

# Tom S. Bertalan

POSTDOCTORAL ASSOCIATE IN MIT MECHANICAL ENGINEERING

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## SKILLS

### Software

LIBRARIES, PACKAGES, FRAMEWORKS, & TOOLS

- NumPy+SciPy+Matplotlib
- Linux and shell scripting
- Git and Subversion
- Eclipse+PyDev
- Scikit-Learn
- Keras/Theano/Tensorflow
- Python multiprocessing
- Continuous integration (Codeship)
- Amazon Elastic Compute Cloud
- Apache+MySQL

### Languages

PROGRAMMING & MARKUP

- Python
- MATLAB
- L<sup>A</sup>T<sub>E</sub>X
- C/C++
- Java
- HTML+Javascript

### Selected Graduate Classes

- Computer Vision
- Machine Learning and Artificial Intelligence
- Foundations of Probabilistic Modeling
- Probability Theory
- Mathematical Neuroscience
- Computation and Coding in Microcircuits
- Neuroscience
- Applied Dynamical Systems
- Mathematical Analysis of Massive Data Sets
- Introduction to Nonlinear Dynamics
- Chemical Reactor Engineering
- Mathematical Methods for Engineering Analysis
- Software Engineering for Scientific Computing

### Selected Undergraduate Classes

- Mathematical Statistics with Applications
- Process Dynamics & Control
- Introduction to Linear Algebra
- Human Anatomy & Physiology
- Applied Differential Equations

### Teaching

AT PRINCETON; AS ASSISTANT INSTRUCTOR

- Chemical & Biological Engineering Lab
- Differential Equations

### Other Skills and Interests

- Arduino and Raspberry Pi
- Autonomous robotics with Robot Operating System (ROS)
- Small electronics manufacture
- Solo and orchestral violin performance

## PROJECTS

### Design and construction of a differential-drive rover

Created a small rover powered by ROS Indigo, implementing SLAM via particle filter using LIDAR unit from a Neato XV-series vacuum, with odometry information supplied by wheel encoders and MEMS gyro/accelerometer/magnetometer.

### Coarse-grained simulation of circadian rhythms in the suprachiasmatic nucleus of the hypothalamus

Contributed to a successful \$1.8MM grant for multi-university research project. Presented at AIChE in 2016; in preparation for IEEE Transactions on Control of Network Systems.

### Coarse-graining of coupled heterogeneous neurons

Used polynomial chaos fitting to learn a low-dimensional representation of states of biological neural network simulations. Published in European Physical Journal; in preparation for Physica D. Presented at AIChE in 2015 and Network Frontiers workshop 2013. Attended a workshop in Leuven, Belgium in 2013.

### Nonlinear manifold learning for reduction of high-dimensional dynamical systems

Used techniques from machine learning to characterize the slow manifold underlying complex, high-dimensional simulation dynamics. In preparation for PNAS.

### Simulation of hierarchy formation thorough social combat in mangrove killifish

Designed, coded, and built an experimental Beowulf cluster for performing agent-based simulations. Presented at multiple undergraduate conferences in 2011 and 2012.

### Multigrid acceleration of fluid flow simulations

Used algebraic multigrid to accelerate simulations of underground reservoirs. Presented at SciPy 2012. Published in Numerical Linear Algebra with Applications and in proc. Interpore 2012.

## EDUCATION

### Princeton University

M.A. AND PH.D

Chemical and Biological Engineering  
Advised by Prof. Yannis Kevrekidis

### The University of Alabama

B.S., MAGNA CUM LAUDE

Chemical and Biological Engineering, minor in Mathematics  
Advised by Prof. Eric Carlson and Prof. Ryan Earley

## AWARDS

- Princeton Program in Plasma Science and Technology research and academic fellowship
- National Science Foundation research fellowship
- William R. Schowalter fund for scholarly conferences
- National merit finalist scholarship
- University honors program
- University president's list
- ΦΗΣ, ΩΧΕ, and ΤΒΠ honor societies

## PUBLICATIONS

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### **“An equal space: intrinsic geometries for complex data with unknown internal order”**

IN PREPARATION FOR PNAS

2017

Felix Kemeth, Sindre Haugland, Tom Bertalan, Erik Bollt, Ronen Talmon, Ronald Coifman, Katharina Krischer, and Ioannis Kevrekidis

### **“Coarse-grained descriptions of dynamics for networks with both intrinsic and structural heterogeneities”**

IN PRESS FOR FRONTIERS IN NEUROSCIENCE

2017

Tom Bertalan, Yan Wu, Carlo Laing, C. William Gear, and Ioannis Kevrekidis.

### **“Dimension reduction in heterogeneous neural networks: Generalized Polynomial Chaos (gPC) and ANalysis-Of-Variance (ANOVA)”**

EUROPEAN PHYSICAL JOURNAL, SPECIAL TOPICS ISSUE

2016

Minseok Choi, Tom Bertalan, Carlo Laing, and Ioannis Kevrekidis.

### **“OpenMG: a new multigrid implementation in Python”**

NUMERICAL LINEAR ALGEBRA WITH APPLICATIONS

2014

Paper. Tom Bertalan, Akand Islam, Roger Sidje, and Eric Carlson

## CONFERENCES

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### **“Coarse modeling of circadian rhythms in heterogeneous neural networks”**

DYNAMICS DAYS 2017; AMERICAN INSTITUTE OF CHEMICAL ENGINEERS ANNUAL MEETING

January 2017; November 2016

Poster; talk. Tom Bertalan, C. William Gear, Yannis G. Kevrekidis, Michael Henson, Erik, and Carlo Laing.

### **“Coarse-graining of heterogeneous neural dynamics”**

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS ANNUAL MEETING

November 2015

Talk. Tom Bertalan, Minseok Choi, Carlo Laing, Ioannis Kevrekidis.

### **“Heterogeneity and reduction for complex network dynamics”**

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS ANNUAL MEETING

November 2014

Talk. Ioannis Kevrekidis, Alexander Holiday, Tom Bertalan, and Carlo Laing.

### **“Polynomial representations of populations with multiple heterogeneities”**

PRINCETON GRADUATE STUDENT SYMPOSIUM

October 2014

Poster. Tom Bertalan, Yan Wu, Brianna Hnath, and Yannis Kevrekidis

### **“OpenMG: a new multigrid implementation in Python”**

SCI-PY: SCIENTIFIC COMPUTING WITH PYTHON

July 2012

Talk. Tom Bertalan, Akand Islam, Roger Sidje, and Eric Carlson

### **“ESIM: a framework for simulation of dominance hierarchy formation in small animal groups”**

UNIVERSITY OF ALABAMA SYSTEM HONORS UNDERGRADUATE RESEARCH CONFERENCE

April 2012

Poster. Tom Bertalan, and Ryan Earley

### **“An open-source computing cluster for virtual experiments with variable parameters”**

UNIVERSITY OF ALABAMA SYSTEM HONORS UNDERGRADUATE RESEARCH CONFERENCE

April 2011

Poster. Tom Bertalan and Eric Carlson

## REFERENCES

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**Yannis Kevrekidis:** [yannisk@jhu.edu](mailto:yannisk@jhu.edu) Bloomberg Distinguished Professor in Applied Mathematics and Statistics at Johns Hopkins University

**Stas Shvartsman:** [stas@princeton.edu](mailto:stas@princeton.edu) Professor of Chem. and Biol. Engineering at Princeton University and the Lewis-Sigler Institute for Integrative Genomics.

**Ryan Earley:** [rearley@ua.edu](mailto:rearley@ua.edu) Associate Professor of Biological sciences at The University of Alabama.