Marshall Davey, PhD

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WORK INTERESTS AND TECHNICAL SKILLS

I am interested in developing computational platforms for modeling physical phenomena on high performance architectures, with a primary focus on capturing physiologic processes for disease and device investigations.

Primary Knowledge Areas: Cardiovascular physiology, fluid-structure interaction (immersed boundary methods), finite element analysis, continuum mechanics, fluid dynamics, high-performance computing, quantitative data analysis

Relevant Development Skills: C/C++, MATLAB, Python, version control (git, GitHub), LaTeX, Linux (Bash), data visualization (Visit, Paraview, FFmpeg), HPC (slurm, MPI, CUDA), scientific computing (IBAMR, SAMRAI, deal.II, libMesh, PETSc), mesh generation (gmsh, Meshmixer, fTetWild), CMake, parameter fitting, machine learning (PyTorch)

WORK EXPERIENCE

Postdoctoral Research Associate June 2024–Present

Griffith Lab, University of North Carolina at Chapel Hill, Department of Mathematics and Biomedical Engineering Chapel Hill, NC

- Developing a generalizable fluid-structure interaction model platform using an immersed boundary method with finite elements
- Implementing and improving heart model platform features for more complex cardiovascular modeling studies and computational performance

Graduate Research Assistant March 2019–May 2024

Griffith Lab, University of North Carolina at Chapel Hill, Department of Mathematics and Biomedical Engineering Chapel Hill, NC

- Developed a novel fluid-structure interaction whole heart model with physiologic three-dimensional descriptions of all four valves
- Tested various contraction schemes and boundary conditions to produce phsyiologic pressure-volume relations
- Provided cardiac function analysis by translating numerical pressure, velocity, flow rate, and displacement data into clinical-like metrics
- Designed model credibility studies for heart model to illustrate dynamic load response via the Frank-Starling mechanism

Graduate Research Assistant August 2018–December 2018

Frölich Lab, University of North Carolina School of Medicine, Neuroscience Center Chapel Hill, NC

- Implemented and joined previously developed cortex and thalamus network models using the Brian 2 Python package
- Tested and investigated neural synchronization from simulated transcranial alternating current stimulation through phase analysis

Research Technician December 2017–August 2018

Elston Lab, University of North Carolina School of Medicine, Department of Pharmacology Chapel Hill, NC

- Utilized cellular level MATLAB model for parameterization and simulation of enzymatic pathways in cystic fibrosis and COPD

EDUCATION

Doctor of Philosophy, Bioinformatics and Computational Biology May 2024
University of North Carolina at Chapel Hill

Master of Physiology, North Carolina State University December 2016

Bachelor of Science, Mathematics, University of North Carolina at Chapel Hill May 2014

AWARDS AND CERTIFICATES

Graduate Certificate in Cardiovascular Science May 2024
University of North Carolina School of Medicine, McAllister Heart Institute

Best Student Poster Award March 2021
Society for Industrial and Applied Mathematics (SIAM) Conference on Computational Science and Engineering Virtual

T32 Predoctoral Training Program July 2019–June 2020
Bioinformatics and Computational Biology, NIH 5T32GM067553-10

PUBLICATIONS

M Davey, C Puelz, S Rossi, MA Smith, DR Wells, G Sturgeon, WP Segars, JP Vavalle, CS Peskin, and BE Griffith. Simulating cardiac fluid dynamics in the human heart. *PNAS Nexus*, pgae392, 2024. doi: 10.1093/pnasnexus/pgae392.

WA Huang, E Negahbani, I Stitt, DJ Passey, S Ahn, **M Davey**, M Dannhauer, T Doan, A Hoover, A Peterchev, S Radtke-Schuller, and F Fröhlich. Transcranial alternating current stimulation entrains alpha oscillations by preferential phase synchronization of fast-spiking cortical neurons to stimulation waveform. *Nature Communications*, 12(1): 3151, 2021.