Wensi Wu (she/her/hers)

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RESERACH OVERVIEW

My research focuses on pioneering emerging computational methods to efficiently simulate complex mechanical and biological systems, with the goal of providing trustworthy predictive models to inform surgical decision-making.

EDUCATION

Cornell University Ithaca, New York
Ph.D., Structural Mechanics | **Minor: Computational Science and Engineering** May 24th, 2021
- Dissertation: "Theoretical Formulation for Oblique Free Surface Impact Emanating from Fluid-Structure Interaction Simulations"
- Committee: Christopher J. Earls (chair), Peter Diamessis, Derek Warner

M.S., Structural Engineering August 20th, 2018
B.S., Civil Engineering | *Magna Cum Laude* May 30th, 2015

ACADEMIC EXPERIENCE

Children's Hospital of Philadelphia | *Research Associate Scientist* 2023–Present
Children's Hospital of Philadelphia | *Postdoctoral Fellow* 2021–2023
Cornell University | *Graduate Research Assistant* 2015–2021
Sandia National Laboratories | *Visiting Researcher* Summer 2017
Duke University | *NSF REU Fellow* Summer 2014
University of Cincinnati | *NSF REU Fellow* Summer 2013

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

PREPRINTS AND ONGOING WORK

2. **W. Wu**, M. Daneker, C. Herz, H. Dewey, J.A. Weiss, A.M. Pouch, L. Lu, M.A. Jolley. "ADEPT: A Noninvasive Method for Determining Elastic Properties of Valve Tissue," *In preparation*.

1. **W. Wu**, M. Daneker, K.T. Turner, M.A. Jolley, L. Lu. "Identifying Heterogeneous Micromechanical Properties of Biological Tissues via Physics-Informed Neural Networks," *arxiv.org/abs/2402.10741*. *Under review*.

REFEREED JOURNAL PUBLICATIONS

6. **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.

5. **W. Wu**, S. Ching, P.M. 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.

4. **W. Wu**, S. Ching, S.A. Maas, A. Lasso, P.M. 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.

3. **W. Wu**, C.J. Earls. "A New Engineering Theory Describing Oblique Free Surface Impact by Flexible Plates," *Ocean Engineering*, Vol. 256, 111473, 2022.

2. **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.

1. **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.

[†] A total of 6 first-author research articles were published.

REFEREED CONFERENCE PROCEEDINGS

2. **W. Wu**, Y. Wu, A.M. Sulentic, J.C. Gee, A.M. Pouch, M.A. Jolley. "Physics in the Loop: Integrating Biomechanics-Derived Training Data into a Neural Ordinary Differential Equation-Based Deformable Registration Framework", *Medical Imaging with Deep Learning*, 2024.

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.

FORTHCOMING CONFERENCE PRESENTATIONS

2. **W. Wu (Presenter)**, Y. Wu, A.M. Sulentic, J.C. Gee, A.M. Pouch, M.A. Jolley. "Physics in the Loop: Integrating Biomechanics-Derived Training Data into a Neural Ordinary Differential Equation-Based Deformable Registration Framework", *Medical Imaging with Deep Learning,* Paris, France. July 2024. [Poster].

1. **W. Wu (Presenter)**, M. Daneker, K.T. Turner, M.A. Jolley, L. Lu. "An Accurate Physics-Informed Neural Network Architecture for Determining the Heterogeneous Micromechanical Elastic Properties of Biological Materials," 16th *World Congress on Computational Mechanics,* Vancouver, British Columbia, Canada. July 2024. [Oral].

CONFERENCE PRESENTATIONS

11. N. Mangine, P.M. Sabin, D.W. Laurence, **W. Wu**, C. Herz, C.N. Zelonis, C. Pinter, A. Lasso, S. Ching, S.A. Maas, J.A. Weiss, M.A. Jolley. "A Parametric Analysis of Chordae Tendineae Density and Branching in Finite Element Simulations of Mitral Valve Closure," 2024 Summer Biomechanics, Bioengineering and Biotransport Conference, Lake Geneva, Wisconsin, US. June 2024. [Oral].

10. C.N. Zelonis, N. Mangine, K. Sunderland, S.A. Maas, S. Ching, Y. Barak-Corren, D.W. Laurence, **W. Wu**, P.M. Sabin, A. Lasso, M. Gillespie, J.A. Weiss, M.A. Jolley. "Simulation of Self-Expanding Transcatheter Pulmonary Valve Deployment in the Right Ventricular Outflow Tract," 2024 Summer Biomechanics, Bioengineering and Biotransport Conference, Lake Geneva, Wisconsin, US. June 2024. [Poster].

9. P.M. Sabin, D.W. Laurence, **W. Wu**, C. Herz, S.A. Maas, J.A. Weiss, M.A. Jolley. "Evaluation of Transcatheter Edge-to-Edge Repair Clip Selection via an Open-Source Finite Element Simulation Framework," 2024 Summer Biomechanics, Bioengineering and Biotransport Conference, Lake Geneva, Wisconsin, US. June 2024. [Poster].

8. **W. Wu (Presenter)**, M. Daneker, M.A. Jolley, K.T. Turner, L. Lu. "Effective Physics-Informed Machine Learning Strategies for Material Identification," 17th *U.S. National Congress on Computational Mechanics,* Albuquerque, New Mexico, US. July 2023. [Oral].

7. **W. Wu (Presenter)** and L. Lu. "Machine Learning for Material Designs," *MACH 2023,* Baltimore, Maryland, US. June 2023. [Oral].

6. **W. Wu (Presenter)** and C.J. Earls. "Towards a Generalized Engineering Theory for Hydrodynamic Slamming Emanating from Partitioned Fluid-Structure Interaction Analysis," 16th *U.S. National Congress on Computational Mechanics,* Virtual. July 2021. [Oral].

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

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

3. 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," *IMAC Annual Meeting*, Orlando, Florida, US. February 2018. [Oral].

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

1. J.W. Kosianka, **W. Wu**, and C.J. Earls. "Condition Assessment and Prognosis using Fluid-Structure Interaction within a Reduced-Order Model Tracking Inversion Framework," 14th *U.S. National Congress on Computational Mechanics,* Montreal, Canada. July 2017. [Oral].

FORTHCOMING INVITED CONFERENCE TALKS

2. "Determining Heterogeneous Elastic Properties of Soft Materials using Physics-Informed Neural Networks," *2024 Materials Science & Technology,* Pittsburgh, Pennsylvania, US. October 2024.

1. "Determining Heterogeneous Elastic Properties of Soft Materials using Physics-Informed Neural Networks", 4th *International Workshops on Advances in Computational Mechanics,* Kitakyushu, Japan. September 2024.

SEMINAR TALKS

2. "Discovering the Material Properties of Soft Tissue Through Machine Learning," Children's Hospital of Philadelphia Cardiology Research Training Seminar. May 2023.

1. "Toward Patient-Specific Computational Modeling of Tricuspid Valve Repair in Hypoplastic Left Heart Syndrome," Children's Hospital of Philadelphia Cardiology Research Training Seminar. May 2023.

GRANTS

Title: Systemic Semilunar Valve (SSV) Mechanics and Simulated Repair in Congenital Heart Disease

Funding Mechanism:	Cardiac Center Innovational Award at the Children's Hospital of Philadelphia
Period of Support:	July 1, 2024 to June 31, 2026
Level of Support:	$100,000
Co-Principal Investigators:	Matthew A. Jolley and Alison M. Pouch
Role:	Co-Investigator

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:	$76,140 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 for research equipment
Co-Principal Investigators:	Matthew A. Jolley, Alison M. Pouch, and Lu Lu
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 J. Earls
Role:	Primary Investigator

LEADERSHIP EXPERIENCE

Children's Hospital of Philadelphia / University of Pennsylvania

Biomedical Postdoctoral Council at the University of Pennsylvania | *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 | *2014 ASCE Upstate NY Region Student Conference Committee*	2013–2014

International High School at Prospect Heights

International Dreamers Scholarship Fund	*Selection Committee*	2018–2022

TEACHING EXPERIENCE

Children's Hospital of Philadelphia / University of Pennsylvania

Multi-institutional Placenta Biomechanics Workshop	*Facilitator*	Spring 2024

- Participated institutions: the Perelman School of Medicine at the University of Pennsylvania and Vanderbilt University

Cornell University

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

MENTORING EXPERIENCE

Children's Hospital of Philadelphia / University of Pennsylvania

Madeline Fialkov	*Currently an undergraduate student at Grinnell College*	2024–Present
Nicolas Mangine	*Currently a research technician at Children's Hospital of Philadelphia*	2023–Present
Christopher N. Zelonis	*Currently a research specialist at Children's Hospital of Philadelphia*	2023–Present
Silvani Amin	*Currently a PhD student at University of Pennsylvania*	2021–Present
Mitchell Danaker	*Currently a PhD student at University of Pennsylvania*	2021–Present
Stephen Ching	*Currently a PhD student at University of Pennsylvania*	2021–2023

Cornell University

Dana Luong	*Currently pursuing a PhD at Albert Einstein College of Medicine*	2016–2020

PROFESSIONAL SERVICES

Manuscript Reviewer

Medical Engineering and Physics	2024 –Present
Journal of the Mechanical Behavior of Biomedical Materials	2024 –Present
APL Machine Learning	2024 –Present

Application/Abstract Reviewer

Intersections Science Fellows Symposium	2023
Science Slam Competition at the Children's Hospital of Philadelphia	2023
Biomedical Postdoctoral Research Symposium at University of Pennsylvania	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