

Miaomiao Dai

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ACADEMIC HISTORY

University of Michigan at Ann Arbor	GPA: 3.97/4.00	August 2024 — present
B.E. in Computer Science		
Major course: Data Structures and Algorithms (A), Introduction to Machine Learning (A), Introduction to Algorithmic Robotics (A), Robot Learning (A+), Computer Vision (A) Foundations of Computer Science (A), Computer Organization (A)		
Shanghai Jiao Tong University, Shanghai		September 2022 — August 2026 (expected)
B.E. in Mechanical Engineering	GPA: 3.56/4.00	

RESEARCH EXPERIENCE

Fast Differential Dynamic Programming for Time-Optimal Trajectory Planning	July 2025 — Present
Advisor: Professor Zhongqiang Ren, Shanghai Jiao Tong University	
➤ Developed a novel control framework that automatically determines the optimal time horizon T^* to solve the long-standing limitation of manual tuning in standard algorithms.	
➤ Invented an efficient evaluation method capable of computing all possible horizons in a single pass , reducing computational complexity from $O(N^2n^3)$ to $O(N n^3)$	
➤ Outperformed prior SOTA methods, which only estimate time and are prone to failure in nonlinear cases, by returning the exact optimal T^* with comparable runtime .	
Scalable Simulation Infrastructure for Autonomous Driving	May 2025 — August 2025
Advisor: Professor Henry Liu, Haowei Sun (Postdoc) University of Michigan, Ann Arbor	
➤ Engineered a scalable simulation pipeline on the Terasim platform to generate adversarial construction zone scenarios , addressing the data scarcity of long-tail corner cases in urban driving.	
➤ Developed an automated algorithm to procedurally generate diverse construction sites across the Ann Arbor digital map, incorporating realistic road topology and constraints.	
➤ Implemented a robust data conversion module to standardize simulation outputs into the Waymo Open Dataset format .	

SELECTED PROJECTS

Deep Learning for Visual Classification & Representation Course Project: Computer Vision	
➤ Built a Vision Transformer (ViT) in PyTorch by manually implementing patch embeddings, learnable CLS tokens, and Multi-head Self-Attention to capture global dependencies within image data.	
➤ Executed a Transfer Learning pipeline by pre-training an eight-class CNN on source domain data and fine-tuning the feature extractor for use on a binary target task, addressing data scarcity effectively.	
➤ Optimized model generalization through data augmentation and rigorous hyperparameter tuning , such as learning rate scheduling, and weight decay, ultimately achieving a test AUROC of 0.87 .	
Neural ODE (Ordinary Differential Equation) for Planar Pushing Dynamics Course Project: Robot Learning	
➤ Developed a continuous-time dynamics model using Neural ODEs to capture the complex physics of robot pushing, resolving discretization errors identified in traditional Residual Networks.	
➤ Achieved a 38% decrease in prediction errors as compared to baseline models by designing a physics-aware SE (2) loss function and finetuning differential equation solvers such as DoPri5.	
➤ Validated the model's practicality by integrating it with a Model Predictive Path Integral (MPPI) controller , empowering a Franka Panda robot to execute precise pushing tasks during simulation.	
Large Language Model Implementation & Training (GPT) Course Project: Natural Language Processing	
➤ Built a modern decoder-only Transformer in PyTorch, incorporating state-of-the-art components including Rotary Position Embeddings (RoPE) , SwiGLU activation , and RMSNorm to replicate LLaMA-style architecture.	
➤ Pre-trained the model on 1B tokens of the FineWeb-Edu dataset using Mixed Precision (BF16) , Gradient Accumulation , and torch.compile which ultimately optimized training throughput and memory efficiency.	
➤ Implemented Supervised Fine-Tuning (SFT) pipeline with selective loss masking on the SmolTalk corpus.	

SKILLS

- **Programming Languages:** Python, C++, C, MATLAB, SQL, LaTeX
- **Deep Learning and AI:** PyTorch, OpenAI Gym, NumPy, SciPy, Pandas, OpenCV, Transformers
- **Robotics and Simulation:** PyBullet, Gazebo, SUMO, Terasim, SolidWorks, ROS
- **Tools and Platforms:** Git, Linux (Ubuntu), Docker, Waymo Open Dataset

HONORS & AWARDS

Honorable Mention in Interdisciplinary Contest in Modeling, May 2023; **First Prize** in the 13th SJTU Liming Cup Mechanical Innovation Competition for Freshmen, May 2023; 2022-2023 **Outstanding Volunteer** of Miyuan Volunteer Team, March 2023