Personal Statement

It is often said that the uniqueness of human intelligence lies in its ability to learn and use tools. This is embodied in how humans, as intelligent agents, understand the physical world, interact with it, and ultimately solve real-world problems. While physics seeks to distill the laws governing the physical world into simple principles, computer science explores how to leverage these principles to acquire information, uncover patterns, and create new realities. The use of various neural networks in AI to perceive and understand the world has become highly sophisticated, yet the domain of AI learning to interact with the physical world still holds immense potential for further development. For me, the most captivating aspect is how agents can learn new skills and transform the world through interaction with the physical environment.

Therefore, my intellectual interests focus on embodied AI, which combines reinforcement learning (RL) and data-driven methods to enable agents to acquire skills through real-world interactions. This technology holds significant potential for applications in robotics, where it can assist humans, and in graphics, where it can enhance character animation and even physical simulation to generate richer and more realistic content. I am particularly interested in how RL-based policies can extract physical properties from motion capture and video data, enabling agents to generate physically plausible character animations and realistic interactions with objects and environments.

Through my research experiences in the Visual Computing and Learning (VCL) Lab at Peking University and my research internship at the University of Illinois Urbana-Champaign (UIUC), I have explored intriguing problems in this field and gained valuable insights into research methodologies. My work has focused on using RL for physics-based control to extract physical information from rich data sources such as motion capture and video, allowing for more physically consistent motion generation. Notably, while existing video generation models often produce visually striking effects, they frequently violate fundamental physical principles. I firmly believe that integrating research with real-world physics exploration can yield more robust results in generation, with potential applications in robotics to enable agents to perform diverse tasks.

My earlier education in physics provided me with a strong foundation in understanding intelligent agents in the physical world, while my transition to computer science equipped me with the skills to approach these challenges from the perspective of computing and AI. Initially, I majored in physics as an undergraduate student at Peking University, where I studied fundamental topics such as theoretical mechanics. Inspired by computer graphics' ability to enrich simulations of the physical world, I developed a keen interest in using computer science to tackle these challenges. This interest led me to transfer to the computer science department, where I built a solid foundation in computer science knowledge and coding skills. Courses such as Character Animation and Physics-based Simulation, taught by Professor Libin Liu, further deepened my interest in graphics, leading me to join the VCL Lab under his guidance.

One of my initial projects explored character fatigue effects during skill performance. Leveraging RL architectures enhanced with generative models like GANs and VAEs, I aimed to constrain joint torques with physical fatigue principles to produce novel and physically consistent motion results. The RL-trained policies demonstrated motions reflecting fatigue dynamics, with the agent adapting its responses based on the complexity of tasks, aligning with my goal of integrating physical characteristics into animation. This project honed my skills in RL and generative model training, providing a strong foundation for future work.

Building on this success, my discussions with Professor Liu and lab peers inspired us to extend our approach to broader motion styles. Instead of solely relying on kinematics-based machine learning models to summarize stylistic patterns, I pursued a physics-based perspective, aiming to uncover interpretable motion styles with controllable physical properties. Adopting a policy fine-tuning structure inspired by AdaptNet, and aligned with stylization methods like AdaIN and CycleGAN, we designed an architecture for multi-task, multi-style physics-based generation. This research is still ongoing, with promising potential for future breakthroughs.

In the summer of 2024, I had the privilege of joining Professor Yuxiong Wang's group at UIUC to explore human-object interaction (HOI) control. Recognizing HOI as a critical aspect of agent-physical world interactions, I aimed to leverage RL methods enhanced by generative models to learn HOI control policies. My initial efforts involved applying GAN-based architectures to learn HOI tasks like ball-holding and dribbling, yielding successful results with policies that dynamically adapted to unseen situations. Currently, we are investigating compliance control in HOI, focusing on how torque influences policies to achieve more natural motions and safer, more stable task executions for real-world robotics applications.

These research experiences have deepened my understanding of physical-world interactions and the broader concept of embodied AI. I have also benefited from interdisciplinary discussions with researchers in adjacent fields, learning to incorporate advancements from LLMs, LVMs, and diffusion models into my research. These experiences have strengthened my ability to independently conceptualize and execute research projects while collaborating effectively with diverse teams. Although these projects inevitably came with conceptual challenges, I view research as a journey of continuous learning and creative exploration.

The opportunity to collaborate with leading researchers at the National University of Singapore (NUS) excites me greatly. I am particularly interested in the work being done at NUS in the fields of AI-driven simulation, reinforcement learning, and robotics. NUS's strong research groups in machine learning, interactive AI, and simulation align closely with my research aspirations. The university's research-driven master's program, which integrates rigorous coursework with rich opportunities for scientific

exploration, offers the ideal environment for me to grow.

I am confident in my ability to thrive in NUS's computer science master's program and am eager to contribute meaningfully to cutting-edge research in embodied AI and related fields.