

# Austin J. Baird PhD

BIOMEDICAL ENGINEERING GROUP LEADER · DISTINGUISHED MEMBER OF THE TECHNICAL STAFF

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## Objective

I have a passion for computational biological modeling and a track record of accomplishments related to this wonderful field. I'm always inspired by new approaches and methods that consistently expand what's possible and what's known. I'm looking to make a broad impact in this research area and have a strong track record of leadership, scholarship, and project management.

## Education

### University of North Carolina at Chapel Hill

Chapel Hill, NC

PHD IN APPLIED MATHEMATICS

August 2014

- *Thesis:* Modeling Valveless Pumping Mechanisms
- *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 six million dollars in research and development funds through Defense Health Agency and Army Research Lab grants
- Lead technical physiology modeler and 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

### Applied Research Associates, Inc.

Raleigh, NC

STAFF ENGINEER 2

January 2017 - December 2018

- Expanded the BioGears physiology model by adding gastro-intestinal digestion/absorption, diuretic drug, pain stimulus, epinephrine release 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

### Applied Research Associates, Inc.

Raleigh, NC

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 reabsorptive function of the kidney
- Taught two semesters of introduction to partial and ordinary differential equations, developed all course materials
- Developed computational mathematical model of the kidney and coordinated work 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

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### JOURNAL ARTICLES

#### 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

#### Neuromechanical 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

#### 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

#### Modeling Valveless Pumping Mechanisms

A. BAIRD

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

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### Defense Health Agency

*Fredrick, MD*

SUSTAIN: PRONLONGED FIELD CARE TRAINING FRAMEWORK

Q3 2018

- *Role:* Lead Physiology Modeler and Proposal Manager
- *Amount:* 2.2 million

### Defense Health Agency

*Orlando, FL*

BURN CARE: VIRTUAL PATIENT APPLICATION TO TRAIN THERMAL INJURY

Q2 2017

- *Role:* Principal Investigator
- *Amount:* 2.1 million

### Army Research Labs

*Raleigh, NC*

FAST COMPUTATIONAL SIMULATIONS OF TRAUMATIC BRAIN INJURY

Q1 2017

- *Role:* Principal Investigator
- *Amount:* 353 thousand

### Defense Health Agency

*Fredrick, MD*

BIOGEARS FOLLOW-ON RESEARCH AWARD

Q4 2016

- *Role:* Principal Investigator
- *Amount:* 1.9 million

## Projects

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### BioGears Physiology Engine

*Raleigh, NC*

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

Feb 2016 - PRESENT

- A whole body physiology engine programmed in C++
- 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

### BurnCARE Medical Training Application

*Raleigh, NC*

ANDROID, UNREAL ENGINE 4, C++

Jan 2018 - PRESENT

- 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
- Led the grant writing effort and secured 2.1 million dollar grant to fund effort in competitive selection process

### Sustain: Prolong Field Care Training Framework

*Raleigh, NC*

C++, JAVASCRIPT, PYTHON

Jan 2018 - PRESENT

- Modular framework to connect different software critical for prolonged care training
- Scenario builder, Unreal Engine 4 training game, networking code, DDS virtual patient management code, and learning record database portal
- Led the grant writing effort and secured 2.2 million dollar grant to fund effort in competitive selection process

### Traumatic Brain Injury Angiogenesis

*Raleigh, NC*

C++, PYTHON, PARAVIEW, 3DSLICER

Jan 2017 - PRESENT

- 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

## Selected Presentations (of 23)

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### **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

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### **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)

*Chapel Hill, NC*

*Spring 2013*

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

## Skills

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

## Professional Memberships

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### Society for Simulation in Healthcare

LEADERSHIP GROUP ON SIMULATION AND MODELING

2016 - PRESENT

### IEEE: Engineering in Medicine and Biology

2018 - PRESENT

### NIH Interagency Modeling and Analysis Group

2019 - PRESENT

## Recommendations

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### 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: [fairyflies9@gmail.com](mailto:fairyflies9@gmail.com)
- Website: <https://sites.google.com/site/swimflypump/>

### Professor M. Gregory Forest

GRANT DAHLSTROM DISTINGUISHED PROFESSOR OF MATHEMATICS AT UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL

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