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Personal Statement

My undergraduate studies in Engineering Mechanics at Tongji University gave me a foundation in mathematical reasoning and physical understanding. When I began exploring scientific machine learning, I found that this foundation did not provide a ready path through unfamiliar methods. My first language-model project required me to decide what I needed to learn before I could make progress. I began breaking unfamiliar tasks into questions I could investigate through reading, experimentation, and discussion. Over time, I became more comfortable moving forward without a complete answer at the outset. This experience changed my understanding of learning, from mastering established methods to developing the judgment to explore questions whose answers remained uncertain.

Working with my teammates in the China International College Students' Innovation Competition helped me understand the value of learning through discussion. We exchanged ideas about language-model fine-tuning, discussed unfamiliar tools, and worked through questions together. These discussions encouraged me to explain my reasoning, consider my teammates' perspectives, and revisit ideas I had not fully understood. We went on to win an award together, but I also valued how our exchanges helped me develop a clearer understanding of the work. I also shared datasets and model checkpoints on Hugging Face and documented projects in public repositories. These experiences strengthened my interest in exchanging knowledge and making my work accessible to others.

My research experiences gradually changed how I assess a model's performance. When I first began working with neural networks, seeing prediction errors decrease gave me a sense of accomplishment. As I gained more experience, I began asking what those improvements meant and whether they were sufficient to judge a model's reliability. In the battery-materials project, accurate predictions at individual steps during training did not necessarily lead to reliable predictions during autoregressive use. When the model used its own predictions as inputs, errors could accumulate over successive steps. In the PINN project, a lower overall prediction error coincided with a larger maximum local error. These experiences made me reconsider what I could reasonably conclude from an apparently better result. I began paying closer attention to what an evaluation revealed and what it left unresolved. Gradually, I learned to value identifying a limitation alongside demonstrating an improvement. This shift helped me become more careful in forming conclusions and more willing to acknowledge what I still needed to understand.

My summer research internship at Johns Hopkins University helped me develop a clearer understanding of independent research and collaboration. My work focused on combining Transolver with finite element methods in a hybrid solver. In a new academic environment, I worked through unfamiliar questions while exchanging ideas with researchers from different backgrounds. I gradually learned to prepare for discussions by reading, trying possible approaches, and identifying where my understanding remained incomplete. This helped me explain both my reasoning and my uncertainties more clearly, and listen more carefully to the perspectives others brought. I began to see collaboration as a shared effort that depended on each person contributing thoughtfully and remaining willing to reconsider their ideas. I came to understand independence as taking responsibility for moving my work forward while recognizing when feedback or another perspective could help. I hope to bring this sense of responsibility and openness to my doctoral research community.

My current research has drawn me toward neural operators and their integration with numerical methods. What interests me is their potential to learn relationships between input and output fields across a family of physical problems, allowing information gained during training to be reused in subsequent simulations. I see this as particularly valuable when related problems must be solved repeatedly. However, I do not think prediction speed or accuracy on a fixed test set is enough to establish their usefulness. I want to understand how their accuracy changes with unfamiliar inputs, different resolutions, and changes in geometry, rather than treating success in one setting as evidence of general applicability. My work on a hybrid finite element–neural operator solver has also made me attentive to what happens when predictions become part of an iterative computation. In that setting, local prediction errors matter through their influence on interface consistency, convergence, and the final solution. These questions motivate my interest in deciding which parts of a simulation can benefit from a neural operator and how numerical methods can support its reliable use.

I also want to extend this understanding to differentiable simulation. Beyond computing a system’s response, I am interested in understanding how that response changes with material parameters, boundary conditions, or design choices. Such sensitivities can help connect simulation with parameter identification, design optimization, and PDE control. What I want to investigate is whether a model that predicts physical fields accurately also provides gradients that are useful for these tasks, and how differentiation should be handled when neural operators and numerical solvers are coupled. This gives me a direction for further study: developing faster simulations while understanding the accuracy of both their predictions and the sensitivities used to guide subsequent decisions.

Through doctoral study, I hope to grow into an independent researcher who can turn broad interests into well-defined questions, assess their significance, and choose appropriate ways to investigate them. I want to develop the judgment to understand why a method works, which assumptions a conclusion depends on, and what the available evidence leaves unresolved. My experiences have shown me that taking responsibility for research requires continually weighing my own reasoning against evidence and feedback: explaining the choices I make while remaining willing to reconsider them when results challenge my expectations. During my PhD, I hope to strengthen this sense of responsibility, careful judgment, and openness through discussion, resource sharing, and collaboration. Ultimately, I want to produce work that communicates both its findings and its limitations clearly, providing a foundation that others can examine and build upon.