607-425-3046
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Matthew Guay
Curriculum Vitae

9608 51st Ave.
College Park, MD 20740

EDUCATION

Ph.D. in Applied Mathematics, University of Maryland, College Park, May 2016 (expected).

Thesis: *Sparse signal representation in digital and biological neural networks* (Due March 2016)

Adviser: Wojciech Czaja

GPA: 3.4

B.A. in Mathematics, *magna cum laude*, Cornell University, August 2011.

Honors thesis: *Infinity-harmonic functions on SG*

Advisers: Robert Strichartz, Alexander Vladimirsky

GPA: 3.4

RESEARCH EXPERIENCE

Sparse signal representation in digital and biological neural networks
Adviser: Wojciech Czaja, August 2014 - present.

- Investigating the connection between continuous Hopfield networks for solving sparse representation problems and biological neural network motifs in intermediate-level sensory processing.
- Research uses the locust olfactory system as a model system for exploring sparse biological neural coding within sensory processing hierarchies. Emphasis is placed on the role of local network competition through feedback inhibition for population encodings of sensory stimuli.
- Investigating the incorporation of locally competitive algorithm (LCA) networks into deep artificial neural network architectures for machine learning.

Computational modeling of locust olfactory processing
Advisers: Wojciech Czaja and Mark Stopfer, January 2014 - present.

- In collaboration with the Stopfer Lab: Section on Sensory Coding and Neural Ensembles, of the National Institute for Child Health and Human Development (NICHD). Performed in part through the National Institutes of Health Summer Internship Program (NIH SIP), 2014.
- Developed and implemented Hodgkin-Huxley-type models of locust antennal lobe networks using MATLAB and CUDA, and mushroom body networks using Python, Cython, and C++, to investigate propagation of stimulus offset activity throughout a hierarchy of olfactory processing centers.
- Collaboration emphasizes interactions with experimentalists to better understand experimental constraints in evaluating theoretical models of sparse sensory coding.

Compressed sensing for STEM tomography of biological structures
Advisers: Wojciech Czaja and Richard Leapman, June 2012 - present.

- In collaboration with the Laboratory of Cellular Imaging and Macromolecular Biophysics, of the National Institute of Biomedical Imaging and Bioengineering (NIBIB). Performed in part through the NIH SIP, 2012 and 2013.
- Researched the application of compressed sensing (CS) to STEM tomography for the 3D imaging of nanoscale biological material. Focused on the disparity in structural sparsity between biological and nanometallurgical datasets, and its implications for the performance of CS reconstructions within and between those domains.
- Developed and implemented a fast compressed sensing reconstruction algorithm in MATLAB for use with STEM bright-field and dark-field tomographic data.

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WORK EXPERIENCE

Teaching assistant - UMD Department of Mathematics. Fall 2011 - present, except Spring 2015.

Graduate research assistant - UMD Math Research Experience for Undergraduates (REU). Summer 2015.

Summer intern - NIH Summer Internship Program. Summer 2012 - 2014.

Head tutor - Cornell Math Support Center. Fall 2010 - Spring 2011.

LEADERSHIP EXPERIENCE

President - UMD Department of Mathematics New Student Committee. 2013 - present.

Co-organizer of the Research Interaction Team on Deep Learning. Fall 2015 - Spring 2016.

Organizer of the Maryland Mathematical Modeling Competition. 2013 - 2014.

Organizer of the Norbert Wiener Center coding workgroup. Fall 2014.

COMPUTER SKILLS

Programming and markup languages: Roughly in descending order of proficiency.
MATLAB, LaTeX, Python, C++, Javascript, WebGL, Julia, CUDA, HTML, CSS, OpenGL.

Operating systems: Windows, Ubuntu Linux.

AWARDS

(2009) Outstanding winning paper, COMAP International Mathematical Contest in Modeling - INFORMS Prize recipient.

PUBLICATIONS

(2016) Mark Stopfer, Zane Aldworth, **Matthew Guay**. *Title to come.* In preparation.

(2016) **Matthew Guay**, Wojciech Czaja, Richard Leapman. *Sparse Tomogram Reconstruction in Low-dose STEM Tomography.* In preparation.

(2015) **Matthew Guay**, Maria Aronova, Wojciech Czaja, Richard Leapman. *Compressed Sensing Electron Tomography for Biological Imaging.* In review.

(2014) **Matthew Guay**, Wojciech Czaja, Richard Leapman. *Compressed Sensing Methods for Electron Tomography of Cellular Structure.* Biophysical Journal 106.2 (2014): 598a-599a.

(2009) Amrish Deshmukh, Nikolaus Stahl, **Matthew Guay**. *Modeling Telephony Energy Consumption.* UMAP J. 30, No. 3, 220-221 (2009).

INVITED AND CONFERENCE TALKS

(2015) *Simulation of Offset Spiking in Locust Kenyon Cells.* National Institute of Child Health and Human Development, National Institutes of Health. October 30, 2015.

(2014) *Narrowing the Gap Between Machine Learning and Neuroscience.* National Institute of Child Health and Human Development, National Institutes of Health. June 13, 2014.

(2012) *Compressed Sensing and Electron Tomography.* National Institute of Biomedical Imaging and Bioengineering, National Institutes of Health. September 11, 2012.

(2011) ∞-*Harmonic functions on SG.* Cornell Conference on Analysis, Probability, and Mathematical Physics on Fractals. September 10-13, 2011.