Marisa Schmidt Bazzi

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PROFILE

Computational scientist with over 7 years of expertise in developing predictive, patient-specific models within biomedical engineering, vascular biomechanics, and device-adjacent workflows. Skilled in integrating mechanistic simulations—including FEA, CFD, FSI, growth and remodeling, and multiphysics transport—with advanced data-driven techniques such as scientific machine learning, constitutive neural networks, symbolic regression, and computer-vision pipelines applied to MRI, IVUS, catheterization, hemodynamic, and clinical data. Experienced in building reproducible Python and C++ workflows optimized for Linux and HPC environments.

PROFESSIONAL EXPERIENCE

02/2024 – present
Palo Alto, CA

Postdoctoral Scholar
Stanford University, Department of Pediatrics

Modeling & Simulation Development:

- Leading hybrid mechanistic and AI/ML modeling workflows to optimize tissue-engineered vascular graft (TEVG) design by integrating large animal experimental data with patient-specific FEA/CFD/FSI simulations, predicting remodeling outcomes and guiding scaffold design decisions.
- Applied scientific machine learning techniques, including constitutive artificial neural networks (CANNs) and symbolic regression, to develop interpretable growth-and-remodeling laws and physics-based material models for native veins and TEVGs.
- Contributed to the open-source SimVascular platform (C++), creating new modules for mesh generation, soft-tissue constitutive mechanics, and fluid–solid–growth (FSG) multiphysics coupling.

Data Processing & Pipeline Engineering:

- Developed Python/C++ pipelines to ingest, clean, harmonize, and extract features from multimodal imaging and physiological datasets (MRI, IVUS, catheterization), supporting downstream ML models, statistical analyses, and mechanistic simulations validated against experimental ground truth.
- Built comprehensive IVUS computer-vision pipelines encompassing frame extraction, probe masking, contour segmentation and smoothing, 3D reconstruction, and STL/mesh generation, enabling patient- and subject-specific FEA/CFD workflows within SimVascular.

09/2018 – 01/2024
Minneapolis, MN

Graduate Research Assistant
Biomedical Engineering, University of Minnesota

Multiscale Modeling & Simulation:

- Developed multiscale predictive models integrating hemodynamics, vascular mechanics, mass transport, and microstructural growth and remodeling (FEA/CFD/FSI) to investigate aortic aneurysm progression, patient-specific blood rheology, and tissue-engineered vascular graft performance—implemented using C++, Python, MATLAB, and Ansys.
- Built reproducible, HPC-based simulation workflows on Linux/SLURM systems, generating synthetic and simulation-informed datasets to benchmark predictive models and analyze longitudinal disease progression across diverse cardiovascular pathologies.

Machine Learning & Data Analysis:

- Applied ML and statistical techniques—including stress-based clustering, HMM-based domain segmentation, sensitivity analysis, and uncertainty quantification—for automated parameter-space exploration and physics-informed feature

PROFESSIONAL EXPERIENCE

engineering from large-scale simulation datasets.

Scholarly Contributions & Dissemination:

- Published 8+ peer-reviewed articles in biomechanics, cardiovascular modeling, and computational biomedical engineering journals, authored a book chapter, and presented research findings at international conferences.

01/2018 – 09/2018
Rio de Janeiro, Brazil

Research Scientist
Laboratory of Micro Hydrodynamics and Flow in Porous Media, PUC-Rio

Solver Development & Validation:

- Developed and verified finite element analysis and computational fluid dynamics solvers for multiphase flow, viscoelasticity, and compressibility modeling, ensuring accuracy and robustness.
- Created internal benchmarks for solver validation and code optimization, enhancing simulation efficiency and reliability.

Technical Documentation & Knowledge Transfer:

- Authored detailed technical documentation covering model assumptions and simulation-to-experiment correlations to support reproducibility and knowledge transfer.

2014 – 2015
Rio de Janeiro, Brazil

Project Services Intern
Royal Dutch Shell

Project Controls & Reporting:

- Managed schedules, cost tracking, and performance reporting for engineering project controls in Deepwater operations within a safety-critical, highly regulated environment.

Cost Estimation & Benchmarking:

- Created a subsea cost benchmarking database, improving estimation accuracy by 15% for future field-development projects.

Cross-Functional Collaboration:

- Collaborated with engineering, logistics, and finance teams to ensure on-time and on-budget delivery of a USD 20M subsea project.

SELECTED SOFTWARE, GITHUB, AND AI/ML PROJECTS

SymRegGR (C++/Python/MATLAB)

- Developed a symbolic regression workflow for tissue-engineered vascular graft growth and remodeling, identifying distinct production and degradation laws based on graft properties and blood-flow variables.
- Applied scientific machine learning to integrate data-driven and mechanistic modeling approaches, improving predictive accuracy for patient-specific vascular simulations.
- Automated complex model discovery processes using Python, C++, and MATLAB scripting to facilitate reproducible research and streamline workflow automation.
- Repository: https://github.com/msbazzi/SymRegGR

SymSEF (Python)

- Developed physics-grounded strain energy functions for native vein and tissue-engineered vascular grafts using neural-network-based constitutive model discovery (CANN-style).
- Employed Sobol sensitivity indices to simplify the learned model into an interpretable closed-form expression that accurately captures the full inferior vena cava developmental dataset.
- Integrated the final constitutive model into finite element analysis (FEA) workflows to enable subject-specific and device-related simulations.
- Repository available at github.com/msbazzi/SymSEF.

IVUS-processing (Python/OpenCV/VTK)

- Developed computer-vision pipelines for intravascular ultrasound (IVUS) video analysis, including frame extraction, probe masking, and lumen/wall contour

SELECTED SOFTWARE, GITHUB, AND AI/ML PROJECTS

segmentation with smoothing, enabling precise measurement of variable wall thickness for subject-specific FSI simulations.
- Implemented 3D reconstruction and STL/surface mesh generation to support patient-specific FEA and CFD workflows tailored to individual vascular anatomies.
- Repository available at github.com/msbazzi/IVUS-processing.

SimVascular, svFSI, svFSG, and svMultiPhysics (C++/Fortran)

- Contributed to the development of open-source cardiovascular finite element analysis (FEA), computational fluid dynamics (CFD), and fluid-structure interaction (FSI) tool chains supporting blood flow, growth, and remodeling, and multiphysics workflows.
- Enhanced mechanistic modeling capabilities for patient-specific simulations, enabling seamless integration with scientific machine learning frameworks and high-performance computing environments.

SKILLS

– AI/ML AND SCIENTIFIC ML

Deep Learning **INTERMEDIATE**	Symbolic Regression **INTERMEDIATE**	Neural Networks **INTERMEDIATE**

– MECHANISTIC MODELING

Finite Element Analysis (FEA) **ADVANCED**	Computational Fluid Dynamics (CFD) **ADVANCED**	Fluid-Structure Interaction (FSI) **ADVANCED**	Growth and Remodeling **ADVANCED**

– PROGRAMMING AND SCRIPTING

Python **ADVANCED**	C++ **INTERMEDIATE**	HPC/Cluster **ADVANCED**	Matlab **ADVANCED**

Ansys/Comsol **INTERMEDIATE**

EDUCATION

09/2018 – 01/2024
Minneapolis, MN

Materials Science | Ph.D.
University of Minnesota-Twin Cities

- Thesis: Multiscale, Multiphysical Phenomena in Arterial Remodeling. Advisor: Victor Barocas.

01/2016 – 01/2018
Rio de Janeiro, Brazil

Mechanical Engineering | M.Sc.
Pontifical Catholic University of Rio de Janeiro

- Dissertation: Numerical investigation of viscoelastic liquid curtain breakup. Advisor: Marcio da Silveira Carvalho.

01/2010 – 12/2015
Rio de Janeiro, Brazil

Mechanical Engineering | B.Sc.
Pontifical Catholic University of Rio de Janeiro

- Undergraduate thesis: Modeling of asphaltene deposition.

SELECTED PUBLICATIONS AND MANUSCRIPTS

04/2026

Alterations in ascending aortic hemodynamics and aortic length correlate with sex-specific thoracic aortic aneurysm dilation and lifespan in a mouse model of severe Marfan syndrome
Computers in biology and medicine
https://doi.org/10.1016/j.compbiomed.2026.111594

SELECTED PUBLICATIONS AND MANUSCRIPTS

K. K. Dwivedi, Y. Wu, M. S. Bazzi, *et al*

10/2025

Ascending aortic aneurysm growth in the Fbln4SMKO mouse is consistent with uniform growth laws
Biomechanics and Modeling in Mechanobiology
https://doi.org/10.1007/s10237-025-01972-5
M. S. Bazzi, H. Wiputra, W. Guan, V. H. Barocas

10/2025

A Technique to Track Scatterers from a Computational Model of Complex Flow to Simulate Continuous High-speed Plane-wave Ultrasound Acquisitions
IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control
doi: 10.1109/OJUFFC.2025.3618637
J. A. Ketterling, G. Wahyulaksana, M. S. Bazzi and H. Wiputra,

02/2025

Computational Analysis of Flow and Transport Suggests Reduced Oxygen Levels Within Intracranial Aneurysms, Especially in Individuals with Sickle-Cell Disease
Journal of Biomechanical Engineering
https://doi.org/10.1115/1.4067323
M. S. Bazzi, H. Wiputra, D. K. Wood, V. H. Barocas

01/2025

Dynamic microphysiological systems to access sickle cell disease—A case study for disease modeling
Academic Press
https://doi.org/10.1016/B978-0-443-13403-6.00013-1
M. S. Bazzi, T. A. Balbino

01/2024

A novel perfusion bioreactor promotes the expansion of pluripotent stem cells in a 3D-bioprinted tissue chamber
Journal of Biofabrication
10.1088/1758-5090/ad084a
E. R. Komosa, W. Lin, B. Mahadik, M. S. Bazzi *et al*

04/2022

Computational and Experimental Comparison on the Effects of Flow-Induced Compression on the Permeability of Collagen Gels
Journal of the Mechanical Behavior of Biomedical Materials
https://doi.org/10.1016/j.jmbbm.2022.105107
C. S. Vidmar, M. S. Bazzi, V. K. Lai

2022

Mouse-Specific Biofluidic and Geometric Biomarkers of Ascending Thoracic Aortic Aneurysm Outcomes
Cardiovascular Engineering and Technology
https://doi.org/10.1007/s13239-021-00600-4
M. S. Bazzi, R. Balouchzadeh, S. N. Pavey, *et al*

2020

A combined experimental-computational approach to quantify patient-specific blood rheology predicts altered systemic blood flow in sickle cell disease
Biophysical Journal
doi: 10.1016/j.bpj.2020.10.011
M. S. Bazzi, J. M. Valdez, V. H. Barocas, D. K. Wood DK.

02/2019

Effect of viscoelastic on liquid sheet rupture
Journal of Non-Newtonian Fluid Mechanics
https://doi.org/10.1016/j.jnnfm.2018.10.007
M. S. Bazzi, M. S. Carvalho

SELECTED PRESENTATIONS

04/2025

Predicting TEVG Outcomes: How Scaffold Design Shapes Vascular Remodeling and Blood Flow
Presented research on predictive modeling of tissue-engineered vascular graft outcomes, emphasizing scaffold design impact on vascular remodeling and hemodynamics. Delivered at Rising Star in Computational and Data Science Workshop, Oden Institute, University of Texas at Austin, Apr 2025.

04/2025

Multiscale, Multiphysical Modeling of Blood Flow Vascular Mechanics and Growth and Remodeling
Delivered invited seminar at UC San Diego presenting advanced multiscale, multiphysical modeling techniques integrating finite element analysis and computational fluid dynamics to simulate blood flow, vascular mechanics, and growth and remodeling processes.

06/2024

Uniform growth laws recapitulate some aspects of ascending aortic aneurysm progression in FBLN4 mice
Presented research on vascular growth laws modeling ascending aortic aneurysm progression in FBLN4 mice at the SB3C conference, June 2024.

07/2023

Impact of sickle cell disease for oxygen transport in intracranial aneurysms
Presented research on the effects of sickle cell disease on oxygen transport within intracranial aneurysms at the 28th Congress of the European Society of Biomechanics.

AWARDS, FELLOWSHIPS AND LEADERSHIP

2025 **CHIP T32 Training Grant**

2025 **Rising Star in Computational and Data Science**

2024 **Baker Postdoctoral Fellowship**

2023 **Equity and Inclusion Leadership Showcase**

2023 **President's Student Leadership and Service Award**

2022 **AHA Predoctoral Fellowship**
rank 8%

2021 **CEMS TA Award**

2021 **Graduate Student Coordinator, CSE Women and BIPOC Initiatives**

2021 **Chair, DEI Working Group**

2018 **Second place, ABCM-EMBRAER Best MSc Dissertation**

2017 **Faperj Nota 10 Fellowship**