

Dominic Boutet

Montreal, Qc, Canada
(438) 390-3895
dominic.boutet@mail.mcgill.ca

INFO Ph.D. student at the IPN, McGill University. My research focuses the the modelling of multimodal neuroimaging data in the study of neurophysiological processes underlying brain activity in health and diseases (e.g., schizophrenia).

EDUCATION *Bachelor of Science*, Interdisciplinary Science
McGill University, Qc, CA, Completed May 2023
Concentration: Neuroscience (Major) & Computer Science (Minor)
Final cGPA: 3.98

Doctor of Philosophy, Neuroscience Science
McGill University, Qc, CA, Started August 2023
Concentration: Computational Neuroscience
Current cGPA: TBD

RESEARCH EXPERIENCE *Undergraduate Research internship* May 2021-August 2023
The Neuro at *NeuroSPEED-BailletLab*, Qc, CA

COMP 396 - Undergraduate Research Project class (Fall 2021):

- Investigating the potential of a novel parameter space reduction metaheuristic that guides search-based optimization algorithms in high-dimensional space.
- Implementation of the general idea behind the metaheuristic.
- Implementation of a simple testing framework based on the calibration of a TVB model to MEG data.
- Writing of a report and preparation of a presentation for course evaluation.

NSERC USRA summer project (2022):

- Developing a formal mathematical expression of the parameter space reduction metaheuristic designed in the previous project, implementing a flexible toolkit for its use, and thoroughly testing its efficacy against other algorithms.
- Writing of the API for initialization and training of neural networks used in the metaheuristic along with an approach to sampling from the parameter subspace.
- Implementation of accelerated simulator models of neurons and neural masses along with various search algorithms for testing.
- Design and implementation of thorough testing on performance and convergence of the metaheuristic against baseline algorithms.
- Writing of a *manuscript* reporting the metaheuristic and its performance.

Undergraduate thesis, NSCI 420 (Fall 2022 - Winter 2023):

- Investigating the effect of varying the number of free parameters in whole-brain dynamical models when used in a *neural fingerprinting* identification task where individuals in a cohort are identified based on their brain activity.
- Modification of the simulation workflow of TVB models from previous projects to facilitate model calibration at varying number of free parameters.
- Implementation of a model calibration framework based on the parameter space reduction metaheuristic designed in a previous project.

- Design and implementation of hypothesis-driven tests on specific combinations of free parameter and the resulting identification accuracy.
- Analysis of the results and writing of an undergraduate thesis.

NSERC USRA summer project (2023):

- Investigating the effect of structural connectivity information in whole-brain dynamical models for *neural fingerprinting*, extension of undergraduate thesis.
- Modification of the workflow from undergraduate thesis project to operate on individual MRI-derived structural connectivity graphs.
- Design and implementation of hypothesis-driven tests on the effect of structural constraints on model predictions and fingerprinting results. [Ongoing]

Research Collaboration
McGill at MUHC, Qc, CA

December 2021-June 2022

Contribution to a cardiovascular imaging data analysis project:

- Development of a feature selection and biomarker validation pipeline from oxygenation-sensitive CMR images (cardiovascular imaging).
- Design of a feature selection approach for biomarker identification.
- Design of a machine learning classifier based validation pipeline leveraging non-parameteric null testing.
- Writing of a manuscript, now published *here*.

Doctoral projects
The Neuro at *NeuroSPEED-BailletLab*, Qc, CA

August 2023-Now

Coming soon!

AWARDS & DISTINCTIONS

Academic Awards:

- Dean's Honour List & Faculty Of Science Scholarships Award (2021)
- NSERC Undergraduate Summer Research Award (2022 & 2023)
- IPN Recruitment Award (2023)
- NSERC Canada Graduate Scholarship (2023)
- FRQS Doctoral Training Scholarship (2024-Now)

SCIENTIFIC CONTRIBUTIONS

Publications:

- Automated Data Transformation and Feature Extraction for Oxygenation-Sensitive Cardiovascular Magnetic Resonance Images (2024)
- A Metaheuristic for Amortized Search in High-Dimensional Parameter Spaces (2023) - [Preprint]

Open Source Projects

- *pystorm*: An open source package that acts as a python port of some functions from the *brainstorm* toolbox. It aims to be lightweight, fast (through GPU support and JIT compilation when possible), and hopefully easily scalable to high performance computing. Available through pypi as **pystorm3**.

COMMUNITY ENGAGEMENT

Undergraduate Research Lead
Youreka Canada, CA

January 2022-May 2022

Acting as Principal Investigator to:

- Design a complete research project based on the topic provided by Youreka.

- Mentor and lead a team of high school students through the whole research process, such as defining a research question, implementing a methodology, interpreting results, etc. Guiding them through the writing of a manuscript and preparation of a presentation for the Youreka Symposium.
- ✧ Details: We established a proof of concept for COVID-19 cases forecasting from vaccination data using time series linear models and won the Youreka Montreal Regional Finalists Award.

Vice-President of the Machine Learning Committee
PharmaHacks, Qc, CA

August 2022-Now

Acting as leader within the organization to:

- Help with the general operations of the organization.
- Help define the role for the new Machine learning committee in the organization.
- Evaluate the Hackathon challenges provided by our sponsors.
- Work with our sponsors in the development of new challenges.
- Design custom "PharmaHacks challenges".