# Shihao Li

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## Summary

Ph.D. student in Mechanical Engineering at The University of Texas at Austin, with foundations in control theory, optimization, and reinforcement learning. Research focuses on deep reinforcement learning for sequential decision-making, distributionally robust predictive control, and LLM-based multi-agent frameworks for automated control synthesis. Currently exploring vision-language-action models for robot manipulation, with focus on bridging the gap between open-loop action prediction and closed-loop reactive control. Seeking research opportunities to apply control and learning expertise to robotics.

## Education

**University of Texas at Austin**, Austin, Texas — August 2023 – Present
*Doctor of Philosophy | Mechanical Engineering | Dynamic Systems and Control* — **GPA: 3.96/4.0**

**University of Texas at Austin**, Austin, Texas — August 2023 – December 2025
*Master of Science | Mechanical Engineering*
*Thesis: "Curriculum-Based Soft Actor-Critic for Multi-Section Roll-to-Roll Tension Control"*
*Advisor: Dr. Dongmei Chen | Committee: Dr. Wei Li*

**Pennsylvania State University**, University Park, Pennsylvania — September 2019 – May 2023
*Bachelor of Science in Mechanical Engineering* — **GPA: 3.67/4.0**
*Major GPA: 3.86/4.0*

## Experience

**Graduate Research Assistant** — Jan 2024 – Present
*University of Texas at Austin – Advanced Power Systems and Controls Lab*

- **Vision-Language-Action Models:** Investigating methods to improve robustness of VLA models for robot manipulation under environmental perturbations. Configured and validated MimicDroid-RoboCasa simulation environment on multi-GPU server (8× RTX A6000). Conducting literature review on action chunking policies, visual servoing, and active vision for visuomotor control
- **LLM Multi-Agent Systems for Control Synthesis:** Developed S2C, a multi-agent LLM framework that synthesizes certified $\mathcal{H}_\infty$ controllers via convex optimization with provable safety guarantees. Achieved **100% synthesis success** on 14 COMPleib benchmarks. Implemented specialized agents with RAG-based domain knowledge retrieval and automated safety verification—demonstrating LLM reasoning for robotic control
- **Reduced-Order Modeling for Real-Time Control:** Developed AURORA, an LLM-based framework automating reduced-order model discovery and controller design for high-dimensional nonlinear systems. Validated on 8 benchmark systems including robotic manipulators, achieving substantial tracking improvements for real-time trajectory optimization
- **Deep Reinforcement Learning for Sequential Decision-Making:** Designed curriculum-based Soft Actor-Critic (SAC) with 22-dimensional observation space and entropy-regularized policy optimization. Implemented three-phase curriculum progressively expanding operational envelope, achieving **80.2% lower tracking error** than LQR baseline. Demonstrated robust disturbance rejection and safe policy transfer—applicable to robotic manipulation under uncertainty
- **Trajectory Optimization under Uncertainty:** Developed distributionally robust data-driven predictive control (MDR-DeePC) combining physics-based models with data-driven prediction for robust trajectory planning. Implemented influence-function methods for data attribution in system identification—relevant to world modeling and learning from demonstrations
- **Physics-Based Modeling and Sim-to-Real Transfer:** Developed physics-based models using contact mechanics and validated through real-world experiments, reducing process time by **62.6%**—demonstrating rigorous simulation-to-reality validation skills

**Teaching Assistant** — Jan – May 2025
*University of Texas at Austin – ME 384Q.1: Introduction to Modern Control*

- Conducted office hours and mentored projects on state-space modeling, controllability, observability, stability, and optimal control; supported MATLAB/Simulink implementations for over 80 students

- Graded homework, midterm, and final exams; reinforced feedback control and dynamic optimization concepts through student Q&A and lecture support

**Undergraduate Research Assistant** Oct 2021 – Apr 2022

*University of California, Los Angeles – Fluid Mechanics of Renewable Energy*

- Examined thermodynamics, design, and operation of renewable energy systems including hydropower, solar, and biomass under supervision of Dr. Nasr Ghoniem
- Conducted comprehensive literature review and analysis of multi-junction solar cell efficiency factors, resulting in peer-reviewed publication in Energy Sources, Part A (2023)

## Awards | Technical Skills

- **Awards:** Warren A. and Alice L. Meyer Endowed Scholarship (UT Austin), Dean's List (7 Semesters, Penn State)
- **ML/Robotics:** VLA Architectures, Action Chunking (ACT), Deep Reinforcement Learning (SAC, PPO), Curriculum Learning
- **LLM & Foundation Models:** Multi-Agent LLM Systems, Prompt Engineering, RAG, Function Calling, Qwen2.5-VL Fine-tuning, vLLM Deployment
- **Theory:** Control Systems, MPC, Visual Servoing, LQR/LQG, $\mathcal{H}_\infty$ Synthesis, Convex Optimization (LMI/SDP)
- **Simulation:** MuJoCo, RoboCasa, robosuite, MATLAB/Simulink
- **Programming:** Python (PyTorch, NumPy, CVXPY, Transformers), Linux/Bash
- **Tools:** Git, GitHub, Docker, conda, GPU Cluster Management, Remote Server Management

## Publications

- **Li, S.**, Li, J., Xu, J., & Chen, D. (2025). From Natural Language to Certified H-infinity Controllers: Integrating LLM Agents with LMI-Based Synthesis. *arXiv preprint arXiv:2511.07894*.
- Li, J., **Li, S.**, & Chen, D. (2025). AURORA: Autonomous Updating of ROM and Controller via Recursive Adaptation. *arXiv preprint arXiv:2511.07768*.
- **Li, S.**, Li, J., Martin, C., Chen, Z., Chen, D., & Li, W. (2026). Curriculum-Based Soft Actor-Critic for Multi-Section R2R Tension Control. *54th SME North American Manufacturing Research Conference (NAMRC 54)*, Accepted.
- Li, J., **Li, S.**, Martin, C., Li, W., & Chen, D. (2026). An LLM-Assisted Multi-Agent Control Framework for Roll-to-Roll Manufacturing Systems. *54th SME North American Manufacturing Research Conference (NAMRC 54)*, Under Review.
- **Li, S.**, Martin, C., Morquecho, E.V., Chen, Z., Chen, D., & Li, W. (2025). Modeling of Adhesion Dynamics in Roll-to-Roll Lamination Processes. *Manufacturing Letters*, 44, pp.552-558.
- **Li, S.**, Li, J., Martin, C., Bakshi, S., & Chen, D. (2025). MDR-DeePC: Model-Inspired Distributionally Robust Data-Enabled Predictive Control. *Modeling, Estimation and Control Conference (MECC)*, October 2025.
- Li, J., Chu, J., Zhao, F., **Li, S.**, Li, W., & Chen, D. (2025). Constrained Optimal Planning to Minimize Battery Degradation of Autonomous Mobile Robots. *arXiv preprint arXiv:2506.13019*.
- Li, J., **Li, S.**, Xu, J., Bakshi, S., & Chen, D. (2025). Influence Functions for Data Attribution in Linear System Identification and LQR Control. *arXiv preprint arXiv:2506.11293*.
- Li, J., **Li, S.**, & Chen, D. (2025). Smart Predict-Then-Control: Integrating identification and control via decision regret. *arXiv preprint arXiv:2506.11279*.
- Li, J., Jian, C., Zhao, F., **Li, S.**, Li, W., & Chen, D. (2025). Robust Optimal Task Planning to Maximize Battery Life. *Modeling, Estimation and Control Conference (MECC)*, October 2025.
- **Li, S.**, Hao, C., Wu, P., Ji, J., Yang, Y., & Yao, J. (2023). Review of Multi-junction Solar Cell & Factors Impacting the Efficiency of Multi-junction Solar Cell. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 45(4), 12737â€“12758.

## Service

- **Peer Reviewer:** Modeling, Estimation and Control Conference (MECC)
- **Peer Reviewer:** ASME Journal of Dynamic Systems, Measurement and Control