Wensi Wu (she/her/hers)
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Reserach Overview

My research interest lies in developing and deploying emerging and robust computational methods to uncover new insights into complex mechanical and biological systems. The theme of my research centers around multi-physics modeling, optimization and uncertainty quantification, and physics-informed machine learning.

Education

Cornell University Ithaca, New York
Ph.D., Structural Mechanics | **Minor: Computational Science and Engineering** May 2021

- Dissertation: "Theoretical Formulation for Oblique Free Surface Impact Emanating from Fluid-Structure Interaction Simulations"
- Committee: Christopher Earls (chair), Peter Diamessis, Derek Warner

M.S., Structural Engineering 2018
B.S., Civil Engineering | *Magna Cum Laude* 2015

Honors and Awards

NIH/NHLBI K25 Mentored Quantitative Research Career Development Award 2023–2027
NIH/NHLBI NRSA T32 Institutional Research Training Fellowship 2022–2023
U.S. National Congress on Computational Mechanics Conference Travel Award 2023
Cornell University Conference Travel Grant 2017–2019
Cornell University Ve-Sing and Tseng So Koo Award 2015
NSF Sponsored Research Experiences for Undergraduates Best Overall Project 2013

Academic Experience

Children's Hospital of Philadelphia | *Research Associate Scientist* 2023–Now
Scientific mentors: Drs. Matthew A. Jolley, Alison M. Pouch, Lu Lu, and Jeffrey Weiss
Advisory mentors: Drs. Kevin T. Turner, Susan Furth, and Brian Litt

- Developing a physics-informed machine learning framework for learning atrioventricular heart valve mechanical properties from medical images.

Children's Hospital of Philadelphia | *Postdoctoral Fellow* 2021–2023
Mentors: Drs. Matthew A. Jolley, Alison M. Pouch, Lu Lu, Jeffrey Weiss, and Kevin T. Turner

- Activtively engaged in the development open-source computational framework for atrioventricular valve modeling.
- Studied the effects of leaflet mechanical properties and morphologies on the resulting function of pathological atrioventricular valves.

Cornell University | *Graduate Research Assistant* 2015–2021
Mentor: Dr. Christopher Earls

- Developed a simple and accurate engineering theory for hydrodynamic slamming using high fidelity fluid-structure interaction analyses.

Sandia National Laboratories | *Visiting Researcher* Summer 2017
Mentors: Drs. Robert Kuether, Matthew Allen, and Paolo Tiso

- Implemented regularized Coulomb friction subroutine to study the influence of friction in the contact interface of jointed structure.

Duke University | *NSF REU Fellow* Summer 2014
Mentor: Dr. Guglielmo Scovazzi

- Studied the resulting pressure distribution of a brain model subjected to blast loading through fluid-structure interaction simulations.

University of Cincinnati | *NSF REU Fellow* Summer 2013
Mentors: Drs. Margaret Kupferle and George Sorial

- Conducted experimental studies to evaluate the contaminant absorption performance between commercial activated carbon and in-house developed activated carbon.

Refereed Journal Publications

1. **W. Wu**, M. Daneker, M.A. Jolley, K.T. Turner, L. Lu*. "Effective data sampling strategies and boundary condition constraints of physics-informed neural networks for identifying material properties in solid mechanics," *Applied Mathematics and Mechanics*, Vol. 44, 2023.

2. **W. Wu**, S. Ching, P. Sabin, D.W. Laurence, S.A. Maas, A. Lasso, J.A. Weiss, M.A. Jolley*. "The effects of leaflet material properties on the simulated function of regurgitant mitral valves," *Journal of the Mechanical Behavior of Biomedical Materials*, Vol. 142, 105858, 2023.

3. **W. Wu**, S. Ching, S.A. Maas, A. Lasso, P. Sabin, J.A. Weiss, M.A. Jolley*. "A computational framework for atrioventricular valve modeling using open-source software," *Journal of Biomechanical Engineering*, Vol. 144, 101012, 2022.

4. **W. Wu***, C.J. Earls. "A new engineering theory describing oblique free surface impact by flexible plates," *Ocean Engineering*, Vol. 256, 111473, 2022.

5. **W. Wu***, C. Bonneville, C.J. Earls. "A principled approach to design using high fidelity fluid-structure interaction simulations," *Finite Element in Analysis & Design*, Vol. 194, 103562, 2021.

6. **W. Wu***, J.W. Kosianka, H.M. Reed, C.J. Stull, and C.J. Earls. "CU-BENs: A structural finite element library," *SoftwareX*, Vol. 11, 100485, 2020.

* Denotes corresponding author

Unpublished Manuscript

1. **W. Wu**, M. Daneker, K.T. Turner, M.A. Jolley, L. Lu*. "An Accurate Neural Network Architecture For Determining the Full-Field Micromechanical Elastic Properties of Heterogeneous Soft Materials Using a Single Dataset," *In Preparation*.

Refereed Conference Proceeding

1. P.J. Hughes, W. Scott, **W. Wu**, R.J. Kuether, M.S. Allen, and P. Tiso. "Interface Reduction on Hurty/Craig-Bampton Substructures with Frictionless Contact", *Nonlinear Dynamics*, Vol. 1, Conference Proceedings of the Society for Experimental Mechanics Series, 2019.

Conference Presentations

1. **W. Wu***, M. Daneker, M.A. Jolley, K.T. Turner, L. Lu (2023) "Effective Physics-Informed Machine Learning Strategies for Material Identification," 17^{th} *U.S. National Congress on Computational Mechanics,* Albuquerque, New Mexico.

2. **W. Wu*** and L. Lu (2023) "Machine Learning for Material Designs," *MACH 2023,* Baltimore, Maryland.

3. **W. Wu*** and C.J. Earls (2021) "Towards a Generalized Engineering Theory for Hydrodynamic Slamming Emanating from Partitioned Fluid-Structure Interaction Analysis," 16^{th} *U.S. National Congress on Computational Mechanics,* Virtual.

4. **W. Wu*** and C.J. Earls (2019) "Tightly Coupled, Partitioned Fluid-Structure Interaction Analysis of a Horizontal Plate Impact onto a Water Free Surface: Computational Framework and Validation," 15^{th} *U.S. National Congress on Computational Mechanics,* Austin, Texas.

5. **W. Wu*** and C.J. Earls (2018) "Open Source, Tightly Coupled, Partitioned Fluid-Structure Interaction Modeling Framework for Naval Applications: The Impact of Slamming Loads on High Speed Watercraft," 13^{th} *World Congress on Computational Mechanics,* New York City, New York.

6. P.J. Hughes*, W. Scott, **W. Wu**, R.J. Kuether, M.S. Allen, and P. Tiso (2018) "Interface Reduction on Hurty/Craig-Bampton Substructures with Frictionless Contact," *IMAC Annual Meeting*, Orlando, Florida.

7. **W. Wu***, J.W. Kosianka, and C.J. Earls (2017) "Open Source, Tightly Coupled, Partitioned Fluid-Structure Interaction Simulation Capability for High Spatiotemporal Resolution During Study of Wave Impact Loads in High Speed Watercraft," 14^{th} *U.S. National Congress on Computational Mechanics,* Montreal, Canada.

8. J.W. Kosianka*, **W. Wu**, and C.J. Earls (2017) "Condition Assessment and Prognosis using Fluid-Structure Interaction within a Reduced-Order Model Tracking Inversion Framework," 14^{th} *U.S. National Congress on Computational Mechanics,* Montreal, Canada.

* Denotes presenter

Seminar Talks

1. **W. Wu** (2023) "Discovering the Material Properties of Soft Tissue Through Machine Learning," Children's Hospital of Philadelphia Cardiology Research Training Seminar.

2. **W. Wu** (2022) "Toward Patient-Specific Computational Modeling of Tricuspid Valve Repair in Hypoplastic Left Heart Syndrome," Children's Hospital of Philadelphia Cardiology Research Training Seminar.

Grants

Title: *Toward Patient-Specific Computational Modeling of Tricuspid Valve Repair in Hypoplastic Left Heart Syndrome*

Funding Mechanism:	NIH/NHLBI K25 Mentored Quantitative Research Career Development Award
Period of Support:	September 1, 2023 to August 31, 2027
Level of Support:	$653,827
Role:	Principal Investigator

Title: *A Novel, Non-invasive Computational Approach for Determining the Etiology of Tricuspid Regurgitation in Patients With Hypoplastic Left Heart Syndrome*

Funding Mechanism: NRSA T32 Training Grant at the Children's Hospital of Philadelphia, Division of Pediatric Cardiology
Period of Support: July 1, 2022 to August 31, 2023
Level of Support: $64,777 to Wu
Program Director: Robert J. Levy
Role: Principal Investigator

Title: *Deep Learning and Physics Informed Neural Networks to Advance Single Ventricle Atrioventricular Valve Modeling*
Funding Mechanism: Additional Ventures Expansion Award
Period of Support: July 1, 2022 to June 30, 2023
Level of Support: $50, 000
Principal Investigator: Matthew Jolley
Role: Co-Investigator

Title: *Partitioned Approach, Implicit Fluid-Structure Interaction for the Study of Hydroelastic Effects in High Speed Watercraft*
Funding Mechanism: National Science Foundation, XSEDE
Period of Support: April 20, 2020 to April 19, 2021
Level of Support: CPUs worth $1,157
Principal Investigator: Christopher Earls
Role: Primary Investigator

Teaching Experience

Cornell University | *Teaching Assistant* Spring 2019
CEE 4740: Introduction to The Behavior of Metal Structures
Cornell University | *Guest Lecturer* Summer 2018
CEE 3720: Intermediate Solid Mechanics
Cornell University | *Teaching Assistant* Spring 2018
CEE 4780/6780: Structural Dynamics and Earthquake Engineering

Leadership Experience

Perelman School of Medicine, University of Pennsylvania
Biomedical Postdoctoral Council | *Career and Training Committee* 2022–2023
Cornell University
CEE Graduate Student Association | *Vice President* 2020–2021
Sport Taekwondo Student Club | *Treasurer and Practice Leader* 2019–2021
Engineering TA Development Program | *TA Development Consultant* 2018–2019
CEE Graduate Student Association | *Treasurer* 2016–2017
Chi Epsilon National Civil Engineering Honor Society | *Treasurer* 2014–2015
American Society of Civil Engineers | 2013–2014
2014 ASCE Upstate NY Region Student Conference Committee
International High School at Prospect Heights
International Dreamers Scholarship Fund | *Selection Committee* 2018–2022

Professional Service

2023 Intersections Science Fellows Symposium | *Application Reviewer* 2023
2023 Science Slam Competition at the Children's Hospital of Philadelphia | *Abstract Reviewer* 2023
Biomedical Postdoctoral Research Symposium at University of Pennsylvania | *Abstract Reviewer* 2022

Professional Memberships

U. S. Association for Computational Mechanics
Tau Beta Pi National Engineering Honor Society
Chi Epsilon National Civil Engineering Honor Society
American Society of Civil Engineers