# Shule（Skyler） Zhao

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Research Interests: Data-Driven Methods/Fluid Mechanics/Aerodynamic Design

## Education

**Northwestern Polytechnical University（Guaranteed Admission）GPA 88.4%** 2023.09 – Present

- *M.Eng.* in Fluid Mechanics Advisor： Zhang Weiwei

**Northwestern Polytechnical University GPA 3.815/4.1** 2019.09 – 2023.06

- *B.Eng* in Aircraft Design and Engineering

## Publications

1. **Zhao, Shule**, and Zhang, Weiwei. "Euler equation embedded machine learning method for wall pressure and skin friction distribution." *Engineering Applications of Computational Fluid Mechanics* 19.1 (2025): 2556450. (JCR Q1)
2. Zhang, Weiwei, and **Zhao, Shule.** "Envisioning the blueprint: Aeronautics in large models era." *Chinese Journal of Aeronautics* (2025): 103607. (JCR Q1)
3. **Zhao, Shule** and Zhang, Weiwei. "Machine learning of skin friction distribution based on surface inviscid flow feature." *Chinese Journal of Theoretical and Applied Mechanics* 56.8 (2024): 2243-2258. （EI）

## Research Experience

➢ **Generative Design Method for Aerodynamic Shapes Based on Diffusion Models** 2025.07 – 2025.09

**Principal Investigator —Zhang Weiwei / Kou Jiaqing**

- Overview： In recent years, generative models such as Variational Autoencoders (VAE), Generative Adversarial Networks (GAN), and Denoising Diffusion Probabilistic Models (DDPM) have developed rapidly, offering new perspectives for aerodynamic shape design. We have developed a generative design method for aerodynamic shapes based on Denoising Diffusion Probabilistic Models. By employing classifier-free guidance, we achieve conditional control over the generation results based on aerodynamic performance metrics like lift-to-drag ratio, enabling the design of airfoils and blended-wing-body (BWB) configurations. Concurrently, we have developed a joint generative-optimization method that significantly improves the conditional accuracy of generated results with a small number of samples. In this work, we also compare mainstream generative models on generation tasks.
- This research is currently ongoing, with an estimated output of one paper.

➢ **Goal-Oriented Manifold Learning Method for Dimension Reduction** 2024.08 – 2025.08

**Principal Investigator —Zhang Weiwei / Kou Jiaqing**

- Overview： To address the need for goal-oriented reduced-dimensional representations in complex, high-dimensional fluid mechanics, we present a novel goal-oriented manifold learning method that integrates a target loss function into a convolutional autoencoder. Unlike traditional deterministic methods like POD and DMD, or unsupervised ML approaches such as standard Autoencoders, our approach yields an indeterminate reduced-dimensional space that explicitly captures latent features related to specific targets. This goal-oriented dimensionality reduction enables enhanced downstream applications. Specifically, we demonstrate its efficacy in aerodynamic optimization by constructing a goal-oriented filter, significantly accelerating the optimization process. Furthermore, for surrogate model construction, we introduce a tailored output-space sampling strategy, allowing for customized exploration of the output domain.
- Preparing 《Efficient Aerodynamic Shape Optimization Using a Goal-Oriented Manifold Geometric Filter》

➢ **Physics embedded Aerodynamic Modeling Methodology** 2022.11 – 2024.06

**Principal Investigator —Zhang Weiwei**

- Overview： With the advancement of artificial intelligence, machine learning has become a crucial tool for constructing aerodynamic surrogate models, with research typically focusing on flow field variables, concentrated loads, and distributed loads. However, building these models often requires extensive datasets and exhibits limited generalization, failing to meet the demands of engineering applications. To address the challenges of modeling with limited samples and the need for high generalization, we have developed an aerodynamic modeling approach that embeds low-fidelity equations. This method utilizes physical variables derived from low-fidelity equation solutions as input, assisting the model in achieving high-accuracy results. Validation on airfoil and wing cases across various flow conditions and geometries has demonstrated that this approach can reduce sample requirements by over 50% and exhibits good applicability to complex flow states such as shocks and flow separation.
- 2 paper published.

## Awards

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| National Scholarship for Postgraduates | October 2024 |
| Shaanxi Provincial Outstanding Graduate | August 2023 |
| NPU Outstanding Undergraduate Student Pacesetter(Selected from all undergraduates campus-wide, 10 recipients) | October 2022 |
| NPU Xiaomi Special Scholarship (Selected from all undergraduates and postgraduates campus-wide, 10 recipients) | October 2022 |
| NPU Outstanding Undergraduate/Postgraduate Student | 2020~2024 |

## Personal Statement

- Technical Skills: Python, MATLAB programming. Proficient in PowerPoint, Word, LaTeX. 3D modeling (e.g., CATIA).
- Computation Fluid Dynamics fundamentals: Pointwise meshing, ANSYS Fluent, PHengLEI solvers, Tecplot post-processing.
- Demonstrated strong organizational and management skills: Served as Executive Chairman of the Student Union in the School of Aeronautics at Northwestern Polytechnical University during undergraduate studies, and as Class Academic Representative. Demonstrated strong organizational and management skills.