Yizheng Wang (2025/11/11)

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EDUCATION BACKGROUND

School of Aerospace Engineering, Tsinghua University (THU) 08/2024–now
- First year of PH.D Candidate Beijing, China
- Future Scholar at Tsinghua University (清华大学未来学者)

School of Aerospace Engineering, Tsinghua University (THU) 08/2019–06/2022
- Professional Master in Aerospace Engineering, Overall GPA: 3.47/4.0 Beijing, China
- Core Courses: Machine Learning, Finite Element Method, Pattern Recognition, Applied Statistics, Numerical Analysis, Computational Solid Mechanics, Computational Dynamics, Tensor Analysis, Solid Mechanics, Experimental Solid Mechanics, Elastoplasticity

College of Air Traffic Management, Civil Aviation University of China 09/2012–07/2016
- Bachelor of Engineering in Transportation (Air Traffic Control), Overall GPA: 3.18/4.0 Tianjin, China

RESEARCH DIRECTION

I am majoring in solid mechanics and have rich experience in physical theory, computation, and experiment. I mainly focus on **solving Partial Differential Equations of solid mechanics** based on the physics-informed neural networks (PINNs), operator learning and deep energy method. My research interest is AI for Science, specifically **AI for mechanics**.

PUBLICATIONS

- **Wang, Yizheng**, Jinshuai Bai, Zhongya Lin, Xiaoying Zhuang, Timon Rabczuk, Yinghua Liu, et.al.. "Artificial intelligence for partial differential equations in computational mechanics: A review" Submitted to *Applied Mechanics Reviews* (IF: 16.3). https://arxiv.org/abs/2410.19843
- **Wang, Yizheng**, Xiaoying Zhuang, Timon Rabczuk, and Yinghua Liu. "AI for PDEs in solid mechanics: A review" Published on *Advances in Mechanics* (IF: 2.386). https://lxjz.cstam.org.cn/cn/article/doi/10.6052/1000-0992-24-016
- **Wang, Yizheng**, Jia Sun, Wei Li, Zaiyuan Lu, and Yinghua Liu. "CENN: Conservative energy method based on neural networks with subdomains for solving variational problems involving heterogeneous and complex geometries." Published on *Computer Methods in Applied Mechanics and Engineering* (IF: 7.188). https://doi.org/10.1016/j.cma.2022.115491
- **Wang, Yizheng**, Jia Sun, Jinshuai Bai, Cosmin Anitescu, Mohammad Sadegh Eshaghi, Xiaoying Zhuang, Timon Rabczuk, and Yinghua Liu. "Kolmogorov Arnold Informed neural network: A physics-informed deep learning framework for solving PDEs based on Kolmogorov Arnold Networks" Published on *Computer Methods in Applied Mechanics and Engineering* (IF: 7.188). https://doi.org/10.1016/j.cma.2024.117518
- **Wang, Yizheng**, Jia Sun, Timon Rabczuk, and Yinghua Liu. "DCEM: A deep complementary energy method for linear elasticity." Published on *International Journal for Numerical Methods in Engineering* (IF: 3.0). https://doi.org/10.1002/nme.7585
- **Yizheng Wang**, Jinshuai Bai, Mohammad Sadegh Eshaghi, Cosmin Anitescu, Xiaoying Zhuang, Timon Rabczuk, Yinghua Liu. "Transfer Learning in Physics-Informed Neural Networks: Full Fine-Tuning, Lightweight Fine-Tuning, and Low-Rank Adaptation." Published on *International Journal of Mechanical System Dynamics* (IF: 3.5). https://doi.org/10.1002/msd2.70030

- **Yizheng Wang**, Xiang Li, Ziming Yan, Yuqing Du, Jinshuai Bai, Bokai Liu, Timon Rabczuk, Yinghua Liu. "A Pretraining-Finetuning Computational Framework for Material Homogenization" submitted to *International Journal for Numerical Methods in Engineering* (IF: 3.7) (under review). https://arxiv.org/abs/2404.07943
- **Yizheng Wang**, Yuzhou Lin, Somdatta Goswami, Luyang Zhao, Huadong Zhang, Jinshuai Bai, Cosmin Anitescu, Mohammad Sadegh Eshaghi, Xiaoying Zhuang, Timon Rabczuk, Yinghua Liu "Towards Unified AI-Driven Fracture Mechanics: The Extended Deep Energy Method (XDEM)" submitted to *Nature Computational Science* (IF: 16.0) (https://arxiv.org/abs/2511.05888).
- Baijin Shuai, **Yizheng Wang** et.al. "Towards the future of physics- and data-guided AI frameworks in computational mechanics." Published on *Acta Mechanics Sinica* (IF: 4.6). https://link.springer.com/journal/10409
- Bokai Liu, Pengju Liu, **Yizheng Wang** et.al. "Explainable machine learning for multiscale thermal conductivity modeling in polymer nanocomposites with uncertainty quantification." Published on *Composite Structure* (IF: 6.3). https://doi.org/10.1016/j.compstruct.2025.119292
- Bokai Liu, **Yizheng Wang**, Timon Rabczuk, et.al. "Multi-scale modeling in thermal conductivity of Polyurethane incorporated with Phase Change Materials using Physics-Informed Neural Networks." Published on *Renewable Energy* (IF: 8.608). https://doi.org/10.1016/j.renene.2023.119565
- Jia Sun, Yinghua Liu, **Yizheng Wang**, Zhenhan Yao, and Xiaoping Zheng. "BINN: A deep learning approach for computational mechanics problems based on boundary integral equations." Published on *Computer Methods in Applied Mechanics and Engineering* (IF: 7.188). https://doi.org/10.1016/j.cma.2023.116012
- Jinshuai Bai, Zhongya Lin, **Yizheng Wang**, et al. "Energy-based physics-informed neural network for frictionless contact problems under large deformation." Published on *Computer Methods in Applied Mechanics and Engineering* (IF: 7.188). https://doi.org/10.1016/j.cma.2025.117787
- Jinshuai Bai, Guirong liu, Timon Rabczuk, **Yizheng Wang**, et al. "A robust radial point interpolation method empowered with neural network solvers (RPIM-NNS) for nonlinear solid mechanics." Published on *Computer Methods in Applied Mechanics and Engineering* (IF: 7.188). https://doi.org/10.1016/j.cma.2024.117159
- Mohammad Sadegh Eshaghi, Cosmin Anitescu, Manish Thombre, **Yizheng Wang**, et al. "Variational Physics-informed Neural Operator (VINO) for Solving Partial Differential Equations." Published on *Computer Methods in Applied Mechanics and Engineering* (IF: 7.188). https://doi.org/10.1016/j.cma.2025.117785
- Mohammad Sadegh Eshaghi, Mostafa Bamdad, Cosmin Anitescu, **Yizheng Wang**, et al. "DeepNetBeam: A Framework for the Analysis of Functionally Graded Porous Beams." Published on *Neurocomputing* (IF: 5.5) (Accept). https://doi.org/10.1016/j.neucom.2024.129119
- Manish Thombre, Cosmin Anitescu, BVSS Bharadwaja, **Yizheng Wang**, et al. "Energy-based methods for solving forward and inverse linear elasticity problems in 2D structures." Published on *Computers & Structures* (IF: 4.8) (Accept). https://doi.org/10.1016/j.compstruc.2025.107899
- Mohammad Sadegh Eshaghi, Cosmin Anitescu, Navid Valizadeh, **Yizheng Wang**, et al. "Multi-Head Neural Operator for Modelling Interfacial Dynamics." Submitted to *International Journal of Mechanical Sciences* (IF: 9.4) (Under review). https://doi.org/10.48550/arXiv.2507.17763
- Mohammad Sadegh Eshaghi, Cosmin Anitescu, Navid Valizadeh, **Yizheng Wang**, et al. "NOWS: Neural Operator Warm Starts for Accelerating Iterative Solvers." Submitted to *Nature Computational Science* (IF: 16.0). https://arxiv.org/abs/2511.02481

- **Wang, Yizheng**, and Yinghua Liu. "PETS-SWINF: A regression method that considers images with metadata based Neural Network for pawpularity prediction on 2021 Kaggle Competition 'PetFinder. My'." Submitted to *Pattern Recognition Letters* (IF: 3.756). https://doi.org/10.48550/arXiv.2201.06061

Reviewers

Journal:
Journal of the Mechanics and Physics of Solids | Engineering Applications of Artificial Intelligence | Engineering Geology | Underground Space | International Journal of Impact Engineering | International Journal of Hydrology | Engineering Analysis with Boundary Elements | Energy and AI | Neural Networks | Frontiers of Structural and Civil Engineering | Computer, Material and Continua | Engineering Structure | International Journal of Mechanical System Dynamics | Scientific Reports | Applied Physics A | International Journal of Mechanics and Materials in Design | Machine Learning for Computational Science and Engineering | Mechanics Based Design of Structures and Machines | International Journal of Hydromechatronics | Computers and Chemical Engineering | Journal of Building Engineering | Applied Mathematical Modelling | Thin-Walled Structures

Conference:
2025 23rd European Control Conference

CONFERENCES

Chinese Congress of Theoretical and Applied Mechanics 2025 (CSTAM-25),Changsha,China 07/2025
Yizheng Wang. "AI for PDEs in computational mechanics." (Oral presentation)

International Conference on Data-Driven Computing and Engineering Machine Learning 2024 (DACOMA-24),Nanjing,China 10/2024
Yizheng Wang. "AI for PDEs in computational mechanics." (Oral presentation)
Won "**Best Paper Awards**" (*Supervised by Prof. Yinghua Liu and Prof. Timon Rabczuk*)

CCSM2023, Nanjing, China 04/2024
Yizheng Wang, and Yinghua Liu. "AI for PDEs in solid mechanics". Oral presentation and host in computaiontal solid mechanics. (Oral presentation)

CCCM2023, Dalian, China 08/2023
Yizheng Wang, and Yinghua Liu. "Deep energy method based on the principle of possible work" at "Artificial Intelligence and Its Applications in Computational Mechanics" (Oral presentation)

International Conference on Data-Driven Computing and Engineering Machine Learning 2022(DACOMA-22), Beijing,China 09/2022
Yizheng Wang. "Solving Partial Differential Equations of Solid Mechanics Based on PINN." (Oral presentation)
Won "**Best Paper Awards**" (*Master's Thesis Supervised by Prof. Yinghua Liu*)

The 15th World Congress on Computational Mechanics (WCCM), 8th Asian Pacific Congress on Computational Mechanics (APCOM), Yokohama Japan Virtual 07/2022
Yizheng Wang, and Yinghua Liu. "A Physics-informed Complementary Energy Form in Solid Mechanics." Presented at Minisymposium MS1716 "Data-driven Approaches in Computational Solid Mechanics." (Oral presentation)

RESEARCH EXPERIENCE

Solving Partial Differential Equations of Solid Mechanics Based on PINN Beijing, China

Master Thesis Supervised by Prof. Yinghua Liu of Institute of Solid Mechanics (ISM) of THU
09/2019–06/2022

- The project studies the application of PINN (Physics-Informed Neural Network) for solving mechanical partial differential equations and extends the existing DEM (Deep Energy Method) to solve complex non-uniform problems
- Proposed CENN, a conservative energy method based on neural networks with subdomains, where the admissible function satisfying the essential boundary condition without boundary penalty is constructed by the radial basis function (RBF), particular solution neural network, and general neural network
- Compared CENN with the strong form PINN, the loss term potential energy at the interfaces has the lower order derivative, showing higher efficacy and accuracy and less hyperparameters; CENN can apply to complex geometries based on the special construction of the admissible function, it outperforms when dealing with singularities, strong discontinuity, complex boundary, non-linear, and heterogeneous PDEs
- Proposed a DCM algorithm in the form of PINN based on the principle of minimum complementary energy; pointed out that DEM is suitable for handling full force boundary conditions, DCM is suitable for handling full displacement boundary conditions; performed numerical experiments showing that DEM and DCM outperforms the strong form of PINN in terms of computational efficiency

2021 Kaggle Competition "PetFinder.my" Beijing, China
Supervised by Prof. Jun Zhu & Prof. Jie Tang of Department of Computer Science and Technology of THU
09/2021–01/2022

- Developed an algorithm for rating the pawpularity (cuteness) of stray pets to improve animal welfare and find more adoption possibilities
- Proposed an image regression model called PETS-SWINF that can process the metadata which describes and provides abstract properties of the dataset images; it takes account both low-order and high-order features of metadata and adaptively adjusts the weights of the image model and the metadata model
- The result demonstrates a higher accuracy of the model with metadata, as the RMSE loss is 17.71876 compared 17.76449 without metadata for the test dataset
- The team ranked 18th out of 3537 in the Public Board of 2021 Kaggle Competition

Finite Element Methods in Computational Solid Mechanics Beijing, China
Supervised by Prof. Xiong Zhang, Assoc. Prof. Yan Liu, and Assoc. Prof. Zhanli Liu of ISM of THU
03/2020–06/2021

- Programmed a complete set of software for calculating linear finite element in solid mechanics, used C++ and MATLAB for linear elements, axisymmetric elements, and quadratic elements, used python for pre and post processors, wrote time integration algorithms for solving dynamic problems
- Studied nonlinear mathematical theories and linear dynamics in computational solid mechanics, wrote an Abaqus UMAT based on Fortran for solving complex deformation cases with intrinsic nonlinearity
- Performed force analysis for bridge design with the finite element programming, for which numerical experiment serves as an effective method to save the testing cost

Numerical Tests on Methods for Solving Linear and Nonlinear Equation Systems Beijing, China
Supervised by Prof. Dinghui Yang of Department of Mathematical Sciences of THU 09/2020–01/2021

- Studied the mathematical principles of direct and iterative methods, then conducted programming, and performed numerical experiments for comparison
- For the direct method to solve linear equations, applied the Gaussian elimination method which can select the pivot element automatically; for highly ill-conditioned Hilbert matrix, adopted iterative methods including J, GS, and SOR: The spectral radius for the problem using J method exceeds 1, while GS and SOR methods converge, therefore concluded that GS and SOR methods works better than J method

- Applied Newton's and Quasi-Newton methods to derive nonlinear equations, discovered that Newton's iterative method has a higher convergence rate than Quasi-Newton method, but the matrix inversion for each step is more compute-intensive, thus overall the Quasi-Newton method has a faster speed

Real-time Face Mask Detection with YOLOv3 Beijing, China
Supervised by Prof. Changshui Zhang of Department of Automation of THU 04–06/2020

- Utilized the YOLOv3 algorithm to develop a model for real-time detection based on large number of photographs of people with face masks obtained from the internet, reached 0.774 of map@0.6 for the test set (https://github.com/AIZOOTech/FaceMaskDetection).
- The model can be embedded into public surveillance cameras to identify whether an individual is wearing a mask or not, thus significantly reducing human cost for pandemic prevention and control

Training Machine Learning Models for Rainfall Prediction Beijing, China
Supervised by Prof. Changshui Zhang of Department of Automation of THU 04–06/2020

- Adopted machine learning models including LSTM, ARIMA, GBRT, XGBoost to train and predict precipitation data from 122 weather stations worldwide, the results showed that the LSTM outperforms with the MAE of 0.0225 (hourly prediction), as well as advantages regarding correlation coefficient (r)

2020 Baidu Star Developer Competition: Traffic Sign Detection and Scene Matching Taiyuan, China
Supervised by Researcher Kaiyuan Zhang of SIBD 03–06/2020

- Participated in developing a traffic sign detection and recognition model, which can identify the features in two sets of image taken at different times in the same location and match the traffic signs
- Won the 12th place in the 2020 Baidu Star Developer Competition (out of 2,312 teams) for the first round, mainly took responsibility for implementing the target detection algorithm

A Study of Physical Phenomenon of Water Spiders Based on Tensor Analysis Beijing, China
Supervised by Prof. Quanshui Zheng of ISM of THU 09/2019–01/2020

- Applied tensor analysis to solve the Young-Laplace equation, compared the theoretical derivation with the experiment phenomena, explained the physical property that allows water spiders to walk on water; the finding can potentially contribute to innovative designs of micro aquatic devices and non-wetting materials

Estimating the Permanent with Monte-Carlo Algorithm Beijing, China
Supervised by Prof. Heng Liang of Department of Automation of THU 09/2019–01/2020

- Improved the efficacy for computing the permanent, a p-complete problem, namely the computation complexity doubles as the matrix size expands by one order, by implementing a Monte-Carlo Algorithm which rely on random sampling and probability distribution to obtain numerical results
- Comprehensively considered the impact of the number of scattered points on increasing the calculation time and improving the accuracy in application: for 3000 scattered points and 90% matrix density, the exact algorithm takes 3900 seconds while the Monte Carlo algorithm takes only 1864 seconds with the accuracy drops by 10.11%

PROFESSIONAL EXPERIENCE

Timon Rabczuk Group Weimar, German
Guest researcher Supervised by Prof. Rabczuk 4/2024–8/2024

- I have came to Bauhaus University as a guest researcher in Weimar supervised by Prof. Rabczuk for AI for mechanics (2023-2024).
- I am supported by the scholarship in Bauhaus University.

Microsoft Research (AI4Science) Beijing, China
Research Assistant, Supervised by Senior Researcher Dr. Qi Meng 11/2022–7/2023

- The AI4Science Team, directed by Dr. Distinguished Scientist Tie-Yan Liu, focuses on the climate and weather prediction with collaborative effort across disciplines encompassing computer science, mathematics, physical sciences, natural sciences, engineering, etc.
- Joined AI for PDE Group to investigate and develop innovative computational methods based on Physics-Informed Neural Network and operators such as DeepONet to achieve higher efficiency and more accuracy than traditional method

Shanxi Intelligence Institute of Big Data Technology and Innovation (SIBD) Taiyuan, China
Research Assistant, Supervised by Researcher Kaiyuan Zhang 06–08/2020

- Assisted in Scoliosis Detection Project, held responsibility of data processing and database maintenance, turned the data into JSON format and imported into MySQL, formatted the irregular data with regex in Python, performed data mining and analysis
- Participated for early stage implementation of algorithm implementation, applied Mask R-CNN, a deep neural network for semantic segmentation problem in computer vision, to identify the key points of the spine in radiograph datasets obtained from major hospitals and make preliminary diagnosis regarding whether a scoliosis exists and demands further medical inspection

Zhejiang Loong Airlines Co., Ltd., Xiaoshan, China *Flight Dispatcher* 09/2016–05/2018

- Took charge of the calculation of aircraft performance (mainly Airbus A320), used operational research methods to optimize the maximum take-off and landing weight
- Conducted route analysis and weather assessment, monitored different phases of the flight

SKILLS AND AWARDS

Computer Skills: Python (proficient), MATLAB (proficient), PyTorch (proficient), Abaqus (competent), C++ (functional), Fortran (functional)

Other Skills: 3rd Place in the 200m Freestyle at the National Swimming Championships in China, National Pool Lifeguard Qualification in China, National Swimming Teaching Qualification in China, Flight Dispatcher Certificate, Aircraft Performance Engineer

Honors and Awards: Received multiple scholarships for academic excellence, Outstanding Contribution to the Student Union of THU, 2-times university-level commendations, 1-time college-level commendation, THU Star for Art and Sport Achievements, the 1st Prize for fresh graduates and new employees of Zhejiang Loong Airlines (2/95, 2016)