

RESEARCH INTERESTS

Multiscale Multiphysics Modeling, Atrioventricular Valve Modeling, Uncertainty Analysis, Physics-Informed Machine Learning

EDUCATION

Children's Hospital of Philadelphia	Philadelphia, Pennsylvania
NIH T32 Trainee in Cardiology	July 2022 - Now
<ul style="list-style-type: none">• Primary mentor: Matthew A. Jolley• Co-mentors: Alison M. Pouch, Lu Lu, Kevin T. Turner	
Postdoctoral fellow	Sep 2021 - Now
<ul style="list-style-type: none">• Primary mentor: Matthew A. Jolley• Co-mentors: Jeffrey A. Weiss, Andras Lasso	
Cornell University	Ithaca, New York
Ph.D., Structural Engineering	May 2021
<ul style="list-style-type: none">• 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 <i>Magna Cum Laude</i>	2015

JOURNAL PUBLICATIONS

1. **W. Wu**, M. Daneker, M.A. Jolley, K.T. Turner, L. Lu (2022) "Effective data sampling strategies and boundary condition constraints of physics-informed neural networks for identifying material properties in solid mechanics, [IN REVIEW].
2. **W. Wu**, S. Ching, S.A. Maas, A. Lasso, P. Sabin, J.A. Weiss, M.A. Jolley (2022) "A computational framework for atrioventricular valve modeling using open-source software," *Journal of Biomechanical Engineering*, Vol. 144, ASME, 101012.
3. **W. Wu***, C.J. Earls (2022) "A new engineering theory describing oblique free surface impact by flexible plates," *Ocean Engineering*, Vol 256, Elsevier, 111473.
4. **W. Wu***, C. Bonneville, C.J. Earls (2021) "A principled approach to design using high fidelity fluid-structure interaction simulations," *Finite Element in Analysis & Design*, Vol. 194, Elsevier, 103562.
5. **W. Wu***, J.W. Kosianka, H.M. Reed, C.J. Stull, and C.J. Earls (2020) "CU-BENs: A structural finite element library," *SoftwareX*, Vol. 11, Elsevier, pp. 1-5.

* Denotes corresponding author

CONFERENCE PROCEEDING

1. P.J. Hughes, W. Scott, **W. Wu**, R.J. Kuether, M.S. Allen, and P. Tiso (2019) "Interface Reduction on Hurty/Craig-Bampton Substructures with Frictionless Contact", In: Kerschen G. (eds) Nonlinear Dynamics, Volume 1. Conference Proceedings of the Society for Experimental Mechanics Series. Springer, Cham.

CONFERENCE PRESENTATIONS

1. **W. Wu** and C.J. Earls, (2021) "Towards a Generalized Engineering Theory for Hydrodynamic Slamming Emanating from Partitioned Fluid-Structure Interaction Analysis," 16th U.S. National Congress on Computational Mechanics, Virtual.
2. **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," 15th U.S. National Congress on Computational Mechanics, Austin, Texas.
3. **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," 13th World Congress on Computational Mechanics, New York City, New York.
4. 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.
5. **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," 14th U.S. National Congress on Computational Mechanics, Montreal, Canada.
6. 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," 14th U.S. National Congress on Computational Mechanics, Montreal, Canada.

INVITED SEMINAR

1. **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.

HONORS AND AWARDS

Ruth L. Kirschstein National Research Service Award (NRSA) Institutional Research Training Fellowship, National Heart Lung and Blood Institute (T32)	2022–2024
Cornell University Conference Travel Grant	2017–2019
Ve-Sing and Tseng So Koo Award	2015
NSF Sponsored Research Experiences for Undergraduates Best Overall Project	2013

COMPUTATIONAL RESOURCE AWARDS

Title: *Deep Learning and Physics Informed Neural Networks to Advance Single Ventricle Atrioventricular Valve Modeling*

Funding Agency: Additional Ventures

Period of Support: July 1, 2022 to June 30, 2023

Level of Support: \$50,000

Principal Investigator: Matthew Jolley

Primary Investigator: Wensi Wu

Brief Summary: We propose to use computational modeling to 1) investigate a framework for the automatic multi-phase (4D) modeling of TV 3D echocardiographic(3DE) images, and 2) derive patient-specific TV material properties from existing image-derived TV models. The proposal leverages the existing infrastructure and extensive expertise at the Children's Hospital of Philadelphia and the University of Pennsylvania, as well as ongoing collaborations. These studies are the first step toward a detailed understanding of structural features of TV dysfunction in hypoplastic left heart syndrome, and individualized surgical repair of the TV informed by 3D structural analysis.

Title: *Partitioned Approach, Implicit Fluid-Structure Interaction for the Study of Hydroelastic Effects in High Speed Watercraft*

Funding Agency: XSEDE

Period of Support: April 20, 2020 to April 19, 2021

Level of Support: 50,000 SUs and 1TB storage

Principal Investigator: Christopher Earls

Primary Investigator: Wensi Wu

Brief Summary: We propose to utilize XSEDE resource to verify and validate the benchmark associated with slamming impact on ship hulls. The study of the structural behaviors in high speed watercraft due to slamming is a very challenging Fluid-Structure Interaction (FSI) problem. Slamming (a highly concentrated pressure loading that occurs at a tiny spatiotemporal scale), triggers spray sheets and multi-phase breaking flows in the fluid, as well as high strain rates and nonlinear responses in the structure. The hydroelastic responses resulting from such impacts are of critical importance for gauging the health and future performance of ship hulls. A very fine temporal and spatial discretization in the FSI analysis is required to properly resolve the flow fields and mitigate numerical instabilities arising from such impulsive loading; such that detailed physical insight into this phenomenon can be uncovered.

RESEARCH EXPERIENCE

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: Dr. Robert Kuether, Dr. Matthew Allen, and Dr. Paolo Tiso

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

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| Duke University <i>REU Fellow</i>
Mentor: Dr. Guglielmo Scovazzi <ul style="list-style-type: none"> Studied the resulting pressure distribution of a brain model subjected to blast loading through fluid-structure interaction simulations. | Summer 2014 |
| University of Cincinnati <i>NSF REU Fellow</i>
Mentors: Dr. Margaret Kupferle, Dr. George Sorial <ul style="list-style-type: none"> Conducted experiments and performed comparative studies between commercial activated carbon and in-house developed activated carbon. | Summer 2013 |

TEACHING EXPERIENCE

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| Cornell University <i>Teaching Assistant</i>
CEE 4740: <i>Introduction to The Behavior of Metal Structures</i> | Spring 2019 |
| Cornell University <i>Teaching Assistant</i>
CEE 4780/6780: <i>Structural Dynamics and Earthquake Engineering</i> | Spring 2018 |
| Syracuse University <i>Academic Excellence Workshops Facilitator</i>
MATH 295: <i>Calculus I</i>
MATH 296: <i>Calculus II</i> | 2012–2013 |

LEADERSHIP EXPERIENCE

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

SERVICE

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| Biomedical Postdoctoral Research Symposium at UPenn <i>Abstract Reviewer</i> | 2022 |
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PROFESSIONAL MEMBERSHIPS

Tau Beta Pi National Engineering Honor Society
Chi Epsilon National Civil Engineering Honor Society
American Society of Civil Engineers (ASCE)