Shucheng Kang

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Education

Tsinghua University, Electronic Engineering (EE), Bachelor of Engineering 2019.9 – 2023.6 (expected)

- GPA: **3.95**/4.0, rank: **5**/252
- Relevant Courses: Computer Program Design (1)(2) (4.0), Linear Algebra (4.0), Data and Algorithm (4.0), Probability and Stochastic Processes (1)(2) (4.0), Statistical Inference (4.0), Introduction to Robotics (4.0), Intelligent Systems and Robotics

Publications

1 Xiang Zhu, **Shucheng Kang**, and Jianyu Chen, "A Contact-Safe Reinforcement Learning Framework for Contact-Rich Robot Manipulation". Accepted by *IROS, 2022*. [arXiv]

2 Tianhao Wei, **Shucheng Kang**, Weiye Zhao, Changliu Liu. "Persistently Feasible Robust Safe Control by Safety Index Synthesis and Convex Semi-Infinite Programming". Submitted to *L-CSS and ACC, 2023* and accepted by *L-CSS*. [arXiv]

High Lighted Research Projects

Abstract Safe Control for High Dimensional Systems 2022.7 – present

Research Assistant. Advisor: Prof. Changliu Liu *Intelligent Control Lab, CMU*

- Discovered the challenge that the state-of-the-art control barrier function (safety index, CBF) lacks persistent feasibility guarantees in high dimensional systems.
- Proposed abstract safe control method to construct a CBF based on the abstracted low-dimensional dynamic model. Estimated the abstract control limits with its maximal inner Lp-norm ball, making safety constraints free of high dimensional information.
- An experiment on 7-dof Franka Panda in simulation demonstrated that our method achieves more than 10^5 speedup compared to directly constructing CBF in high dimensional space.

Robust Safe Control for Uncertain Dynamic Models 2022.4 – 2022.9

Research Assistant. Advisor: Prof. Changliu Liu *Intelligent Control Lab, CMU*

- Identified that the state-of-the-art control barrier function (safety index, CBF) loses safety guarantees when the system dynamics have uncertainty.
- Proposed Uncertainty-Robust Safety Index Synthesis (UR-SIS) to construct a CBF with persistent feasibility guarantees for all possible dynamics, via evolutionary search in the discretized state space. Additionally Proposed two Robust Safe Set Algorithms (RSSA) to generate provable safe control.
- The proposed UR-SIS and RSSA achieve zero safety violations in SegWay and SCARA robotics benchmarks.

A Contact-Safe Reinforcement Learning Framework for Contact-Rich Robot Manipulation 2021.4 – 2022.3

Research Assistant. Advisor: Jianyu Chen *Intelligent Systems and Robotics Laboratory, Tsinghua*

- Identified the limitations of existing reinforcement learning works in contact-rich manipulation tasks, where they might generate unsafe contact forces due to the distribution shift.
- Proposed a contact-safe RL framework based on the VICES method with null space projection to keep task-space contact force small. When joint contact force is detected, provided contact compensation in both impedance controller and null space projection.
- The proposed framework achieves 1/3 joint contact force and task space disturbance compared to the RL + VICES baseline.

Honors and Awards

- 4^{th} Place in Tsinghua University Drone Challenge (5%) 2021.12
- **National Scholarship** (highest student reward in Chinese universities, 2%) 2021.10
- Tang Lixin Scholarship (5%) 2020.10
- 3^{rd} Prize in Tsinghua University Hardware System Design Competition (10%): created a LaTeX-style Writing Machine 2020.9

Skills

Programming Languages

- Proficient: C/C++, Python, Matlab, ROS
- Knowledgeable: Verilog HDL, R

Language Skills

- Best TOEFL Scores: Reading 30 / Listening 30 / Speaking 22 / Writing 28 / Total 110
- GRE: Verbal 154 / Quantity 170 / AW4.0

Leadership and Teachering Experience

- **Teaching Assistant**, *Computer Program Design* 2021.7 – 2021.9
- **Minister**, *Learning and Training Division, EE Student Association of Science and Technology* 2021.6 – 2022.6