIONAL ACTIVITIES

- Mentored undergraduate and graduate researchers working at the Worldwide Computing Laboratory, Rensselaer Polytechnic Institute.
- Reviewer for UCC 2017, IEEE BigData 2017, AAMAS 2019, and IEEE Cluster 2019.
- Conducted workshops for high school students for "STEM Day" at the Worldwide Computing Laboratory, Rensselaer Polytechnic Institute, in 2018 and 2019.

PUBLICATIONS

- **S. Paul**, "Formal Verification of Decentralized Coordination in Autonomous Multi-Agent Aerospace Systems", PhD Dissertation, Rensselaer Polytechnic Institute, Troy, NY, May 2022.
- **S. Paul**, S. Patterson, and C. A. Varela. "Formal Guarantees of Timely Progress for Distributed Knowledge Propagation", *Proc. of the 3rd Workshop on Formal Methods for Auton. Syst.*, Oct. 2021.
- V. T. Valapil, H. Herenzia-Zapana, M. Durling, K. Armstrong, **S. Paul**, S. Borgyos, A. Moitra, and W. Premerlani. "Towards Formalization of a Data Model for Operational Risk Assessment", *Proc. of the 40th AIAA/IEEE Digit. Avionics Syst. Conf.*, Oct. 2021.
- **S. Paul** and C. A. Varela. "Data-Driven Wind-Aware Emergency Trajectory Generation", *Journal of Aircraft*, Accepted May. 2021. (*To appear*)
- B. Meng, **S. Paul**, A. Moitra, K. Siu, and M. Durling. "Automating the Assembly of Security Assurance Case Fragments", *Proc. of the 40th Int. Conf. on Comp. Safety, Reliability, and Security*, Sep. 2021.
- **S. Paul**, G. A. Agha, S. Patterson, and C. A. Varela. "Verification of Eventual Consensus in Synod Using a Failure-Aware Actor Model", *Proc. of the 13th NASA Formal Methods Symp.*, May 2021.
- B. Meng, D. Larraz, K. Siu, A. Moitra, J. Interrante, W. Smith, **S. Paul**, D. Prince, H. Herencia-Zapana, M. F. Arif, M. Yahyazadeh, V. T. Valapil, M. Durling, C. Tinelli, and O. Chowdhury. "VERDICT: A Language and Framework for Engineering Cyber-Resilient and Safe System", *Systems*, Mar. 2021.
- **S. Paul**, S. Patterson, F. Kopsaftopoulos, and C. A. Varela. "Towards Formal Correctness Envelopes for Dynamic Data-Driven Aerospace Systems", *Handbook Dyn. Data-Driven App. Syst.*, Accepted Nov. 2020. (*To appear*)
- **S. Paul**, S. Patterson, and C. A. Varela. "Collaborative Situational Awareness for Conflict-Aware Flight Planning", In *Proc. of the 39th AIAA/IEEE Digit. Avionics Syst. Conf.*, Oct. 2020.
- B. Meng, A. Moitra, A. W. Crapo, **S. Paul**, K. Siu, M. Durling, D. Prince, H. Herencia-Zapana. "Towards Developing Formalized Assurance Cases", In *Proc. of the 39th AIAA/IEEE Digit. Avionics Syst. Conf.*, Oct. 2020.
- **S. Paul**, F. Kopsaftopoulos, S. Patterson, and C. A. Varela. "Dynamic Data-Driven Formal Progress Envelopes for Distributed Algorithms", In *Proc. of InfoSymbiotics/DDDAS2020*, Oct. 2020.
- E. Cruz-Camacho, **S. Paul**, F. Kopsaftopoulos, and C. A. Varela. "Towards Provably Correct Probabilistic Flight Systems", In *Proc. of InfoSymbiotics/DDDAS2020*, Oct. 2020.

- **S. Paul**, S. Patterson, and C. A. Varela. "Conflict-Aware Flight Planning for Avoiding Near Mid-Air Collisions", In *Proc. of the 38th AIAA/IEEE Digit. Avionics Syst. Conf.*, San Diego, CA, USA, Sep. 2019.
- **S. Paul**, "Emergency Trajectory Planning for Fixed-Wing Aircraft", Master's Thesis, Rensselaer Polytechnic Institute, Troy, NY, Dec. 2018.
- **S. Paul**, F. Hole, A. Zyteck, and C. A. Varela. "Wind-Aware Trajectory planning for Fixed-Wing Aircraft in Loss of Thrust Emergencies", In *Proc. of the 37th AIAA/IEEE Digit. Avionics Syst. Conf.*, London, England, Sep. 2018.
- **S. Paul**, F. Hole, A. Zyteck, and C. A. Varela. "Flight Trajectory Planning for Fixed-Wing Aircraft in Loss of Thrust Emergencies", In *InfoSymbiotics/DDDAS2017*, Cambridge, MA, Aug. 2017.

POSTERS

- **S. Paul**, F. Hole, A. Zyteck, and C. A. Varela. "LOT Emergency Trajectory Generation for Fixed-Wing Aircraft", Rensselaer Polytechnic Institute, Nov. 2018.

REFERENCES

Carlos A. Varela

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