

Christopher V. Rackauckas

MATHEMATICIAN · THEORETICAL BIOLOGIST

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Research focus: How do biological organisms control/use noise, and how can scientists/clinicians utilize the information in noise?

Summary

- Applied Mathematician** Experience with computational mathematics, stochastic processes, dynamical systems, and statistics.
- Scientist** Experimental and theoretical research in physics, biology, climatology, economics, and chemistry.
- Software Engineer** Over eight years of experience with individual and team software engineering in academia and industry.
- Programming Polyglot** Adept at transferring knowledge to quickly learn new mathematics, software, tools, and programming languages.
- Well-Rounded Individual** Past activities include wrestling, track & field, theater, dance, scuba diving, and Model United Nations.

Research Interests

- Mathematics** Stochastic (Partial) Differential Equations, Computational Differential Equations, Stochastic Analysis
- Computation** High-Performance Computing, Machine Learning, “Big Data”, Package Development
- Biology** Systems, Developmental, Zebrafish, Craniofacial, Hindbrain, Cell Lineages, Breast Cancer

Education

University of California, Irvine

PH.D. IN MATHEMATICS

Irvine, California

Expected 2019

University of California, Irvine

M.S. IN MATHEMATICAL, COMPUTATIONAL, AND SYSTEMS BIOLOGY

Irvine, California

Expected 2016

University of California, Irvine

M.S. IN MATHEMATICS

- Certificate in Mathematical, Computational, and Systems Biology

Irvine, California

2015

Oberlin College

B.A. WITH HONORS IN MATHEMATICS WITH MINORS IN COMPUTER SCIENCE, PHYSICS, AND ECONOMICS

- GPA: 3.8/4.0, GRE: V166 (96%), Q169 (98%), W5.5 (96%)

Oberlin, Ohio

2013

Current Research Projects

High-Order Adaptive Methods for Stochastic ODEs

PI: PROF. Q. NIE, UNIVERSITY OF CALIFORNIA, IRVINE

- Utilizing high-order Stochastic Runge-Kutta methods for SODEs to develop adaptive SODE methods.
- Investigating the statistics of the Brownian Bridge to apply arbitrary time steps.
- Implementing the solutions as high-performance open source packages.

Numerical SODEs

2014-Present

Machine Learning for the Optimization Numerical Methods for Stochastic ODEs

PI: PROF. Q. NIE, UNIVERSITY OF CALIFORNIA, IRVINE

- Analyzing the mathematical problem from an experimental viewpoint and applying scientific methods.
- Implementing machine learning methods to optimize the numerical methods for various properties.
- Identifying computationally-efficient high-order implicit methods.

Numerical SODEs

2014-Present

Neural Crest Migration Patterns in Craniofacial Development

PIs: PROF. Q. NIE AND PROF. T. SCHILLING, UNIVERSITY OF CALIFORNIA, IRVINE

- Utilizing confocal microscopy to image the migration and cell-fate decisions of neural crest cells.
- Quantifying the outcomes of hypotheses via SDE models

Systems Developmental Biology

2013-Present

Mechanisms for Control of Variability in Biological Organisms

Mathematical Biology

PI: PROF. Q. NIE, UNIVERSITY OF CALIFORNIA, IRVINE

2013-Present

- Developed phenomenological (S)PDE models of retinoic acid signaling pathways of zebrafish.
- Identified network motifs which are used to attenuate the noise in the response signal.

Detection of Superspace Symmetry in Incommensurate Crystallography

Crystallography

PI: PROF. J. ROWSELL, OBERLIN COLLEGE

2013-Present

- Solved for and refined crystal structure from crystallography experiments using SHELX and Jana2006.
- First reported structure of "H-Acid", a commodity dye intermediate in heavy use since 1890.

Work Experience

Project Manager, Baidu, Inc.

Hong Kong, China

RESEARCH IN INDUSTRIAL PROJECTS FOR STUDENTS (RIPS-HK)

Summer 2013

- Lead an international team of researchers on a mathematical/computational research project for Baidu, Inc.
- Developed new algorithms for movie recommendation utilizing machine learning techniques.

Research Assistant

Oberlin, Ohio

OBERLIN COLLEGE DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

2012-2013

- Modeled incommensurate crystal structures using x-ray diffraction data from crystallography experiments.
- Solved for the modulated structure for low temperature crystals of "H-Acid", a commodity dye intermediate.

Web Developer

Oberlin, Ohio

OBERLIN COLLEGE RESIDENTIAL EDUCATION

2009 - 2013

- Created and maintained secure web forms and programs in PHP and Perl.
- Developed the associated MYSQL relational databases for the housing data.
- Wrote scripts to convert housing data into interactive Excel sheets for use by non-programmers.

Web Developer

Oberlin, Ohio

FREELANCE

2009 - 2013

- Created and maintained websites for professors and businesses.
- Scripted interfaces to ensure that information could be updated by individuals without programming experience.
- Examples: Fernando Gomez Herrero's personal page (fernandogomezherrero.com), Acoustik Musik LTD. (acoustikmusik.com), and my personal page (chrisrackauckas.com).

Model Developer and Technical Assistant

Oberlin, Ohio

OBERLIN MODELING INITIATIVE

2012

- Developed computational models for the Nova 2 Model Library and for classroom use.
- Wrote tutorials detailing how to script models using NovaScript.
- Created the World library for agent-based modeling in Nova.

Lighting/Sound Technician

Oberlin, Ohio / Mission Viejo, CA

OBERLIN COLLEGE AND MISSION VIEJO HIGH SCHOOL THEATER

2008-2010

- Designed and implemented lighting and sound for musical theater performances, dance showcases, and plays.
- Maintained technical equipment, utilized digital signal processing for sound design, and built sets.

Teaching Experience

Data Science Initiative Instructor

UC Irvine

UC IRVINE DATA SCIENCE INITIATIVE

2016-Present

- Developed and taught a workshop on advanced Julia programming.
- Mentored teams of students in machine learning for the Mobile Data Science Hackathon.

Systems Biology Short Course Workshop Tutor

UC Irvine

UC IRVINE CENTER FOR COMPLEX BIOLOGICAL SYSTEMS

2014-Present

- Taught Mathematica and MATLAB to workshop participants

Teaching Assistant

UC Irvine

UC IRVINE DEPARTMENT OF MATHEMATICS

2014-2015

- Taught upper division courses: Mathematical Biology, Probability and Statistics II, and Numerical Differential Equations.
- Lectured twice a week. Developed quizzes. Graded quizzes, homeworks, and exams.

Calculus Tutor

OBERLIN COLLEGE MATHEMATICS DEPARTMENT

- Responsibilities included teaching Oberlin College students first and second semester calculus.

Oberlin, Ohio

2009-2010

Extracurricular Activity

Pro Bono Web and Data Analysis Software Engineer

MARYLAND DEPARTMENT OF NATURAL RESOURCES

- Developed statistical analysis software for analyzing the output of data from continuous monitoring stations.
- Analyses were made to run through a graphical user interface (GUI) so that researchers and educators could be able to run the sophisticated statistical analyses without prerequisite programming knowledge.
- Developed an animated water quality map to be displayed on the Department of Natural Resources "Eyes on the Bay" website that would show the changes in the environment over time to help educate the public on the changing environmental conditions.

Virtual

2012 - 2013

Representative for the Biological Sciences

UC IRVINE ASSOCIATED GRADUATE STUDENTS

- Held positions in the Social and the Funding Committees

UC Irvine

2014-2015

Honors & Awards

FELLOWSHIPS AND SCHOLARSHIPS

2016	Data Science Initiative Summer Fellowship , UC Irvine Data Science Initiative	DSI
2014	DMS160004 , Numerical Methods and Models Using Stochastic (Partial) Differential Equations in Biology	XSEDE
2014	National Science Foundation Graduate Research Fellowship , National Science Foundation	NSF
2014	Ford Predoctoral Fellowship , National Academies of Science	Ford Foundation
2013	T32 Predoctoral Training Grant , National Institute of Biomedical Imaging and Bioengineering	UC Irvine
2013	Graduate Dean's Recruitment Fellowship , University of California, Irvine	UC Irvine
2013	Mathematical and Computational Biology (MCB) Fellowship , University of California, Irvine	UC Irvine
2010	S-STEM Scholarship , National Science Foundation	Oberlin College
2009	John F. Oberlin Scholarship , Oberlin College	Oberlin College

MONETARY AWARDS

2015	Opportunity Award , Center for Complex Biological Systems	CCBS
2013	Margaret C. Etter Student Lecturer Award , American Crystallographic Association, Service Crystallography SIG	ACA
2012	Best Poster Presentation for Statistics , Shenandoah Undergraduate Mathematics Conference	JMU

MISCELLANEOUS

2013	Certificate of Appreciation , Maryland Department of Natural Resources	DNR
2007	Eagle Scout , Boy Scouts of America	BSA
2014	Outstanding Presentation Award , Mathematical Association of America	MAA

Presentations

How do biological organisms interpret noisy signals? A peak into mathematical systems biology

ASSOCIATED GRADUATE STUDENTS GRADUATE RESEARCH SYMPOSIUM

UC Irvine

April 22, 2016

Superspace Refinement of the (3+1) Dimensional Incommensurately Modulated Phase of the Hydrated Sodium Salt of a Commodity Dye Intermediate

AMERICAN CRYSTALLOGRAPHY ASSOCIATION ANNUAL MEETING

Sheraton Waikiki Beach Hotel

July 22, 2013

Was the Earth Entirely Covered by Glaciers? A Mathematical Investigation of "Snowball Earth"

HONORS PRESENTATION

Oberlin College

May 9, 2013

Did Glaciers Cover the Planet? An Inquiry Into “Snowball Earth”

SENIOR SYMPOSIUM

[Oberlin College](#)

April 26, 2013

Did a Jormungand state exist? An investigation using the Budyko-Widiasih model

MATHEMATICS OF CLIMATE RESEARCH NETWORK

[Webinar](#)

March 6th and 20th, 2013

Water Quality Monitoring of Maryland’s Tidal Waterways

SHENANDOAH UNDERGRADUATE MATHEMATICS CONFERENCE (SUMS)

[James Madison University](#)

September 29, 2012

Publications

Noise modulation in retinoic acid signaling sharpens segmental boundaries of gene expression in the embryonic zebrafish hindbrain

SOSNIK J, ZHENG L, RACKAUCKAS C, DIGMAN M, GRATTON E, NIE Q, SCHILLING T

[eLife Sciences](#)

April 12, 2016

On The Budyko-Sellers Energy Balance Climate Model with Ice Line Coupling

WALSH J, RACKAUCKAS C

[Discrete and Continuous
Dynamical Systems – Series B](#)

September 2015

An Application of Robust Regression to Bernanke’s Analysis of Nonmonetary Effects in the Great Depression

RACKAUCKAS C

[Journal of Statistical and
Econometric Methods](#)

February 7, 2014

Assessment of Statistical Methods for Water Quality Monitoring in Maryland’s Tidal Waterways

LE R, RACKAUCKAS C, ROSS A, ULLOA N.

[SIAM Undergraduate Research
Online](#)

April 17, 2013

Technical Reports

Doubly Ensemble Movie Prediction with Social Media Data Using TBEEF

RACKAUCKAS C, CAI W, JARVIS C, XU C, CHING A

[MLOSS Repository](#)

August 10, 2013

The Jormungand Climate Model

RACKAUCKAS C

[OhioLINK Electronic Theses and
Dissertation Center](#)

July 11, 2013

Water Quality Monitoring of Maryland’s Tidal Waterways, HPCF-2012-12

LE R, Rackauckas C, ROSS A, ULLOA N. ADVISORS: POPURI S, NEERCHAL N, SMITH B

[UMBC HPCF](#)

October 2012

Notable Software

DifferentialEquations.jl

RACKAUCKAS C

- Julia package for solving various forms of differential equations.
- Supports stochastic (partial) differential equations (S(P)DEs) via recent research algorithms.
- Utilizes multi-node parallelization and GPU/Xeon Phi acceleration for HPC applications.
- Implements finite element and finite difference solvers for various important nonlinear (S)PDEs.

[Github Repository](#)

May 11, 2016 - Present

Triple Bagged Ensemble Framework (TBEEF)

RACKAUCKAS C, CAI W, JARVIS C, XU C, CHING A

- Machine learning software for recommendation problems using double ensembles.
- Over 1,000 downloads as of May 11, 2016.

[MLOSS Repository](#)

August 10, 2013

Skills

- Mathematics** **Stochastic** (partial) differential equations, real/complex analysis, abstract algebra, computational algebra, differential geometry, dynamical systems, mathematical modeling, numerical analysis, scientific computing, optimization, probability, mathematical statistics, computational statistics, Bayesian statistics, information theory, machine learning, time series analysis, algorithmic analysis, and theory of computation.
- Programming** **Julia**, MATLAB, Mathematica, Java, C (MPI), C++, R, Python, Javascript, PHP, MYSQL, Perl, and HTML5/CSS3
- Science** **Systems** biology, molecular biology, developmental biology, evolutionary biology, electrodynamics, classical/Lagrangian/Hamiltonian mechanics, quantum mechanics, statistical mechanics, general relativity, micro/macroeconomics, econometrics, biophysics, general chemistry, physical chemistry, and analytical chemistry.
- Software** **Linux**, Adobe Master Collection, SPSS, Stata, SHELX, Jana2006, Mercury, Diamond, and Nova.
- Engineering** **Software** engineering, audio engineering, digital signal processing, and control theory.

Professional Affiliations

- American Crystallographic Association**, ACA
- American Mathematical Society**, AMS
- Mathematical Association of America**, MAA
- Mathematics of Climate Research Network**, MCRN
- Society for Industrial and Applied Mathematics**, SIAM
- Society for the Advancement of Chicanos and Native Americans in Science**, SACNAS
- Sigma Xi**