Ran Tao

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Education

University of Illinois at Urbana-Champaign
Ph.D. Student in Mechanical Engineering — *Expected May 2026*
- GPA: 3.91

University of Illinois at Urbana-Champaign
M.Sc. in Mechanical Engineering — *Fall 2021 - December 2022*
- GPA: 3.91

University of Illinois at Urbana-Champaign
B.Sc. in Mechanical Engineering — *Fall 2017 - May 2021*
- GPA: 3.99
- Highest Honor: University Honor
- MechSE Bei Tse & May Chao Award (Spring 2021)

Research Experience

Advanced Controls Research Lab (PI: Naira Hovakimyan) — Fall 2021 – Present
Graduate Student Researcher — *Urbana, IL*
- AI for Agriculture Management
  - Developed an intelligent crop management system using RL and IL techniques from crop simulations
  - Trained management policies using deep RL algorithms under full observation, leveraging a large number of state variables from the simulator
  - Employed IL to train management policies for partial observation, requiring only a few state variables that can be easily obtained from the real world
  - Optimized nitrogen fertilization and irrigation for enhanced crop yield, profit, and environmental sustainability
  - Conducted simulations with maize crops in Florida, US, and Zaragoza, Spain, achieving over 45% improvement in profit while minimizing environmental impact compared with recommended methods from domain experts
- Backup plan safety for autonomous vehicles under mission uncertainty
  - Developed and evaluated a new safety concept called "backup plan safety" for autonomous vehicle path planning under mission uncertainty
  - Formulated a feasibility maximization problem using multi-objective model predictive control (MPC) with multi-horizon control inputs
  - Guaranteed the asymptotic stability of the closed-loop system by designing the multi-cost function and improved computation efficiency using MPPI
  - Validated the performance of the proposed safety concept through simulations of a UAV path planning problem
- Adaptive Model Predictive Control with guaranteed transient performance and robust constraint satisfaction
  - Developed an adaptive MPC framework for systems with matched uncertainties
  - Leveraged L1 adaptive controller to compensate for uncertainties and ensure guaranteed transient performance
  - Designed an MPC for the nominal system based on the tightened constraints using the performance bounds from L1 adaptive control, ensuring robust constraint satisfaction
  - Conducted simulation experiments on a flight control example to validate the efficacy of the proposed framework

Cai Research Group (PI: Lili Cai) — March 2019 – Spring 2021
Undergraduate Student Research Assistant — *Urbana, IL*
- Radiation Cooling Film Project
  - Synthesized micro-structure film for radiative cooling with high emissivity and low absorptivity
  - Conducted thermal measurement on outdoor experiments and optimized the film composition ratio
  - Built a simulation model of the radiation cooling film and its environment to predict the radiative cooling performance using MATLAB
- 3D Printing of Radiative Cooling Film Project
  - Explored the feasibility of utilizing 3D printing technology to fabricate radiation cooling film through plentiful experiments
  - Investigated the effect of printing temperature, pressure, speed and print bed temperature on the product's radiation cooling effect

Intern Experience

Sun Harmonics Co., Ltd July 2019 – August 2019
Mechanical Engineer Intern *Hangzhou, China*

- Utilized CAD software to create accurate and detailed 3-D models of the solar panel holder and other products from the company
- Collaborated with clients to understand their requirements and specifications
- Conducted material selection for the solar panel holder based on functionality and cost considerations
- Developed a manufacturing process for the holder, ensuring efficient production and assembly

Projects

Crimes against Women in India Prediction | *Python* Fall 2022

- Designed a predictor for crimes against women in India with Deep Neural Network

Technical Skills

Research Expertise: adaptive control, MPC, reinforcement learning, supervised learning, state estimation, dynamics modeling, simulation and control of autonomous vehicles
Programming Languages: Python, MATLAB
Technologies/Frameworks: Pytorch, LaTeX
3-D CAD Modeling: SolidWorks, Creo

Published Papers

- Zhou, Kai, Wei Li, Bijal Bankim Patel, Ran Tao, Yilong Chang, Shanhui Fan, Ying Diao, and Lili Cai. "Three-dimensional printable nanoporous polymer matrix composites for daytime radiative cooling." Nano letters 21, no. 3 (2021): 1493-1499.

- Wu, Jing, Ran Tao, Pan Zhao, Nicolas F. Martin, and Naira Hovakimyan. "Optimizing Nitrogen Management with Deep Reinforcement Learning and Crop Simulations." In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, pp. 1712-1720. 2022.

- Tao, Ran, Pan Zhao, Jing Wu, Nicolas F. Martin, Matthew T. Harrison, Carla Ferreira, Zahra Kalantari, and Naira Hovakimyan. "Optimizing Crop Management with Reinforcement Learning and Imitation Learning." Accepted by IJCAI 23.