

# SHAORU CHEN

Microsoft Research, New York City

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## SUMMARY

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I am a Postdoctoral Researcher in Microsoft Research, NYC working on evaluation of large language models (LLMs) and using language model feedback for reinforcement learning. My research covers machine learning, optimization, control, and formal methods with a strong publication record. I enjoy team work and am passionate about making AI systems perform better with safety and reliability.

## EDUCATION

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**University of Pennsylvania**

*Philadelphia, PA*

**Ph.D. in Electrical and Systems Engineering**

*Aug. 2017 - Dec. 2022*

Advised by: Prof. Victor M. Preciado. GPA: 3.96/4.00.

**Zhejiang University**

*Hangzhou, China*

**B.E. in Electrical Engineering**

*Aug. 2013 - Jun. 2017*

Chu Kochen Honors College, Advisor: Prof. Jian Chen. GPA: 90.8/100.

## SKILLS

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**Programming Languages**

Python, Matlab

**Tools**

PyTorch, Gurobi, Yalmip, CVX, Git, L<sup>A</sup>T<sub>E</sub>X

## EXPERIENCE

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**Microsoft Research, NYC**

*Jan. 2023 - Present*

*Postdoctoral Researcher*

*New York City, NY*

- Language model feedback for decision making.
  - Investigating and improving the correlation between LLM feedback and the optimal value function on various decision-making tasks.
  - Training and utilizing distilled small language feedback models as critics for reinforcement learning.
- Representation learning for goal-conditioned planning through high-dimensional observation.
  - Designed and learned the latent state representation that maintains the geometry of the environment in the latent space for vision-based planning and policy learning.
  - Developed a hierarchical motion planning method using latent representation that outperforms strong deep reinforcement learning baselines.
- Verification-aided learning of formal safety certificates for learning-enabled systems.
  - Proposed a novel fine-tuning method based on convex optimization for learning neural network safety certificates. Boosted the success rate by 5x times and significantly reduced the algorithm runtime through the principled fine-tuning method.

**University of Pennsylvania**

*Aug. 2017 - Dec. 2022*

*Graduate Research Assistant*

*Philadelphia, PA*

- Scalable neural network verification through operator splitting.

- Proposed DeepSplit, a neural network verification algorithm that is scalable, parallelizable, and enjoys fast theoretical convergence guarantees.
- Achieved 7x speedup in certifying robustness of deep NN image classifiers compared with commercial solvers, and 10x tighter bounds in dynamical system reachable set approximation compared with equally scalable NN verification baselines.
- Boosting tightness of robust model predictive control for uncertain systems.
  - Proposed a novel robust MPC method that jointly searches for robust feedback policies and uncertainty over-approximations through a numerically efficient convex quadratic program.
  - Achieved significant and consistent tightness improvement over all existing robust MPC methods in comprehensive numerical experiments.

## HONORS AND AWARDS

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Chu Kochen Honors College Research Fellowship, Zhejiang University	2017
Chunhui Scholarship (highest honor in College of Control Science and Engineering, ZJU)	2017
First-Class Scholarship for Outstanding Students of Zhejiang University (top 3%)	2014, 2015
Outstanding Student Leader Awards, Zhejiang University	2014
First Prize of Chinese Physics Olympiad (Top 55 in Jiangsu Province, China)	2012

## PROFESSIONAL SERVICE

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**Publicity Co-Chair of the Control Systems Society (CSS) NextCom** – A committee established in December 2023 aiming to support students and early career researchers from the control community.

**Teaching assistant for four courses** (Learning for Dynamics and Control, Model Predictive Control, Modern Convex Optimization, Introduction to Optimization Theory) at the University of Pennsylvania.

**Journal Reviewer** IEEE Transactions on Automatic Control (TAC), Automatica, IEEE Open Journal of Control Systems (OJCSYS), IEEE Control Systems Letters (L-CSS), IEEE Transactions on Vehicular Technology (TVT).

**Conference Reviewer** IEEE Conference on Decision and Control (CDC), IEEE International Conference on Robotics and Automation (ICRA), American Control Conference (ACC), IFAC World Congress, Annual Learning for Dynamics and Control Conference (L4DC), ACM International Conference on Hybrid Systems: Computation and Control (HSCC), IFAC Symposium on System Identification (SYSID).

## PUBLICATIONS

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(\* indicates equal contribution)

### Preprints

1. **Shaoru Chen**, Mahyar Fazlyab. Learning Performance-Oriented Control Barrier Functions Under Complex Safety Constraints and Limited Actuation. Submitted to Learning for Dynamics and Control (L4DC), 2024.
2. Anurag Koul, Shivakanth Sujit, **Shaoru Chen**, Ben Evans, Lili Wu, Byron Xu, Rajan Chari, Riashat Islam, Raihan Seraj, Yonathan Efroni, Lekan Molu, Miro Dudik, John Langford, Alex Lamb. PcLast: Discovering Plannable Continuous Latent States. Submitted to International Conference on Machine Learning (ICML), 2024.
3. Lekan Molu, **Shaoru Chen**. Structural Properties and Control of Soft Robots Modeled as Discrete Cosserat Rods. Submitted to the IEEE Conference on Decision and Control (CDC), 2024.

## Journal Publications

1. **Shaoru Chen**, Victor M. Preciado, Manfred Morari, and Nikolai Matni. Robust model predictive control with polytopic model uncertainty through System Level Synthesis. *Automatica*, 2023.
2. Shuo Yang\*, **Shaoru Chen\***, Victor M. Preciado, and Rahul Mangharam. Differentiable Safe Controller Design through Control Barrier Functions. *IEEE Control Systems Letters*, 2022.
3. **Shaoru Chen\***, Eric Wong\*, J. Zico Kolter, and Mahyar Fazlyab. DeepSplit: Scalable Verification of Deep Neural Networks via Operator Splitting. *IEEE Open Journal of Control Systems (OJCSYS)*, 2022.
4. James T. Allen, **Shaoru Chen**, and Nael H. El-Farra. Model-based Strategies for Sensor Fault Accommodation in Uncertain Dynamic Processes with Multi-rate Sampled Measurements. *Chemical Engineering Research and Design*, 2019.

## Conference Publications

1. **Shaoru Chen**, Lekan Molu, Mahyar Fazlyab. Verification-Aided Learning of Neural Network Barrier Functions with Termination Guarantees. *American Control Conference (ACC)*, 2024.
2. **Shaoru Chen\***, Kong Yao Chee\*, Nikolai Matni, M. Ani Hsieh, George J. Pappas. Safety Filter Design for Neural Network Systems via Convex Optimization. *IEEE Conference on Decision and Control (CDC)*, 2023.
3. **Shaoru Chen**, Victor M. Preciado, and Mahyar Fazlyab. One-shot reachability analysis of neural network dynamical systems. *International Conference on Robotics and Automation (ICRA)*, 2023.
4. **Shaoru Chen**, Ning-Yuan Li, Victor M. Preciado, and Nikolai Matni. Robust Model Predictive Control of Time-Delay Systems through System Level Synthesis. *IEEE Conference on Decision and Control (CDC)*, 2022.
5. **Shaoru Chen**, Mahyar Fazlyab, Manfred Morari, George J. Pappas, and Victor M. Preciado. Learning Rregion of Attraction for Nonlinear Systems. *IEEE Conference on Decision and Control (CDC)*, 2021.
6. **Shaoru Chen**, Mahyar Fazlyab, Manfred Morari, George J. Pappas, and Victor M. Preciado. Learning Lyapunov Functions for Hybrid Systems. *International Conference on Hybrid Systems: Computation and Control (HSCC)*, 2021.
7. **Shaoru Chen**, Han Wang, Manfred Morari, Victor M. Preciado, and Nikolai Matni. Robust Closed-loop Model Predictive Control via System Level Synthesis. *IEEE Conference on Decision and Control (CDC)*, 2020.
8. Ximing Chen, **Shaoru Chen**, and Victor M. Preciado. Safety Verification of Nonlinear Polynomial System via Occupation Measures. *IEEE Conference on Decision and Control (CDC)*, 2019.
9. Han Wang, Mahyar Fazlyab, **Shaoru Chen**, and Victor M. Preciado. Robust Convergence Analysis of Three-Operator Splitting. *Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, 2019.
10. **Shaoru Chen**, James T. Allen, and Nael H. El-Farra. Stability and Performance-Based Strategies for Sensor Fault Accommodation in Multi-rate Sampled-data Processes. *20th World Congress of the International Federation of Automatic Control (IFAC)*, 2017.
11. Zhiyang Liu, Jian Chen, **Shaoru Chen**, Lianghui Huang, and Zhigang Shao. Modeling and Control of Cathode Air Humidity for PEM Fuel Cell Systems. *20th World Congress of the International Federation of Automatic Control (IFAC)*, 2017.