SHENGHUA FENG

Safety-Critical Software and Application Group · Institute of Software, CAS
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Employment

Institute of Software, Chinese Academy of Sciences May. 2025 - Present
Special Assistant Researcher at Safety-Critical Software and Application Group

Zhongguancun Laboratory Aug. 2023 - Apr. 2025
Assistant Researcher at Operating System Verification Group

Education

Institute of Software, Chinese Academy of Sciences Sep. 2018 - Jun. 2023
Ph.D. in Computer Science (with honour) at St. Key Lab. Comput. Sci. *Advisor: Prof. Dr. Naijun Zhan*

- Dissertation: Formal Verification of Stochastic Systems
- Award: CCF Formal Methods Committee Outstanding Doctoral Dissertation

Dept. of Computing Science, University of Colorado, Boulder Oct. 2019 - Apr. 2020
Visiting scholar at Prog. Lang. and Verification Group *Advisor: Prof. Dr. Sriram Sankaranarayanan*

Department of Mathematics, Nanjing University Sep. 2014 - Jun. 2018
B.Sc. in Mathematics (with honour) · Rank: 3/118

Research Interests

My primary research interests focus on the formal verification and synthesis of programs and hybrid discrete-continuous systems, aiming to enhance the reliability and effectiveness of software systems—particularly safety-critical cyber-physical systems in which physical processes and software components are deeply intertwined. This is an interdisciplinary field that intersects computer science, logic, and control theory. My overarching goal is to advance the capabilities of formal verification techniques for complex systems and apply these developments effectively to real-world cyber-physical systems. Currently, my research interests include verification and synthesis of delayed and stochastic hybrid systems, qualitative and quantitative analyses of probabilistic programs, and operating system verification.

Academic Services

Teaching Assistant

Mathematical logic and theories of programming, M.Sc., UCAS WS 2021

Committee Member

Artifact Evaluation Committee Member of Formats 2022 Jun. 2022

Organization committee Member of SSFM 2018, SSFM 2019 Aug. 2018/2019

External Reviewer

FM '24, HSCC '23/24, CICM '24, ATVA '22, ICFEM '22/23, TACAS '22/23, ChinaSoft '21, ADHS '21, TCAD, IEEE TAC, IFAC

Honors & Awards

Advanced Individual of Zhongguancun Laboratory Jan. 2025

CCF Formal Methods Committee Outstanding Doctoral Dissertation Dec. 2023

Outstanding Graduate of Institute of Software, CAS Jun. 2023

National Scholarship Oct. 2020

Outstanding Student of Nanjing University 2018

1nd Prize in Chinese Mathematics Competitions (CMC) 2015

Publications

[1] Zhiyang Li, Mingqi Yang, **Shenghua Feng**✉, and Mingshuai Chen✉ . Fixed-point reasoning for stochastic systems. In Design and Verification of Cyber-Physical Systems: From Theory to Applications. Springer, 2025. [To appear].

[2] Han Su, **Shenghua Feng**✉, Sinong Zhan, Naijun Zhan. Switching Controller Synthesis for Hybrid Systems Against STL Formulas. In *Proceedings of the International Symposium on Formal Methods* (**FM 2024**), Milan, Italy, 2024, pp. 229-247, 2024.

[3] **Shenghua Feng**, Tengshun Yang, Mingshuai Chen, Naijun Zhan. A Unified Framework for Quantitative Analysis of Probabilistic Programs. In *Principles of Verification: Cycling the Probabilistic Landscape* (**PVCS 2024**). Germany, pp. 230–254. 2024.

[4] Hao Wu, **Shenghua Feng**, Ting Gan, Jie Wang, Bican Xia, Naijun Zhan. On Completeness of SDP-Based Barrier Certificate Synthesis over Unbounded Domains. In *Proceedings of the International Symposium on Formal Methods* (**FM 2024**), Milan, Italy, 2024, pp. 248-266, 2024.

[5] **Shenghua Feng**, Mingshuai Chen, Han Su, Benjamin Lucien Kaminski, Joost-Pieter Katoen, Naijun Zhan. Lower Bounds for Possibly Divergent Probabilistic Programs. The OOPSLA 2023 issue of the *Proceedings of the ACM on Programming Languages* (**OOPSLA 2023**), Vol. 7.

[6] Bai Xue, Qiuye Wang, Naijun Zhan, Martin Fränzle, **Shenghua Feng**. Differential Games Based on Invariant Sets Generation. In American Control Conference 2022 (**ACC 2022**).

[7] **Shenghua Feng**, Mingshuai Chen, Bai Xue, Sriram Sankaranarayanan, Naijun Zhan. Unbounded-Time Safety Verification of Stochastic Differential Dynamics. In *Proceedings of the International Conference on Computer Aided Verification* (**CAV 2020**), Los Angeles, USA, pp. 327-348, 2020.

[8] **Shenghua Feng**, Mingshuai Chen, Naijun Zhan, Martin Fränzle, and Bai Xue. Taming delays in dynamical systems: Unbounded verification of delay differential equations. In *Proceedings of the International Conference on Computer Aided Verification* (**CAV 2019**), New York City, USA, July 13-18, 2019, pp. 650-669, 2019.

[9] Bai Xue, Qiuye Wang, **Shenghua Feng**, Naijun Zhan. Over- and Underapproximating Reach Sets for Perturbed Delay Differential Equations. IEEE Transactions on Automatic Control (**IEEE TAC 2021**), 66(1): 283-290 (2021).

Manuscripts under Review

[10] **Shenghua Feng**, Mingshuai Chen, Hao Wu, Han Su, and Naijun Zhan. Tolerant barrier certificates for stochastic systems. 2024. Under submission

Selected Tools/Prototypes/Codes

• **LOSVerify**:A set of Coq proofs and C annotations that certify the functional correctness of an operating system kernel.

• **udder**: A tool that verifies whether a delay differential dynamical system will eventually enter an unsafe region by computing its stability envelope.

• **STLConSyn**: A prototype that synthesizes switching controllers for hybrid systems against a subset of signal temporal logic formulas.

• **SDEVeri**: A prototype that computes the upper bound of the failure probability for a stochastic differential dynamical system eventually entering an unsafe region.

Technical Skills

Programming Languages	C/C++, Python, Matlab/Simulink, Mathematica
Software Tools	model checkers, algebra systems, interactive theorem prover, SDP solvers