

GREGORY CANAL

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EDUCATION

Georgia Institute of Technology, Atlanta, GA

Ph.D. in Electrical and Computer Engineering

August 2015 – August 2021

technical interest areas: machine learning, digital signal processing

Georgia Institute of Technology, Atlanta, GA

M.S. in Electrical and Computer Engineering

December 2017

Duke University, Durham, NC

B.S.E. in Electrical and Computer Engineering, Minor in Music

August 2011 - May 2015

CURRENT RESEARCH

Georgia Institute of Technology, Sensory Information Processing Lab

2016 -

Graduate Research Assistant

Advisor: Christopher Rozell, Ph.D.

The objective of my Ph.D. research is to utilize tools from feedback information theory to develop mathematical foundations and optimal algorithms for interactive machine learning systems in various settings.

Feedback coding for active learning,

2019 - 2021

- Formulated active learning as a feedback coding problem, and analytically characterized logistic regression in a coding-theoretic framework
- Developed a new algorithm for coding-theoretic example selection in general active learning problems and analyzed its use in logistic regression
- Implemented (in Python) and evaluated the algorithm's performance in active learning for logistic regression on real-world datasets, demonstrating competitive performance to existing methods while achieving an order of magnitude computational speed-up for selection

Active embedding search via noisy paired comparisons,

2018 - 2019

- Developed, implemented (in Python), and analyzed new algorithms for searching similarity embeddings by adaptively querying paired comparisons that evaluate user preferences between embedding objects, in collaboration with other students
- Evaluated methods on simulated preference learning tasks and demonstrated improvements over state-of-the-art techniques
- Extended static pairwise search techniques to estimation and identification in dynamical systems models, and to union of subspaces models

Active ordinal querying for tuplewise similarity learning,

2017 - 2019

- Utilized concepts from active learning and information theory to design and implement (in Python) an efficient sampling strategy to train a similarity learning algorithm using a novel high-order ordinal query type, in collaboration with another student
- Demonstrated improved performance over the state-of-the-art method on simulated and newly collected human datasets

SCINET: Swarm Control via Interactive Neural Teleoperation,

2015 - 2021

- Developed a brain-computer interface (BCI) that utilizes an optimal feedback coding scheme to control a robotic swarm through the extraction and classification of EEG features with filtering and machine learning techniques written in MATLAB
- Collaborated with the GRITS robotics group to interface the BCI with a robotic swarm, achieving an accuracy of 75% correct swarm configurations over 70 trials of a single subject and verifying system usability via Amazon Mechanical Turk

Interactive object segmentation with noisy binary inputs,

2016 - 2018

- Managed two undergraduate students in an extension of BCI control algorithms used in SCINET to the domain of image segmentation, combining concepts from human-computer interaction and information theory with computer vision

PREVIOUS RESEARCH EXPERIENCE

Pratt Fellows Research Program, SSPACISS Laboratory, Duke University

2014 - 2015

Undergraduate Researcher

Advisor: Leslie Collins, Ph.D.

- Designed, executed, and analyzed experiments investigating the use of brain-computer interfaces for rapid visual searching of images
- Learned C++ and Qt programming to develop real-time experimental applications within existing software to generate data for signal processing and classification in MATLAB

PROFESSIONAL EXPERIENCE

LGS Innovations, Florham Park, NJ

Summer 2017

Graduate Student Intern

- Investigated, developed, analyzed, and tested signal models and source separation solutions for multiple-input multiple-output digital communications systems, including a novel problem-specific extension of independent component analysis which was subsequently integrated into a deployed customer system
- Successfully demonstrated solution performance on both simulated and real-world customer datasets
- Fully documented methods and results in an internal report and presented in a departmental seminar

TEACHING EXPERIENCE

Georgia Institute of Technology, School of Electrical and Computer Engineering

Fall 2015

Graduate Teaching Assistant - ECE 2026: Introduction to Signal Processing

- Instructed undergraduate students in weekly laboratory sessions that explored signal processing concepts in MATLAB

Duke University, Department of Electrical and Computer Engineering

Head Laboratory Teaching Assistant (Spring 2015) - ECE 280: Signals and Systems

Laboratory Teaching Assistant (Fall 2013, Fall 2014) - ECE 280: Signals and Systems

- Led weekly laboratory sessions that implemented signal processing concepts with MATLAB, Simulink, and data acquisition boards, tailoring instruction to individual students while balancing the needs of the class by leading group lessons
- Served as head laboratory teaching assistant, with additional responsibilities consisting of coordinating with laboratory managers and faculty to plan exercises, and leading weekly meetings to prepare teaching assistants for each lab

SERVICE

- Reviewer: *24th International Conference on Artificial Intelligence and Statistics (AISTATS)* 2021
- Reviewer: *Signal Processing with Adaptive Sparse Structured Representations (SPARS)* 2019
- Organizer, Atlanta Science Festival community outreach event on *Neuro-Engineering: Blurring the Lines Between Mind and Machine* 2019
- Board member, Georgia Tech ECE Graduate Student Organization 2016 - 2019
- Developed and organized events for graduate students in the School of Electrical and Computer Engineering
 - Served as a student mentor for multiple incoming graduate students to advise in coursework, research, and life as a Ph.D. student at Georgia Tech
- Student technician, Duke Engage - Engineering World Health Summer Institute, Tanzania Summer 2013
- Volunteered for a month as a hospital technician, with duties including troubleshooting and repairing biomedical devices, taking item inventory and prioritizing repairs, and establishing a hospital engineering infrastructure

CONFERENCE PUBLICATIONS

- **G. Canal**, M. Bloch, and C. Rozell. Feedback coding for active learning. In *The 24th International Conference on Artificial Intelligence and Statistics (AISTATS)*, April 2021. (Acceptance rate 30%).
- M. Connor, **G. Canal**, and C. Rozell. Variational autoencoder with learned latent structure. In *The 24th International Conference on Artificial Intelligence and Statistics (AISTATS)*, April 2021. (Acceptance rate 30%).
- M. O'Shaughnessy, **G. Canal**, M. Connor, M. Davenport, and C. Rozell. Generative causal explanations of black-box classifiers. In *The 34th Conference on Neural Information Processing Systems (NeurIPS)*, December 2020. (Acceptance rate 20%).
- **G. Canal***, S. Fenu*, (equal contribution) and C. Rozell. Active ordinal querying for tuplewise similarity learning. In *AAAI Conference on Artificial Intelligence (AAAI)*, New York, NY, February 2020. Selected for oral presentation. (Acceptance rate 20%).
- **G. Canal***, M. O'Shaughnessy*, (equal contribution) C. Rozell, and M. Davenport. Joint estimation of trajectory and dynamics from paired comparisons. In *International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP)*, Guadeloupe, West Indies, December 2019.
- **G. Canal**, A. Massimino, M. A. Davenport, and C. J. Rozell. Active embedding search via noisy paired comparisons. In *The 36th International Conference on Machine Learning (ICML)*, Long Beach, CA, June 2019. Selected for long oral presentation. (Acceptance rate 23%).
- **G. Canal**, S. Manivasagam, S. Liang, and C. J. Rozell. Interactive object segmentation with noisy binary inputs. In *Proceedings of the IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, Anaheim, CA, November 2018. Poster presentation.

CONFERENCE ABSTRACTS

- **G. Canal**, A. Massimino, M. A. Davenport, and C. J. Rozell. Active embedding search via noisy paired comparisons. In *Signal Processing with Adaptive Sparse Structured Representations (SPARS) Workshop*, Toulouse, France, July 2019. Poster presentation.
- **G. Canal**, S. Fenu, A. Massimino, M. A. Davenport, and C. J. Rozell. Informative ordinal querying for similarity embedding construction and search. In *Coordinated Science Laboratory Student Conference*, Urbana, IL, February 2019. Poster presentation.
- **G. Canal**, Y. Diaz-Mercado, M. Egerstedt, and C. J. Rozell. Controlling high-complexity robotic swarms with low-complexity eeg brain-computer interfaces. In *International BCI Meeting*, Pacific Grove, CA, May 2018. Selected for oral presentation.

- **G. Canal**, Y. Diaz-Mercado, M. Egerstedt, and C. Rozell. Controlling high-complexity robotic swarms with low-complexity EEG brain-machine interfaces. In *Society for Neuroscience Annual Meeting*, Washington, D.C., November 2017. Poster presentation.

WORKSHOPS:

- Selected participant in ComSciCon-Atlanta, Atlanta, GA, March 2020.
- Participant in Information Theory and Applications (ITA) Workshop, University of California San Diego, San Diego, CA, February 2020. Poster presentation.
- Selected participant in Georgia Tech’s Career, Research, and Innovation Development Conference (CRIDC), Georgia Institute of Technology, Atlanta, GA, February 2019. Poster presentation.
- Selected participant in TRIPODS Summer School, Institute for Foundations of Data Science, University of Wisconsin-Madison, Madison, WI, July 2018. Poster presentation.

GRANTS CONTRIBUTED TO:

- DARPA – Active Similarity Learning and Manifold Graphs for Learning with Few Labels 2019 - 2022
- Assisted in the development of project objectives and co-authored multiple proposal sections

PATENTS:

- G. Canal, C.J. Rozell, S. Fenu, M. Davenport, A. Massimino. Systems and Methods for Preference and Similarity Learning, filed February 3, 2020. International (PCT) Patent Application No.: PCT/US2020/016379.

HONORS AND AWARDS

IDEaS-TRIAD Research Scholarship	2020
International BCI Meeting Student Award	2018
LGS Innovations STAR Scholar Award	2017
Georgia Tech President’s Fellowship	2015
Tau Beta Pi Fellowship	2015
Duke University	-
- Summa Cum Laude	2015
- Graduation with Departmental Distinction	2015
- Outstanding Undergraduate Teaching Award	2015
- Phi Beta Kappa	2015
- Dean’s List with Distinction / Dean’s List	2011 - 2015
- Student Marshal	2014
- STEAM Challenge Honorable Mention	2014
- Tau Beta Pi	2014
- Eta Kappa Nu	2013
- Anne Marie Parsons Memorial Prize in Jazz Studies	2012