Vihaan Misra

Contact Information

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WebPage LinkedIn GitHub Google Scholar

Education

Carnegie Mellon University Pittsburgh, USA
Ph.D. in Robotics August 2023 – Present
Research Focus: Controllable multimodal generative modelling under physical constraints for robotics and creative-AI — developing diffusion-based and optimization-driven methods for text-guided 2D/3D synthesis that jointly satisfy semantic objectives and geometric feasibility. Advised by Dr. Jean Oh.

Carnegie Mellon University Pittsburgh, USA
Master's in Robotics August 2023 – August 2025
GPA: 3.81/4.0
Thesis: Towards Natural Language-Driven Shape Arrangement Synthesis with Semantically-Aware Geometric Constraint Systems. [Link]
Thesis Committee: Prof. Jean Oh, Prof. Jun-Yan Zhu, Prof. Zackory Erickson, Peter Schaldenbrand.

Netaji Subhas University of Technology (formerly NSIT) New Delhi, India
B.Tech. in Electrical Engineering with a minor in Artificial Intelligence August 2019 – August 2023
GPA: 8.52/10 *(Top 5% in Department)*
Relevant Coursework: Applied Mathematics, Data Structures and Algorithms, Matrix Computation, Design and Analysis of Algorithms

Publications

- **Vihaan Misra**, Peter Schaldenbrand, Jean Oh, "ShapeShift: Text-to-Mosaic Synthesis via Semantic Phase-Field Guidance" – *Under Review, SIGGRAPH*
- **Vihaan Misra**, Peter Schaldenbrand, Jean Oh, "Robot Synesthesia: A Sound and Emotion Guided AI Painter" – IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS 2024**) – **Best Arts Paper Award** [Paper] | [Website]
- **Vihaan Misra**, Peter Schaldenbrand, Jean Oh, "Robot Synesthesia: A Sound and Semantics Guided AI Painter" – AAAI-23 Workshop on Creative AI Across Modalities. [Paper]
- Peter Schaldenbrand, Gerry Chen, **Vihaan Misra**, Lorie Chen, Ken Goldberg, Jean Oh, "Robot Painting: Art for Robotics" – IEEE Conference on Robotics and Automation (**ICRA@40**) [Paper] [Video]
- **Vihaan Misra**, Shivshankar S. Menon, Snehanshu Saha, Vaskar Raychoudhary, "AdaGen: Adaptive Generalized Knowledge Transfer Framework for Sensor-Based Surface Classification for Wheelchair Routing" – **Springer Nature Computer Science** [Paper]
- Abena Boadi-Agyemang, Peter Schaldenbrand, **Vihaan Misra**, Jean Oh, Aaron Steinfield, "If I Move, Do You Move? Investigating the Role of Interpersonal Synchrony in Human-Robot Collaborative Art-making" – *Under Review, HRI 2025*
- **Vihaan Misra**, Peter Schaldenbrand, Jean Oh, "Text-to-Image Synthesis using Semantic Priors" – Robotics Institute Summer Scholars Journal, Carnegie Mellon University. [Link]
- Rohan Pandey, **Vihaan Misra**, et al., "A Machine Learning Application for Raising WASH Awareness in the Times of COVID-19 Pandemic" – **Scientific Reports, Nature**. [Paper]
- Ashwin Misra, Anuj Agrawal, **Vihaan Misra**, "Robotics in Industry 4.0" – Handbook of Smart Materials, Technologies, and Devices, **Springer**, 2021. [Chapter]
- Ashwin Misra, Ankit Mittal, **Vihaan Misra**, Deepanshu Pandey, "Improving Non-Deterministic Uncertainty Modelling in Industry 4.0 Scheduling." [arXiv]

Awards

- **Best Arts Paper Award**, IEEE/RSJ IROS 2024, Abu Dhabi, UAE.
- **Robotics Institute Summer Scholars (RISS) Research Internship Award**, Carnegie Mellon University.
- **MITACS Globalink Research Internship Award**, University of Waterloo.
- **National Winner**, Pan-India Hackathon at IIT Ropar: ML-based precision agriculture for crop disease detection. [Project]
- **Top 0.5 Percentile**, Joint Entrance Examination (1M+ candidates).

Research Experience

Carnegie Mellon University Pittsburgh, USA – Bot Intelligence Group
Graduate Research Assistant – Generative AI, Robotics August 2023 – Present

- Designed **ShapeShift**, a phase-field optimization framework that synthesizes physically valid mosaic layouts from text prompts using CLIP-guided semantic losses and geometric constraint solvers. Under review at SIGGRAPH.
- Built **Robot Synesthesia**, a multimodal painting system that maps audio spectral features and emotion

embeddings to brush-stroke parameters via a differentiable renderer, enabling a 6-DOF robot arm to paint from music. Won **Best Paper** at IROS 2024.
- Extended the **FRIDA** painting framework from single-modal to multimodal conditioning — integrated text, audio, sketch, and style inputs into a differentiable real2sim2real optimization loop.

Mercedes-Benz Research and Development Bangalore, India
Research Intern – Computer Vision Jan 2023 – August 2023

- Engineered a lane-level perception pipeline for traffic line detection, sign recognition, and road element classification from street-view imagery.
- Developed a map-matching module aligning multi-source spatial-temporal trajectory data to road network graphs for HD map construction.

Carnegie Mellon University Pittsburgh, USA – Bot Intelligence Group
Research Intern – Generative AI, Robotics May 2022 – January 2023

- Co-developed **FRIDA**, a fully differentiable simulation environment for robot painting using a real2sim2real approach.
- Built **Sketch2Photo** [Link]: a sketch-to-photorealistic image synthesis module using image-text-sketch alignment and conditional generation, under Dr. Aayush Bansal and Dr. David Forsyth.

University of Alberta Edmonton, Canada – Rehabilitation Robotics Lab
Research Intern – Reinforcement Learning, NLP July 2021 – April 2022

- Designed and deployed a conversational AI agent for social anxiety therapy using deep RL-based dialogue management under Dr. Nathanial Maeda.
- Validated the system with clinical professionals at HealthGauge through patient interaction studies.

International Institute of Information Technology Hyderabad – Robotics Research Center
Research Intern – Computer Vision, Robotics February 2021 – November 2021

- Proposed a learning-based joint-space cost model for UR5 robotic arm rearrangement that replaced Euclidean heuristics, improving planning efficiency for automatic object rearrangement under Prof. K. Madhav Krishna. [Video]

University of Miami Florida, USA
Research Intern – Computer Vision, Transfer Learning February 2021 – October 2021

- Introduced an adaptive activation function and a generalized transfer learning framework (**AdaGen**) for sensor-based surface classification to assist wheelchair routing, outperforming fixed-activation baselines while reducing computational cost. Published in Springer Nature CS. [Paper]

Indraprastha Institute of Information Technology New Delhi, India – TavLab
Research Intern – Reinforcement Learning, NLP May 2020 – March 2021

- Led development of the **WashKaro** TB awareness application: designed RL-based adaptive quizzes, a deep learning chatbot, and a sentiment analysis module under Prof. Ponnurangam Kumaraguru and Prof. Tavpritesh Sethi.
- Coordinated a team to collect data directly from TB patients through an NGO partnership; published in Nature Scientific Reports. [Application]

Demos

- Demonstration of "Robot Synesthesia" at a collaborative music-art concert with composer Dr. Jonghee Kang, Seoul, Korea (Nov 2024).
- Demonstration of CoFRIDA Robot Artist at Burke Rehabilitation Center, New York (July 2024).
- Demonstration of "Robot Synesthesia" at **Amazon MARS** Conference (March 2024).
- Organized "Assessment of Robotics Capabilities" meeting, co-located with IEEE ICRA 2023. [Website]
- Demonstration of painting robot at **IJCAI-ECAI 2022**. [Link]

Service

- **Graduate Student Delegate**, Robotics Department, CMU: Represent the largest graduate student group in departmental governance.
- **President**, Indian Graduate Student Association (IGSA), CMU.
- **Organizer**, Robotics & AI Workshops for High School Students, CMU.

Technical Skills

Languages: Python, C/C++, MATLAB, Java, JavaScript
ML & AI: PyTorch, TensorFlow, Keras, Diffusion Models, CLIP, Transformers, Reinforcement Learning (StableBaselines), Scikit-learn
Robotics: ROS, Sim-to-Real Transfer, Motion Planning, 6-DOF Manipulation
Tools: Git, Linux, NumPy, OpenCV, Docker