

Austin J. Baird, PhD

BIOMEDICAL ENGINEERING GROUP LEADER · DISTINGUISHED MEMBER OF THE TECHNICAL STAFF

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About

I am driven by innovations in computational biology that span multiple spatial scales, from cellular function to whole-body physiological responses. I am inspired by research that will have an impact on quality of healthcare and believe that these solutions must bridge multiple disciplines in order to optimize patient outcomes. I am looking for a role that will empower me to pursue my research, teach the next generation of computational biologists, and foster, grow and lead a team.

Education

University of North Carolina, Chapel Hill

Chapel Hill, NC

PHD IN APPLIED MATHEMATICS

August 2014

- *Thesis:* Modeling Valveless Pumping Mechanisms, link
- *Advisor:* Dr. Laura Miller, *Committee:* Forest, M. Gregory, Adalsteinsson, David, White, Brian, Mucha, Peter, Kier, William M.

University of California, Santa Cruz

Santa Cruz, CA

BA IN MATHEMATICS

June 2008

- *Honors Thesis:* Modeling Native California Grassland Populations

Experience

Applied Research Associates, Inc.

Raleigh, NC

BIOMEDICAL MODELING GROUP LEADER (SENIOR ENGINEER, DISTINGUISHED MEMBER OF THE TECHNICAL STAFF)

December 2018 - PRESENT

- Lead a multidisciplinary team across 4 different projects
- In charge of agile development processes, product roadmap, delivery scheduling, and direct communication with government customers
- Led and won multiple research and development funds through Defense Health Agency and Army Research Lab grants
- Principal investigator of the BioGears, BurnCare training application, and the traumatic brain injury angiogenesis projects
- Organized teaming across three research hospitals and multiple small businesses
- Communicate research progress through multiple conferences and peer reviewed publications, including the BioGears 2020 conference
- Oversaw implementation of all models associated with BioGears releases 7.0-7.3

STAFF ENGINEER 2

January 2017 - December 2018

- Expanded the BioGears physiology model by adding gastro-intestinal digestion/absorption, diuretic drug, and pain stimulus models
- Nominated and won federal innovation award in collaboration with Telemedicine & Advanced Technology Research Center (TATRC) government lab
- Updated the BioGears build library to be hosted on Github, modernized development timeline
- Won two government contracts totaling 4 million dollars in additional research and development funding
- Oversaw implementation of all models associated with BioGears releases 6.1-6.3

STAFF ENGINEER

February 2016 - January, 2017

- Implemented a new renal system model in the BioGears engine with local autoregulation
- Contributed to updated blood/gas model and matrix circuit solver implementation
- Led validation and unit testing of C++ code base
- Oversaw Jenkins cloud build testing environment including daily reporting and system validation

Webassign

Raleigh, NC

CONTENT DEVELOPER

August 2015 - February 2016

- Created detailed solutions for the differential equation teaching application including step-by-step instructions
- Coordinated content outlines with leadership teams to detail requirements

Duke University

Durham, NC

VISITING ASSISTANT PROFESSOR

August 2014 - August 2015

- Analyzed how pressure changes induced by heart failure affect the hemodynamic and reabsorption function of the kidney
- Taught two semesters of introduction to partial and ordinary differential equations, developed all course materials
- Coordinated validation and experimental data with University of Ontario research hospital clinicians
- Presented results at experimental biology, Boston MA
- Investigated blood clotting in the renal veins using the immersed boundary method

University of North Carolina, Chapel Hill

Chapel Hill, NC

GRADUATE RESEARCH FELLOW

September 2010 - August 2014

- Developed a fully coupled fluid-structure interaction code in C++ and Python to test the performance of valveless pumping
- Created a new computational valveless pumping mechanism using muscle cells to provide neuro-mechanical forcing in the system
- Presented and work at 12 conferences, domestic and abroad and published results
- Led wet lab organism maintenance and worked with lab-mates to collect particle image velocity data from
- Collaborated with colleagues from the Biology department to collect experimental results to validate computational models

Publications

JOURNAL ARTICLES

A multiscale computational model of angiogenesis after traumatic brain injury, investigating the role location plays in volumetric recovery

A. BAIRD, L. OELSNER, C. FISHER, M. WITTE, M. HUYNH

Mathematical Biosciences and Engineering 18.4 (2021) pp. 3227–3257. 2021

BioGears: A C++ library for whole body physiology simulations

A. BAIRD, M. MCDANIEL, S. A. WHITE, N. TATUM, L. MARIN

Journal of Open Source Software 5.56 (2020) p. 2645. 2020

BurnCare tablet trainer to enhance burn injury care and treatment

A. BAIRD, M. SERIO-MELVIN, M. HACKETT, M. CLOVER, M. MCDANIEL, M. ROWLAND, A. WILLIAMS, B. WILSON

BMC Emergency Medicine 20.1 (2020) pp. 1–10. BioMed Central, 2020

Open Source Pharmacokinetic/Pharmacodynamic Framework: Tutorial on the BioGears Engine

M. MCDANIEL, J. CARTER, J. M. KELLER, S. A. WHITE, A. BAIRD

CPT: pharmacometrics & systems pharmacology 8.1 (2019) pp. 12–25. Wiley Online Library, 2019

A Whole-Body Mathematical Model of Sepsis Progression and Treatment Designed in the BioGears Physiology Engine

M. MCDANIEL, J. KELLER, S. WHITE, A. BAIRD

Frontiers in physiology 10 (2019) p. 1321. Frontiers, 2019

Neumechanical Pumping: Boundary Flexibility and Traveling Depolarization Waves Drive Flow Within Valveless, Tubular Hearts

A. BAIRD, L. WALDROP, L. MILLER

Japan Journal of Industrial and Applied Mathematics 32.3 (2015) pp. 829–846. Springer, 2015

A Mathematical Model and MATLAB Code for Muscle–Fluid–Structure Simulations

N. A. BATTISTA, A. J. BAIRD, L. A. MILLER

Integrative and comparative biology 55.5 (2015) pp. 901–911. Oxford University Press, 2015

Modeling Valveless Pumping Mechanisms

A. BAIRD

College of Arts and Sciences, Department of Mathematics (2014). 2014

BOOK CHAPTER

Numerical Study of Scaling Effects in Peristalsis and Dynamic Suction Pumping

A. BAIRD, T. KING, L. MILLER

Contemp. Math 628 (2014) pp. 129–148. 2014

CONFERENCE PROCEEDINGS

A Full-Body Model of Burn Pathophysiology and Treatment Using the BioGears Engine

M. McDANIEL, A. BAIRD

2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2019

Electro-Dynamic Suction Pumping at Small Scales

A. BAIRD, L. MILLER

APS Division of Fluid Dynamics Meeting Abstracts, 2013

Funding

Defense Health Agency

SUSTAIN: PROLONGED FIELD CARE TRAINING FRAMEWORK

- Role: Lead Physiology Modeler and Proposal Manager
- Amount: \$2,200,000
- Contract(s): W81XWH-18-C-0169

Fredrick, MD

March 2018

Defense Health Agency

BURN CARE: VIRTUAL PATIENT APPLICATION TO TRAIN THERMAL INJURY

- Role: Principal Investigator
- Amount: \$2,100,000
- Contract(s): W911NF-18-C-0037

Orlando, FL

January 2017

Army Research Labs

FAST COMPUTATIONAL SIMULATIONS OF TRAUMATIC BRAIN INJURY

- Role: Principal Investigator
- Amount: \$353,000
- Contract(s): W911NF-17-1-0572

Raleigh, NC

January 2017

Defense Health Agency

BIOGEARS FOLLOW-ON RESEARCH AWARD

- Role: Principal Investigator
- Amount: \$1,900,000
- Contract(s): W81XWH-13-2-0068, W81XWH-17-C-0172

Fredrick, MD

August 2016

Projects

BioGears Physiology Engine

ARM, C++, GITHUB, JAVA, PYTHON, XML

- TATRC and DHA funded project to lower the barrier for whole-body physiology simulation in health care training and research
- Lumped parameter physics based cardio-pulmonary model with compartment overlays for complete systems biology modeling support
- Models include: circulation, drug pharmacokinetics-pharmacodynamics, traumatic brain injury, pneumothorax, urine concentration, blood coagulation, pain stimulus, infection, digestion absorption, and others
- Multi-platform build support and agile process development

Raleigh, NC

Feb 2016 - PRESENT

BurnCARE Medical Training Application

ANDROID, C++, UNREAL ENGINE 4,

- DHA and ARL funded project to improve burn care training and patient care in the military
- Burn care application developed in Unreal Engine 4 for the Android tablet platform
- Modular concept designed to teach individual, unique burn treatment requirements
- Collaborative effort with the U.S. Army Institute of Surgical Research

Raleigh, NC

Jan 2018 - PRESENT

Sustain: Prolonged Field Care Training Framework

C++, JAVASCRIPT, PYTHON

- DHA funded project to create a computational framework for prolonged field care training in the military
- Modular framework to connect different software critical for training
- Scenario builder, Unreal Engine 4 training game, networking code, DDS virtual patient management code, and learning record database portal

Raleigh, NC

Jan 2018 - PRESENT

Traumatic Brain Injury Angiogenesis

C++, PYTHON, PARAVIEW, 3DSLICER

- Army Research Labs funded basic research project on angiogenesis after a traumatic brain injury
- Visual studio c++ managed code base
- 3D fractal model of the vasculature with dynamical system model of the VEGF protein interaction and role in the angiogenesis process

[Raleigh, NC](#)

Jan 2017 - PRESENT

Selected Presentations (of 28)

University of Arizona Modeling and Computation Seminar

"A WHOLE-BODY PHYSIOLOGICAL MODEL OF SEPSIS AND ASSOCIATED TREATMENTS, DESIGNED IN THE BIOGEARS ENGINE"

[Tucson, AZ](#)

March 2021

BioGears Conference

"BIOGEARS DRUG MODELING OVERVIEW"

- *Conference Talks:* [link](#)

[Raleigh, NC](#)

March 2020

Military Health System Research Symposium

"BURN CARE: VIRTUAL TABLET TRAINING TO ENHANCE BURN INJURY CARE AND TREATMENT"

[Orlando, FL](#)

August 2019

Society for Simulation in Health

BIOGEARS MODEL TO SIMULATE PATIENT RESPONSES TO SEPSIS

[Raleigh, NC](#)

March 2019

American College of Surgeons Simulation Summit

BIOGEARS: A FRAMEWORK FOR MULTISCALE PHYSIOLOGY MODELING

[Chicago, IL](#)

March 2019

Department of Defense Working Group on Computational Modeling of Human Lethality, Injury, and Impairment from Blast-Related Threats

BIOGEARS HUMAN PHYSIOLOGY ENGINE

[Arlington, VA](#)

February 2019

Virtual Physiological Human Conference

AN IN-SILICO WHOLE-BODY FRAMEWORK TO SIMULATE KINETICS AND DYNAMICS OF PHARMACEUTICALS AND ASSOCIATED REVERSAL AGENTS

[Zaragoza, Spain](#)

September 2018

International Meeting on Simulation in Healthcare

AN IN-SILICO WHOLE-BODY FRAMEWORK TO SIMULATE KINETICS AND DYNAMICS OF PHARMACEUTICALS AND ASSOCIATED REVERSAL AGENTS

[Los Angeles, CA](#)

January 2018

Chemical and Biological Defense Science and Technology Conference

BIOGEARS: SIMULATING WHOLE-BODY RESPONSE TO CHEMICAL EXPOSURE

[Long Beach, CA](#)

November 2017

Experimental Biology

IMPLICATIONS OF INCREASE RENAL VENOUS PRESSURE FOR RENAL HEMODYNAMIC AND REABSORPTIVE FUNCTION STUDIED BY A MATHEMATICAL MODEL OF THE KIDNEY

[Boston, MA](#)

March 2015

Duke Interdisciplinary Discussion Course

MOVING FLUID IN TUBES

[Durham, NC](#)

October, 2014

Society of Mathematical Biology

ELECTRO-DYNAMIC SUCTION PUMPING AT SMALL SCALES

[Osaka, Japan](#)

August 2014

Teaching Experience

Duke University, Math 353

INTRODUCTION TO ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS FOR ENGINEERS

Durham, NC

Spring 2015

Duke University, Math 353

INTRODUCTION TO ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS FOR ENGINEERS

Durham, NC

Fall 2014

University of North Carolina, Chapel Hill, Math 290

APPLIED MATHEMATICAL METHODS (COMPUTATIONAL LAB)

- *Course Materials:* [link](#)

Chapel Hill, NC

Spring 2013

University of North Carolina, Chapel Hill, Math 190

CHAOS AND POPULATION DYNAMICS

Chapel Hill, NC

Fall 2012

Skills

Technical	Python, C++, Buildbot, Paraview, VTK, CMAKE, XML, AWS, Docker, Matlab, R
Modeling	Systems Biology, Fluid-Structure Interaction, Pharmacology (PKPD), Injury Physiology, Dynamical Systems, Protein Interaction, Angiogenesis, Circulation, Lumped Parameter
Management	Agile Development, Scrum, Personnel Management, Hiring, Public Speaking, Financial Coverage, Grant Writing, Teaming, Sub-Contractor Management

Affiliations

Society for Simulation in Healthcare

LEADERSHIP GROUP ON SIMULATION AND MODELING

2016 - PRESENT

IEEE

ENGINEERING IN MEDICINE AND BIOLOGY

2018 - PRESENT

NIH

INTER-AGENCY MODELING AND ANALYSIS GROUP

2019 - PRESENT

Recommendations

Dr. Laura Miller

PROFESSOR OF BIOLOGY AND MATHEMATICS UNC, CHAPEL HILL, UNIVERSITY OF ARIZONA

- Address: Department of Biology CB 3280 Coker Hall University of North Carolina Chapel Hill, NC 27599
- Phone: 919-943-2434
- Email: fairflies9@gmail.com
- Website: <https://sites.google.com/site/swimflypump/>

Dr. M. Gregory Forest

GRANT DAHLSTROM DISTINGUISHED PROFESSOR OF MATHEMATICS AT UNC, CHAPEL HILL

- Address: CB 3250, UNC Chapel Hill, Chapel Hill, NC 27599-3250
- Email: forest@unc.edu
- Phone: (919) 962-9606
- Website: <https://aps.unc.edu/faculty-member/forest-greg/>

Dr. Arvind Santhanakrishnan

ASSOCIATE PROFESSOR SCHOOL OF MECHANICAL & AEROSPACE ENGINEERING, OKLAHOMA STATE UNIVERSITY

- Address: 201 General Academic Building, Stillwater, OK 74078-5016
- Phone: (405) 744-5704
- Email: askrish@okstate.edu
- Website: www.appliedfluidslab.org

Dr. Lindsay Waldrop

ASSISTANT PROFESSOR SCHMID COLLEGE OF SCIENCE AND TECHNOLOGY; BIOLOGICAL SCIENCES, CHAPMAN UNIVERSITY

- Email: waldrop@chapman.edu
- Website: <https://www.waldroplab.com/>