

Dule Shu

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EDUCATION

Carnegie Mellon University

Doctor of Philosophy in Mechanical Engineering
GPA: 3.92/4.00

Pittsburgh, PA

2024.5

(anticipated graduation)

Pennsylvania State University

Master of Science in Electrical Engineering
GPA: 3.62/4.00

University Park, PA

2018.5

Selected Coursework: Real Analysis, Convex Optimization, Stochastic Optimization, Math Logic, Applied Stochastic Processes, Pattern Recognition, Linear Control Systems

Harbin Institute of Technology

Bachelor of Engineering in Automation
GPA: 83/100

Harbin, China

2007.7

Undergraduate Thesis: Linear Matrix Inequalities for Robust Controller Design

SKILLS

Python, PyTorch, MATLAB

PhD RESEARCH

Carnegie Mellon University

Deep Learning for Reduced Computational Complexity in Simulating
Partial Differential Equations (PDEs)

Pittsburgh, PA

2022.5 – 2024.5

- Developed a super-resolution neural network model for fluid flow data using a denoising diffusion probabilistic model for robustness on out-of-distribution low-res input.
- Developed a deep learning model for spatial reconstruction of incomplete fluid flow data using a vector-quantized generative adversarial network for improved numerical stability and accuracy.
- Collaborated with labmates to develop a Transformer-based neural PDE solver which implements axial factorized kernel integral to reduce the computational complexity.
- Collaborated with labmates to develop a deep learning surrogate model simulating PDE in a learned latent space for a reduced computational cost.

ADDITIONAL RESEARCH EXPERIENCE

Carnegie Mellon University

Deep Generative Models

Pittsburgh, PA

2019.8 – 2022.4

- Developed a deep generative model to synthesize 3D mesh objects for evaluating a design cycle consisting of synthesis and physics-based validation.
- Developed a generative adversarial network to evaluate the threat of synthesized attacks against network intrusion detection systems with minimal use of training data by active learning.
- Conducted a pilot study which investigates STEM learners' ability to decipher AI-generated video created by a face-swapping generative model.
- Developed a generative adversarial network for multi-modal data encryption to demonstrate the viability of deep generative methods in steganography.

Pennsylvania State University

Research assistant in the DARPA FUN Design program

University Park, PA

2018.8 – 2019.5

• Collaborated with labmates to develop computational tools for the generation and evaluation of 3D designs.

Graduate student advisor for Penn State Advanced Vehicle Team in EcoCAR3 2015.8 – 2018.5

- Developed a method for road-anomaly detection using contours of sum-of-square polynomials.
- Developed a switch control algorithm for vehicle path planning modeled as a finite-transition system using linear temporal logic.

ACADEMIC PROJECTS

Carnegie Mellon University

Course project for Learning Based Image Synthesis Final (16726)

Pittsburgh, PA

2022.1 – 2022.5

- A Study of Deep Learning-based 3D Point Clouds Reconstruction.

(project webpage: <https://www.andrew.cmu.edu/course/16-726-sp22/projects/dules/project/>)

PUBLICATIONS (Selected)

Shu, D., Li, Z., & Farimani, A. B. (2023). A physics-informed diffusion model for high-fidelity flow field reconstruction. *Journal of Computational Physics*, 478, 111972.

Li, Z., Shu, D., & Farimani, A. B. (2023). Scalable Transformer for PDE Surrogate Modeling. *NeurIPS 2023*.

Li, Z., Patil, S., Shu, D., & Farimani, A. B. (2023, October). Latent Neural PDE Solver for Time-dependent Systems. In *NeurIPS 2023 AI for Science Workshop*.

Shu, D., Doss, C., Mondschein, J., Kopecky, D., Fitton-Kane, V., Bush, L., & Tucker, C. (2021, July). A Pilot Study Investigating STEM Learners' Ability to Decipher AI-generated Video. In *2021 ASEE Virtual Annual Conference*.

Doss, C., Mondschein, J., Shu, D., Wolfson, T., Kopecky, D., Fitton-Kane, V. A., ... & Tucker, C. (2023). Deepfakes and scientific knowledge dissemination. *Scientific Reports*, 13(1), 13429.

Shu, D., Leslie, N. O., Kamhoua, C. A., & Tucker, C. S. (2020, July). Generative adversarial attacks against intrusion detection systems using active learning. In *Proceedings of the 2nd ACM workshop on wireless security and machine learning* (pp. 1-6).

Shu, D., Cong, W., Chai, J., & Tucker, C. S. (2020, July). Encrypted rich-data steganography using generative adversarial networks. In *Proceedings of the 2nd ACM Workshop on Wireless Security and Machine Learning* (pp. 55-60).

Shu, D., Cunningham, J., Stump, G., Miller, S. W., Yukish, M. A., Simpson, T. W., & Tucker, C. S. (2020). 3d design using generative adversarial networks and physics-based validation. *Journal of Mechanical Design*, 142(7), 071701.

Cunningham, J. D., Shu, D., Simpson, T. W., & Tucker, C. S. (2020). A sparsity preserving genetic algorithm for extracting diverse functional 3D designs from deep generative neural networks. *Design Science*, 6, e11.

Shu, D., Lagoa, C., & Cleary, T. (2017, October). A sum-of-squares polynomial approach for road anomaly detection using vehicle sensor measurements. In *Dynamic Systems and Control Conference* (Vol. 58288, p. V002T17A004). American Society of Mechanical Engineers.

Shu, D., & Lagoa, C. M. (2017, February). A linear temporal logic-based approach for vehicle motion planning. In *2017 IEEE International Conference on Mechatronics (ICM)* (pp. 25-30). IEEE.

CONFERENCES / PRESENTATIONS (Selected)

Shu, Dule, Li, Zijie. "Robust Reconstruction of High-Fidelity Fluid Field Using Physics-informed Diffusion Model." *APS DFD*, Washington, DC, Nov 20, 2023. Poster.

Li, Zijie, Shu, Dule. "Scalable Transformer for PDE Surrogate Modeling." *NeurIPS*, New Orleans, LA, Dec 12, 2023. Poster.

Shu, Dule. "A Pilot Study Investigating STEM Learners' Ability to Decipher AI-generated Video." *ASEE Virtual Annual Conference*, Virtual, 2021. Presentation.

Shu, Dule. "Generative Adversarial Attacks Against Intrusion Detection System Using Active Learning." *ACM WiSec*, Virtual, 2020. Presentation.

TEACHING ASSISTANT EXPERIENCE

Carnegie Mellon University

Teaching assistant

Pittsburgh, PA

2022.9 – 2022.12

- Taught weekly recitation for Dynamic Systems and Control (24352).

Pennsylvania State University

Lab assistant

Pittsburgh, PA

2017.8 – 2018.5

- Taught the lab session of Electronic Circuit Design I (EE 310) to help undergraduate students on designing and building electronic circuits.