

CHUCHU FAN

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RESEARCH INTEREST

Safe Autonomous Systems; Cyber-Physical Systems; Formal Methods; Control Theory; Machine Learning; Reinforcement Learning; Robotics

ACADEMIC POSITIONS

Massachusetts Institute of Technology Aug. 2020 - Present
Wilson Assistant Professor of Aeronautics and Astronautics

California Institute of Technology Nov. 2019 - July. 2020
Postdoc Researcher in Computing and Mathematical Sciences Supervisor: Prof. [Richard Murray](#)

University of California at Irvine Oct. 2019 - June. 2020
Assistant Specialist in Bren School of Information and Computer Science

EDUCATION

University of Illinois at Urbana-Champaign Aug. 2013 - Nov. 2019
Ph.D. in Computer Engineering *Advisor: Prof. [Sayan Mitra](#)*

- **Thesis:** Formal methods for safe autonomy: data-driven verification, synthesis, and applications
- Tools developed: [DryVR](#); [C2E2](#); [RealSyn](#); [FACTEST](#)

Tsinghua University Sep. 2009 - Jul. 2013
B.E. in Automation (with honor)

University of Southern California Jun. 2012 - Aug. 2012
Visiting Scholar in Computer Science *Advisor: Prof. [Laurent Itti](#)*

HONORS AND AWARDS

UIUC CSL Student Thesis Award	2020
Chinese Outstanding Student Abroad Award	2019
Robert T. Chien Memorial Award from UIUC	2019
Mavis Future Faculty Fellows (MF3) of UIUC	2018
M. E. Van Valkenburg Graduate Research Award from UIUC	2018
Selected Attendee of the 5th Heidelberg Laureate Forum	2017
Yi-Min Wang and Pi-Yu Chung Endowed Research Award from UIUC	2017
Rising Stars in EECS (Class of 2016)	2016
EMSOFT Best Paper Finalist	2016
Rambus Computer Engineering Fellowship from UIUC	2016
Robert Bosch Best Verification Result Award in CPSweek	2015
Excellent Graduate of Tsinghua University	2013

PUBLICATIONS

JOURNAL

31. [TAC'21] [Chuchu Fan](#), Zengyi Qin, Umang Mathur, Qiang Ning, personSayan MitraS. Mitra, and Mahesh Viswanathan. "Controller synthesis for linear system with reach-avoid specifications." *Transaction on Automatic Control*, 2021.
30. [TECS'18] [Chuchu Fan](#), James Kapinski, Xiaoqing Jin and Sayan Mitra. "Simulation-driven reachability using matrix measures." *ACM Transactions on Embedded Computing Systems*, 2018. [\[pdf\]](#)
29. [IEEEDT'18] [Chuchu Fan](#), Bolun Qi and Sayan Mitra. "Data-driven formal reasoning and their applications in safety analysis of vehicle autonomy features." *IEEE Design & Test*, 2018. [\[pdf\]](#)
28. [NAHS'17] Zhenqi Huang, [Chuchu Fan](#), and Sayan Mitra. "Bounded Invariant Verification for Time-Delayed Nonlinear Networked Dynamical Systems." *IFAC Nonlinear Analysis: Hybrid Systems*, 2017. [\[pdf\]](#)
27. [IEEEDT'15] Zhenqi Huang, [Chuchu Fan](#), Alexandru Mereacre, Sayan Mitra, and Marta Kwiatkowska. "Simulation-based Verification of Implantable Medical Devices with Guaranteed Coverage." *IEEE Design & Test*, 2015. [\[pdf\]](#)
26. [SPL'13] Qiang Ning, Kan Chen, Li Yi, [Chuchu Fan](#), Yao Lu, Jiangtao Wen. "Image Super-Resolution via Analysis Sparse Prior." *IEEE Signal Processing Letters*, 2013. [\[pdf\]](#)

CONFERENCE

25. [L4DC'21] Dawei Sun, Mohammad Javad Khojasteh, Shubhanshu Shekhar, and [Chuchu Fan](#). "Uncertainty-aware Safe Exploratory Planning using Gaussian Process and Neural Control Contraction Metric." *Learning for Dynamics and Control*, 2021.
24. [ICLR'21] Zengyi Qin, Kaiqing Zhang, Yuxiao Chen, Jingkai Chen, and [Chuchu Fan](#). "Learning Safe Multi-agent Control with Decentralized Neural Barrier Certificates." *International Conference on Learning Representations*, 2021.
23. [AAAI'21] Jingkai Chen, Jiaoyang Li, [Chuchu Fan](#), and Brian Williams. "Scalable and Safe Multi-Agent Motion Planning with Nonlinear Dynamics and Bounded Disturbances." *AAAI Conference on Artificial Intelligence*, 2021. [\[Github\]](#)
22. [ADHS'21] Kristina Miller, [Chuchu Fan](#), and Sayan Mitra. "Planning in Dynamic and Partially Unknown Environments." *7th IFAC Conference on Analysis and Design of Hybrid Systems*, 2021.
21. [HSCC'21] Jingkai Chen, Brian Williams, and [Chuchu Fan](#). "Optimal mixed discrete-continuous planning for linear hybrid systems." *ACM International Conference on Hybrid Systems: Computation and Control*, 2021.
20. [AIAA Scitech'21] [Chuchu Fan](#), Kristina Miller, Dawei Sun, and Sayan Mitra. "Fast and Guaranteed Safe Controller Synthesis for Aerial Vehicle Models (Invited paper)." *AIAA Scitech 2021 Forum*, 2021.

19. [CoRL'20] Yuxiao Chen, Ugo Rosolia, [Chuchu Fan](#), Aaron Ames, and Richard Murray. "Reactive motion planning with probabilistic safety guarantees." *Conference on Robot Learning*, 2020.
18. [CoRL'20] Dawei Sun, Susmit Jha, and [Chuchu Fan](#). "Learning Certified Control using Contraction Metric." *Conference on Robot Learning*, 2020. [[Github](#)]
17. [CAV'20] [Chuchu Fan](#), Kristina Miller, and Sayan Mitra. "Fast and Guaranteed Safe Controller Synthesis for Nonlinear Vehicle Models." *International Conference on Computer-Aided Verification*, 2020. [**Artifact Evaluated**] [[pdf](#)] [[Website](#)]
16. [TACAS'20] Hussein Sibai, Navid Mokhlesi, [Chuchu Fan](#) and Sayan Mitra. "Multi-Agent Safety Verification using Symmetry Transformations." *International Conference on Tools and Algorithms for the Construction and Analysis of Systems*, 2020.
15. [NACCL'19] Qiang Ning, Hangfeng He, [Chuchu Fan](#) and Dan Roth. "Partial or Complete, That's The Question." *North American Chapter of the Association for Computational Linguistics*, 2019. [[pdf](#)]
14. [CAV'18] [Chuchu Fan](#), Umang Mathur, Sayan Mitra and Mahesh Viswanathan. "Controller Synthesis Made Real: Reach-avoid Specifications and Linear Dynamics." *International Conference on Computer-Aided Verification*, 2018. [**Artifact Evaluated**] [[pdf](#)]
13. [FM'18] [Chuchu Fan](#), Zhenqi Huang and Sayan Mitra. "Approximate Partial Order Reduction." *International Symposium on Formal Methods*, 2018. [[pdf](#)]
12. [ADHS'18] [Chuchu Fan](#), Yu Meng, Jürgen Maier, Ezio Bartocci, Sayan Mitra and Ulrich Schmid. "Verifying nonlinear analog and mixed-signal circuits with inputs." *IFAC Conference on Analysis and Design of Hybrid Systems*, 2018. [[pdf](#)]
11. [SEM'18] Qiang Ning, Zhongzhi Yu, [Chuchu Fan](#), and Dan Roth. "Exploiting Partially Annotated Data in Temporal Relation Extraction." *The Joint Conference on Lexical and Computational Semantics*, 2018. [[pdf](#)]
10. [CAV'17] [Chuchu Fan](#), Bolun Qi, Sayan Mitra and Mahesh Viswanathan. "DRYVR: Data-driven verification and compositional reasoning for automotive systems." *International Conference on Computer-Aided Verification*, 2017. [**Artifact Evaluated**] [[pdf](#)]
9. [EMSOFT'16] [Chuchu Fan](#), James Kapinski, Xiaoqing Jin and Sayan Mitra. "Locally Optimal Reach Set Over-approximation for Nonlinear Systems." *International Conference on Embedded Software*, 2016. [**Best Paper Finalist**] [[pdf](#)]
8. [CAV'16] [Chuchu Fan](#), Bolun Qi, Sayan Mitra, Mahesh Viswanathan and Parasara Sridhar Duggirala. "Automatic reachability analysis for nonlinear hybrid models with C2E2." *International Conference on Computer-Aided Verification*, 2016. [[pdf](#)]
7. [ATVA'15] [Chuchu Fan](#) and Sayan Mitra. "Bounded Verification with On-the-Fly Discrepancy Computation." *Automated Technology for Verification and Analysis*, 2015. [[pdf](#)]
6. [HSB'15] Md. Ariful Islam, Richard DeFrancisco, [Chuchu Fan](#), Radu Grosu, Sayan Mitra and Scott Smolka. "Model Checking Tap Withdrawal in *C. Elegans*." *Hybrid Systems Biology*, 2015. [[pdf](#)]
5. [CAV'15] Parasara Sridhar Duggirala, [Chuchu Fan](#), Sayan Mitra, and Mahesh Viswanathan. "Meet a Powertrain Verification Challenge." *International Conference on Computer-Aided Verification*, 2015. [**Artifact Evaluated**] [[pdf](#)]
4. [ARCH'15] [Chuchu Fan](#), Parasara Sridhar Duggirala, Sayan Mitra, and Mahesh Viswanathan. "Progress

on Powertrain Verification Challenge with C2E2.” *Applied Verification for Continuous and Hybrid Systems*, 2015. [**Best Verification Result Award**] [\[pdf\]](#)

3. [CAV’14] Zhenqi Huang, [Chuchu Fan](#), Alexandru Mereacre, Sayan Mitra, and Marta Kwiatkowska. “Invariant verification of nonlinear hybrid automata networks of cardiac cells.” *International Conference on Computer-Aided Verification*, 2014. [\[pdf\]](#)

TUTORIAL

2. [CCA’16] Parasara Sridhar Duggirala, [Chuchu Fan](#), Sayan Mitra, and others. “Tutorial: Software tools for hybrid systems verification, transformation, and synthesis: C2E2, HyST, and TuLiP.” *IEEE Conference on Control Applications*, 2016. [\[pdf\]](#)

BOOK CHAPTER

1. [Chuchu Fan](#) and Sayan Mitra. “Data-driven Safety Verification of Complex Cyber-Physical Systems.” *Design Automation of Cyber-Physical Systems*, Springer, 2019. [\[pdf\]](#)

GRANTS

4. [PI] MIT Schwarzman College of Computing & Defense Science and Technology Agency in Singapore research collaboration, “Building Dependable Autonomous Systems Through Learning Certified Decisions and Control”, 2020 - 2023.
3. [PI] Assured Autonomy - Darpa, “Assurance for Learning Enabled Systems”, 2020 - 2021.
2. [Co-PI] with Sayan Mitra, [Siebel Energy Institute Research Grants](#), “A Formal Verification and Synthesis Tool for Safety Critical Power Grid Infrastructures and Cyber-Physical Systems”, 2018.
1. [PI] [NSF SBIR-1549058](#), “SBIR Phase I: Debugging Smart Cyber-Physical Systems”, 2016.

PATENTS

2. “Bounded Verification through Discrepancy Computations”, TF14195-02(US), granted Feb. 2016.
1. “Image Super-Resolution via Analysis Sparse Prior”, CN103049885, granted Apr. 2013.

INDUSTRIAL EXPERIENCES

Rational Cyphy Inc. (Champaign, IL) Jan. 2016 - Jun. 2016
Technical Director

- Leading a group of software engineers to develop and commercialize formal verification tools

Toyota Technical Center (Los Angeles, CA) Jan. 2015 - May 2015
Research Intern [Mentor: James Kapinski](#)

- Project: Verification of parametric complex nonlinear systems

Microsoft Research Asia (Beijing, China) Jan. 2012 - Jun. 2012
Research Intern

- Projects: Hardware design of wireless sensor networks and wearable health monitoring systems

ACADEMIC SERVICES

- **Program Committee Chair** (NSV Workshop 2021)
- **Program Committee Member** (DARS'19, RV'20, HSCC'20,21)
- **Repeatability Evaluation Committee Member** (HSCC'18, HSCC'19)
- **Chair of Social Media and publicity** (HSCC'18, AutoCPS'20)
- **Artifact Evaluation Committee Member** (CAV'17, CAV'20)
- **Lecturer** at UIUC: ECE584 (Embedded System Verification)
- **Lecturer** at MIT: 16.30/31 (Feedback Control System)

INVITED TALKS

8. "Building Dependable Autonomous Systems through Learning Certified Control", *Texas Tech University CS Seminar*, Virtual, 2020.
7. "Fast and Guaranteed Safe Controller Synthesis for Dynamical Systems", *Mechanical and Civil Engineering Seminar*, Caltech, Pasadena, CA, 2020.
6. "Verification and Synthesis Algorithms for Safe Autonomy", *Faculty Candidate Talk*, MIT, Cornell, UMD, USC, Duke, Rice, WUSTL, NYU, UCI, UCD, UBC, Waterloo, ASU, CU boulder, 2019.
5. "Data-driven Verification of Cyber-physical systems", *Vanderbilt University*, Nashville, TN, 2017.
4. "Locally Optimal Reach Set Over-approximation for Nonlinear Systems", *Feedback Friday of UIUC*, Urbana, IL, 2016.
3. "Simulation-driven Verification of Cyber-Physical Systems", *French-American Doctoral Exchange Seminars*, Grenoble, France, 2016.
2. "Bounded Verification with Application on Toyota Powertrain Control Benchmarks", *CSL Social Hours*, Urbana, IL, 2016.
1. "Local Discrepancy Computation in Simulation-guided Verification", *Midwest Verification Day*, Urbana, IL, 2015.

MENTORING, LEADERSHIP & ACTIVITIES

- **Advisor** (Sep. 2020 - Present): Zengyi Qin, Yue Meng.
- **French-American Doctoral Exchange Program** (Class of 2016): Representative Ph.D Student working on Cyber-Physical System from the U.S.
- **Undergraduate Student Research Mentor** (Aug. 2015 - Aug. 2019): Bolun Qi (Facebook Inc.), Yu Meng (UIUC), Nishant Dash (UIUC), Minghao Jiang (UIUC), Rongzhou Li (Oracle), Yangge Li (UIUC)
- **Vice Chair of the Automation Student Association of Science and Technology at Tsinghua University** (Jul. 2010 - Jul. 2012): Responsible for organizing technology activities for over 600 students; directed the Future Intelligent Robot Club sponsored by Texas Instruments.
- **Volunteer Teacher** (Jun. 2010 - Sep. 2010): In the Chun-Lei Education Support Program for underdeveloped areas in southwest China.