

Yohan Chatelain

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PROFESSIONAL SUMMARY

Experienced Computer Scientist with a focus on High-Performance Computing (HPC), low-level optimisation, numerical instabilities and Artificial Intelligence (AI). Skilled in teaching (4 courses), mentoring (6 Bs to PhD), and publishing (15 papers). Enhanced computational tool efficiency and performance, achieving significant speed and resource optimisation. Developed solutions for HPC and Python-based scientific computing, prioritising reliability and numerical stability.

SKILLS

- C, C++, Python, Java, Shell, FORTRAN, x86, OCaml, Rust, Bash
- NumPy, SciPy, Pandas, TensorFlow, PyTorch
- BLAS, LAPACK, OpenMP, MPI, MKL, OneApi, CUDA, LLVM, Clang, Linux kernel

EXPERIENCE

POSTDOCTORAL FELLOW, CONCORDIA UNIVERSITY; MONTRÉAL, QC, CANADA – 09/2020-PRESENT

Engaged in development of high-efficiency tools in high-performance computing through advanced research and student mentorship.

- Co-led works on Convolutional Neural Network (CNN) numerical analysis in bioinformatics and neuroimaging
- Co-led works on precision reduction (64 bits to 8 bits) in data stream classification with F1 score improvement (+15%)
- Co-authored study highlighting the role of numerical stability in MRI tumor segmentation deep learning
- Co-authored study replicating machine learning models to predict Parkinson's disease progression
- Designed a unified C/C++ interface for top-tier numerical analysis tools, France's National Research Agency (€600k)
- Led the creation of the open-source tool PyTracer for tracing numerical instabilities in Python programs
- Maintained open-source Fuzzy for evaluating numerical errors with scientific Python through Docker
- Authored significantdigit Python package designed for statistical analysis of Stochastic Arithmetic calculations

PHD STUDENT, PARIS-SACLAY UNIVERSITY; VERSAILLES, FRANCE - 10/2016-12/2019

Conducted innovative research and tool development in high-performance computing, focusing on computational reduction.

- Engineered compiler backend tool to simulate reduced floating-point formats. Achieving up to 67% reduction in communication volume, reducing energy and execution time when applied to a parallel fluid mechanics solver.
- Led VeriTracer dev to visualise numerical instabilities in clang-supported languages, integrated in Java IDE
- Maintained and co-designed Verificarlo, optimised backends with x2 for the speed, wrote compilation passes (LLVM)

SOFTWARE ENGINEER, INTEL; HILLSBORO, OR, US - 01/2019-06/2019

Part of the Numerics US team (MKL, IML, VML) to enhance Intel's numerical computing performance and reliability.

- Modernised Intel Mathematical Library (IML) by optimising 50% of its functions
- Implemented continuous integration for test validation, bolstering mathematical library quality.

SOFTWARE DEVELOPER, UNIVERSITY OF VERSAILLES; VERSAILLES, FRANCE - 04/2016-09/2016

Developed a novel multi-threaded capture for capturing and replaying independent pieces of code within CERE tool

- Developed multi-threaded capture for CERE in C; x2 experiment scalability and improving memory replay
- Used the new capture model to microbenchmark NAS for energetic prediction model

SOFTWARE DEVELOPER, EXASCALE COMPUTING RESEARCH; BRUYÈRES-LE-CHÂTEL, FRANCE - 05/2015-09/2015

Developed tool to specialise C code based on value profiling

- Implemented automatic functions specialiser in LLVM and value profiling analysis in Python
- Benchmarked specialised version to measure speedups gains

SOFTWARE DEVELOPER, LRI; SACLAY, FRANCE - 03/2014-05/2014

Implementation of program termination criterion for a generic first-order call-by-value language in ML style in OCaml

EDUCATION

- **Université Paris-Saclay, Versailles, France – PhD, 12/2019**
Title: "Tools for debugging and optimizing floating-point computations in HPC"
- **Université Paris-Saclay, Versailles, France – Master, 09/2016**
Field: High Performance Computing
- **Université Paris-Saclay, Orsay, France – Bachelor, 06/2014**
Field: Computer Science

TEACHING

CONCORDIA UNIVERSITY; MONTRÉAL, QC, CANADA

- **COURSE INSTRUCTOR - 09/2023-12/2023**
Fundamentals of programming, Bachelor level
Introductory course to the basic principles of programming with classes and objects using C++

UNIVERSITY PARIS-SACLAY; VERSAILLES, FRANCE

- **TEACHING ASSISTANT - 09/2018-12/2019**
Compilers, Bachelor level
Overview of compilation from language parsing to assembly generation with practical implementation in LLVM
- **TEACHING ASSISTANT - 09/2016-06/2018**
Advanced Algorithm, Bachelor level
Time and space complexity, recursive schemes and graph traversal
- **TEACHING ASSISTANT - 09/2016-06/2018**
Parallel Architecture, Master level
Shared and distributed memory parallelisation, cache policy, network topology and analysis of research publications

MENTORING

PH.D. LEVEL

- **Ines Gonzales Pepe**
Concordia University; Montreal, QC, Canada - 09/2023 - present
Subject: "Numerical stability of deep learning in bioinformatics"
Supervisor: Tristan Glatard, Mentoring: Gregory Kiar (50%)
- **Ali SALARI**
Concordia University; Montreal, QC, Canada - 10/2020 - 02/2022
Subject: "The effect of Computational Environments on Big Data Processing Pipelines in Neuroimaging"
Supervisor: Tristan Glatard, Mentoring: Gregory Kiar (50%)

MASTER LEVEL

- **Ines Gonzales PEPE**
Concordia University; Montreal, QC, Canada - 09/2021 - 09/2023
Subject: "Numerical Stability of DeepGOPlus Inference"
Co-supervisor: Tristan Glatard (50%)
- **Damien THENOT**
Université Paris-Saclay; Versailles, France - 06/2018 - 09/2018
Subject: "Development of a Java IDE for Veritracer"
Co-supervisor: Pablo de Oliveira Castro (50%)

UNDERGRADUATE LEVEL

- **Nigel YONG**
Concordia University; Montreal, QC, Canada - 05/2021 - 06/2021
Subject: "Optimizing performance of PyTracer"
Co-supervisor: Tristan GLATARD (50%)
- **Marc VICUNA**
Concordia University; Montreal, QC, Canada - 01/2021 - 05/2021
Subject: "Reducing numerical precision preserves classification accuracy in Mondrian Forests"
Co-supervisors: Martin KHANNOUZ (33%) | Tristan GLATARD (33%)

GRANTS

ACCELNET IN-BIC - 10/2021

PI: Yohan Chatelain - \$10,000 (USD)

Understanding the magnitude, origins, and implications of numerical instabilities for human brain tractometry within PyAFO

CONCORDIA HORIZON POST-DOCTORAL FELLOWSHIP - 09/2020-09/2022

PI: Yohan Chatelain - \$50,000/yr. (USD)

Studying numerical instabilities in neuroimaging

RESEARCH

PEER-REVIEWED PUBLICATIONS IN JOURNALS

1. PyTracer: Automatically profiling numerical instabilities in Python
Yohan Chatelain, Nigel Yong, Gregory Kiar, Tristan Glatard. IEEE Transactions on Computers (IEEE TC) (2022)
2. Data Augmentation Through Monte Carlo Arithmetic Leads to More Generalizable Classification in Connectomics
Gregory Kiar, **Yohan Chatelain**, Ali Salari, Alan C. Evans, Tristan Glatard In Neurons, Behavior, Data Analysis and Theory, 2021.
3. Numerical Uncertainty in Analytical Pipelines Lead to Impactful Variability in Brain Networks
Gregory Kiar, **Yohan Chatelain**, Pablo de Oliveira Castro, Eric Petit, Ariel Rokem, Gaël Varoquaux, Bratislav Misic, Alan C. Evans, Tristan Glatard. In PLOS ONE (2021).
4. Piecewise holistic autotuning of parallel programs with CERE
Mihail Popov, Chadi Akel, **Yohan Chatelain**, William Jalby, and Pablo de Oliveira Castro, Concurrency and Computation: Practice and Experience, vol. 29, Aug 2017.

PEER-REVIEWED PUBLICATIONS IN CONFERENCES

1. Numerical Uncertainty of Convolutional Neural Networks Inference for Structural Brain MRI Analysis
Inés Gonzalez Pepe, Vinuyan Sivakolunthu, Hae Lang Park, **Yohan Chatelain**, Tristan Glatard.
Uncertainty for Safe Utilization of Machine Learning in Medical Imaging (UNSURE, MICCAI) (2023)
2. Reproducibility of tumor segmentation outcomes with a deep learning model
Morgane Des Ligneris, Axel Bonnet, **Yohan Chatelain**, Tristan Glatard, Michaël Sdika, Gaël Vila, Valentine Wagnier-Dauchelle, Sorina Pop, Carole Frindel.
International Symposium on Biomedical Imaging (ISBI), 2023.
3. Reducing numerical precision preserves classification accuracy in Mondrian Forests
Marc Vicuna, Martin Khannouz, Gregory Kiar, **Yohan Chatelain**, Tristan Glatard.
6th Workshop on Real-time Stream Analytics, Stream Mining, CER/CEP & Stream Data Management. In 2021 IEEE International Conference on Big Data (Big Data) (pp. 2785-2790).
4. Accurate simulation of operating system updates in neuroimaging using Monte-Carlo arithmetic
Ali Salari, **Yohan Chatelain**, Gregory Kiar, Tristan Glatard.
Uncertainty for Safe Utilization of Machine Learning in Medical Imaging (UNSURE, MICCAI) (2021) pp. 14-23. Springer Publishing.
5. Automatic exploration of reduced floating-point representations in iterative methods
Yohan Chatelain, Eric Petit, Pablo de Oliveira Castro, Ghislain Lartigue, David Defour (2019, August).
In the European Conference on Parallel Processing (Euro-Par) (pp. 481-494). Springer, Cham.
6. VeriTracer: Context-enriched tracer for floating-point arithmetic analysis
Yohan Chatelain, Pablo de Oliveira Castro, Eric Petit, David Defour, Jordan Bieder, and Marc Torrent.
In 2018 IEEE 25th Symposium on Computer Arithmetic (ARITH) (pp. 61-68). IEEE

PREPRINTS

1. A numerical variability approach to results stability tests and its application to neuroimaging
Yohan Chatelain, Loïc Tetrel, Christopher J Markiewicz, Mathias Goncalves, Gregory Kiar, Oscar Esteban, Pierre Bellec, Tristan Glatard.
arXiv:2307.01373
2. Longitudinal brain structure changes in Parkinson's disease: a replication study
Andrzej Sokolowski, Nikhil Bhagwat, **Yohan Chatelain**, Mathieu Dugre, Alexandru Hanganu, Oury Monchi, Brent McPherson, Michelle Wang, Jean-Baptiste Poline, Madeleine Sharp, Tristan Glatard. bioRxiv:2023.04.28.538743
3. Predicting Parkinson's disease progression using MRI-based white matter radiomic biomarker and machine learning: a reproducibility and replicability study
Mohanad Arafe, Nikhil Bhagwat, **Yohan Chatelain**, Mathieu Dugre, Andrzej Sokolowski, Michelle Wang, Yiming Xiao, Madeleine Sharp, Jean-Baptiste Poline, Tristan Glatard. bioRxiv:2023.05.05.539590.
4. Numerical Stability of DeepGOPlus Inference
Ines Gonzalez Pepe, **Yohan Chatelain**, Gregory Kiar, Tristan Glatard. arXiv preprint arXiv:2212.06361.

COMMUNICATIONS AT INTERNATIONAL CONFERENCES (SUMMARY)

1. Testing the long-term reproducibility of fMRIPrep results.
Yohan Chatelain, Loïc Tetrel, Christopher J. Markiewicz, Gregory Kiar, Oscar Esteban, Pierre Bellec and Tristan Glatard. OHBM 2022, Glasgow, Scotland.
2. Fuzzy environments for the perturbation, evaluation, and application of numerical uncertainty via MCA in the scientific Python ecosystem.
Gregory Kiar, **Yohan Chatelain**, Ali Salari, Eric Petit, Pablo de Oliveira Castro, and Tristan Glatard. SciPy Conference, 2021.
3. Towards Abinit on ExaScale supercomputers: the challenge for electronic structure physicists
Jordan Bieder, Marc Torrent, and **Yohan Chatelain**. APS Meeting Abstracts. 2018

WORKSHOPS, TUTORIALS, AND SUMMER PROGRAMS

1. IXPUG 2019: Intel Extreme Performance Users Group, CERN, Geneva, Switzerland
2. IXPUG 2018: Intel Extreme Performance Users Group, Intel Corporation, Hillsboro, OR, USA
3. ESTN 2018: 8èmes École Thématique de Simulation Numérique, Cargèse, 2018
4. RAIM 2017: 9èmes Rencontres «Arithmétique de l'Informatique Mathématique», Lyon, 2017
5. ABIDEV 2017: The 8th ABINIT developer's workshop, Frejus, 2017

LANGUAGES

- French (Native)
- English (Professional)