

HANFENG ZHAI

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Department of Mechanics, Shanghai University | 99 Shangda Rd., Shanghai 200444, China

EDUCATION

Cornell University

M.S. in Mechanical Engineering

ITHACA, NY

Sep. 2021 – June 2023

Supervisor: Jingjie Yeo

Shanghai University

B.S. in Theoretical and Applied Mechanics (*Outstanding Graduate of Shanghai*)

THESIS: Predicting microbubble system dynamics with physics-informed deep learning

SHANGHAI, CHINA

Sep. 2017 – June 2021

Supervisor: Guohui Hu

HONORS & AWARDS

Outstanding Graduate of Shanghai

Shanghai Ministry of Education

May, 2021

[\[Name List\]](#)

Second Class Award

The 3rd Undergraduate Academic Forum of Shanghai University

May, 2021

[\[School News\]](#)

Outstanding Student Nomination

Shanghai University

Dec., 2020

[\[Name List\]](#)

Top Class Academic Scholarship

School of Mechanics and Engineering Science, Shanghai University

Nov., 2020

[\[Name List\]](#)

Arts and Sports Scholarship

School of Mechanics and Engineering Science, Shanghai University

Nov., 2020

[\[Name List\]](#)

Athletic Scholarship

Shanghai University American Football Team

Nov., 2018

[\[Name List\]](#)

Outstanding Student Nomination

Shanghai University

July, 2018

[\[Name List\]](#)

EXPERIENCE

Research Assistant

Institute of Mechanics, Chinese Academy of Science

BEIJING, CHINA

May 2021 – Present

Supervisor: Xu Zheng

Undergraduate Research Assistant

Shanghai Institute of Applied Mathematics and Mechanics

SHANGHAI, CHINA

May 2020 – Present

Supervisor: Guohui Hu

- Apply linear regression algorithm to predict concrete strength [1]; decision tree algorithm to predict frigate propulsion velocity [2]; naïve Bayes classification for yacht hydrodynamics velocities [3].
- Carried out bubbly flows numerical simulations in microscale with COMSOL Multiphysics.
- Proposed BubbleNet, a novel deep learning framework for inferring bubble dynamics with physics-informed neural networks, and open the project on GitHub [4], to predict the bubbly flow simulations data [5].

Scientific Editor Intern

QbitAI

BEIJING, CHINA

Jan. 2021 – Feb. 2021

- Translate research articles assigned by QbitAI instructors from *Nature*, *Science*, *PNAS*, & *Quanta*, *Phys.org*, etc.
- Wrote five scientific reporting articles on programmable meta-materials, gas components of Saturn, NASA mars plan, California earthquake simulation, using deep learning to solve partial differential equations. And assist with sorting out materials with other articles.
- My articles can be viewed at [1], [2], [3], [4], [5].

Undergraduate Research Assistant

Shanghai University & University of Washington

SHANGHAI, CHINA

Sep. 2019 – Mar. 2020

Supervisor: Bingbing An, Dongsheng Zhang, Dwayne D. Arola

- Carried out research in the group on enamel microstructure fracture resistance investigation.

- Writing tech reports and doing presentations directly or remotely with the project principal Dwayne D. Arola from University of Washington.
- Using Abaqus CAE to analyze the mechanical properties of several bioinspired materials.

Student Athlete

China University American Football League

SHANGHAI, CHINA
Nov. 2017 – June 2019

- Played Defensive End & Linebacker at Shanghai University Bombers American football team, won 3rd place twice in 2017 - 2018 & 2018 - 2019 seasons.
- Joined Russell Wilson football training camp as a DB. (July, 2018) [[Media Coverage](#)].

PROJECTS

Inferring Bubble Dynamics with Physics-Informed Deep Learning

Research project at Shanghai Institute of Applied Mathematics and Mechanics

Independent Researcher

Sep. 2020 – Present

Supervisor: Guohui Hu

- Carried out several microfluidic numerical simulation of bubbly flow based on the biomedical backgrounds.
- Implemented deep neural network to predict the physics fields (i.e., velocities, pressure, phase.) of the microfluids.
- Proposed a novel deep learning framework inspired by physics-informed neural network to predict bubbly flow and validate that the new framework can predict bubbly flow with higher accuracy.
- The source code can be downloaded through GitHub [[1](#)], and paper can be seen from arXiv [[2](#)].

Fracture Resistance of Human Enamel Microstructure

Research project at Shanghai University

Group Member

Sep. 2019 – Mar. 2020

Supervisor: Dongsheng Zhang and Dwayne D. Arola

- Polished and etch the enamel specimen and observe enamel microstructure through SEM and took photos.
- Proposed a specific band structure based on the SEM photos for enamel microstructure.
- Verifies that the band structure can resist crack growth through simulations carried out by Abaqus CAE.

Mechanical Properties of Biomaterials

Projects series on solid mechanics

Independent Researcher

Apr. 2020 – Aug. 2020

Supervisor: Bingbing An

- **Structural design of composite materials with superior mechanical behaviors: lesson from the microstructure of nacre and enamel** [[Report](#)]
Course project: CAD Application in Structural Mechanics
Designed a specific microstructure that displays higher fracture toughness and stiffness inspired from the microstructures of enamel and nacre.
- **Formulation and application of rate-independent stress update algorithm of hydrostatic pressure: elastoplastic yielding in composite.** [[Report](#)]
Course project: Plasticity Theory
Construct the constitutive model of fibre reinforced composite through rate-independent stress update algorithm, and estimate the fracture influence on the composite.
- **An investigation of the elastoplastic nature of ITD on the toughness of the dentin microstructure.** [[Report](#)]
Shanghai University Summer Research Program
Designed a specific microstructure that displays higher fracture toughness and stiffness inspired from the microstructures of enamel and nacre.

Structural Design of Lightweight Compressive Layers

Course project: Finite Element Method and Its Applications

Team Leader

Sep. 2019 – Dec. 2019

Supervisor: Yicheng Song

- Designed different compression structures inspired from traditional Chinese arch bridge and truss structure.
- Built three models by CAD software and 3D printed them successfully.
- Repeated debugging before added a large metal block plate above the test piece to produce uniform loading, and then carried out loading on the test piece.
- Estimated the results of both experiments and simulations and proposed the best design of compressive interlayer.
- The project is nominated " *Excellent Undergraduate Course Project*". The [poster](#) can be viewed on my page, which were displayed at the school hall.

Thermal Estimation of Smartphone Chip

Course project: *Elastic Mechanics*

Supervisor: Junqian Zhang

Independent Researcher

Dec. 2019 – Mar. 2020

- Model the smartphone with ANSYS workbench with basic structure of battery and chip.
- Construct mathematical derivation and theoretical analysis of chip under thermal field adopting the theory of plate in multiphysics fields.
- Carried out thermal simulation with ANSYS and compare the results with theoretical results.
- Explain how the chip will change undergoes battery's thermal influence from both the results.
- The [tech report](#) can be viewed on my page, and I posted a [intro video](#).

Design of Intelligent Tuning Equipment for Stringed Instruments

National College Student Innovation and Entrepreneurship Project, No. 201910280001

Supervisor: Kai Li

Project Principal

Oct. 2019 – Aug. 2020

- Modeled independently the integrated guitar structure, performed string vibration simulation in ANSYS and specified the effect of the guitar resonance cavity on the overall sound quality and the effect of pitch.
- Designed materials and fixtures according to the theoretical model, and settled on fixing the guitar strings by winding welding to minimize the measurement error under tension.
- Recorded accurately the experimental data, including frequency acquisition of recorded sounds with software.
- Instructed teammate with GUI programs and successfully imported data into MATLAB and Origin Pro for spectrum analysis.
- The details can be viewed on the [NCIE](#) website, the [report](#) and [poster](#) is available on my page.

SOFTWARE

BubbleNet

A deep learning package for inferring microbubble dynamics with physics-informed neural networks.

Environment: Python, MATLAB, TensorFlow. [\[Website\]](#) · [\[Code\]](#) · [\[Paper\]](#) · [\[Video\]](#)

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PUBLICATION

H. Zhai and G. Hu*. (2021) "Inferring micro-bubble dynamics with physics-informed deep learning". *arXiv preprint*. arXiv:2105.07179.

RESEARCH PRESENTATIONS

1. **Computation Methods for Applied Mechanics Problem.** *The 3rd Undergraduate Academic Forum of Shanghai University.* Dec. 30th, 2020. [\[Poster\]](#) [\[Paper\]](#) [\[News\]](#)
2. **A brief introduction of deep learning algorithms applied to mechanics.** *Prof. Zhansheng Guo's Lab, Shanghai University.* Apr. 20th, 2021. [\[Slides\]](#)

TECHNICAL SKILLS

Coding & Programming: Python, MATLAB & Octave, Mathematica, C++, HTML, L^AT_EX, Bash, MPI, TensorFlow, PyTorch.

Computer Systems: Ubuntu, macOS, Windows 7 & 10.

Simulation Softwares: COMSOL Multiphysics, OpenFOAM, LAMMPS, ANSYS workbench & APDL, Abaqus CAE.

Knowledge & Theories: Computational Fluid Dynamics, Fluid & Solid Mechanics (Elasticity & Plasticity), Structural Mechanics, Machine Learning & Deep Learning, etc.

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