

# Ran Tao

217-904-5083 | [rant3@illinois.edu](mailto:rant3@illinois.edu) | [Website](#) |

## 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* (the 32nd International Joint Conference on Artificial Intelligence).