Yohan Chatelain

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LINKEDIN - GOOGLE SCHOLAR - WEBSITE

SUMMARY

Postdoctoral Fellow at Concordia University, I specialize in high-performance computing, numerical analysis, neuroimaging, and artificial intelligence. My research is dedicated to improving the computational efficiency and reliability of scientific applications. By developing tools at the interface of numerical analysis and computational architecture optimizations, I aim at optimizing the performance and accuracy of computational applications across various scientific domains.

EXPERIENCE

09/2020 -

POSTDOCTORAL FELLOW, CONCORDIA UNIVERSITY – MONTRÉAL, QC, CANADA

Numerical stabililty evaluation in neuroimaging, bioinformatics and AI.

- Fast Stochastic Arithmetic instrumentation of Pytorch with LLVM IR (x100 speedup compare to standard approach)
- Numerical stablity evalution of CNN in bioinformatics and neuroimaging applications
- Improve the generalizability and robustness of MRI-derived biomarkers of Parkinson's Disease [w/ McGill]
- Providing a modular and scalable platform to analyze floating-point arithmetic [w/ ANR grant France]
- Evaluating and improve the reproducibility of scientific results in the field of medical imaging [w/ CNRS France]
- Statistical tests using numerical uncertainties to quantify acceptable variation bounds in MRI [w/ Udem, Lausanne, Standford]
- Numerical stability evaluation of human brain tractometry within PyAFQ, AccelNet IN-BIC funding [w/ University of Washington]
- Pytracer, a trace-based Python tool for visualizing numerical instabilities of Python codes
- Fuzzy, an ecosystem for evaluating the effect of numerical errors on computational tools [w/ UVSQ]
- Significantdigit, Python package for solid statistical analysis of stochastic arithmetic [w/ UVSQ]

10/2016 - 12/2019

PHD STUDENT, PARIS-SACLAY UNIVERSITY – VERSAILLES, FRANCE

Research and tool development in high-performance computing, focusing on computational reduction.

- VPREC, tool to simulate reduced floating-point formats [w/ Intel]
- VeriTracer, visualiser for numerical instabilities in clang-supported languages, integrated in Java IDE
- Verificarlo, clang-based compiler to instrument floating-point arithmetics operations (LLVM IR level) [w/ Intel]

01/2019 - 06/2019

SOFTWARE ENGINEER, INTEL – HILLSBORO, OR, US

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.

04/2016 - 09/2016

SOFTWARE DEVELOPER, UNIVERSITY OF VERSAILLES – VERSAILLES, FRANCE

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

05/2015 - 09/2015

SOFTWARE DEVELOPER, EXASCALE COMPUTING RESEARCH – BRUYÈRES-LE-CHÂTEL, FRANCE

Developed tool to specialise C code based on value profiling

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

03/2014 - 05/2014

SOFTWARE DEVELOPER, LRI – SACLAY, FRANCE

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

EDUCATION

- **PhD – Université Paris-Saclay, Versailles, France** 2019
  Title: "Tools for debugging and optimizing floating-point computations in HPC"
- **Master – Université Paris-Saclay, Versailles, France** 2016
  Field: High Performance Computing
- **Bachelor – Université Paris-Saclay, Orsay, France** 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 09/2023 -
  Concordia University - Montreal, QC, Canada
  Subject: "Numerical stability of deep learning in bioinformatics"
  Supervisor: Tristan Glatard, Mentoring: Gregory Kiar (50%)
- Mathieu DUGRE 09/2022 -
  Concordia University - Montreal, QC, Canada
  Subject: "Impacts of reduced precision for neuroimaging applications"
  Supervisor: Tristan Glatard
- Ali SALARI 10/2020 - 10/2022
  Concordia University - Montreal, QC, Canada
  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 09/2021 - 09/2023
  Concordia University - Montreal, QC, Canada
  Subject: "Numerical Stability of DeepGOPlus Inference"
  Supervisor: Tristan Glatard (50%)
- Damien THENOT 06/2018 - 09/2018
  Université Paris-Saclay - Versailles, France
  Subject: "Development of a Java IDE for Veritracer"
  Supervisor: Pablo de Oliveira Castro (50%)

UNDERGRADUATE LEVEL

- Nigel YONG 05/2021 - 06/2021
  Concordia University - Montreal, QC, Canada

Subject: "Optimizing performance of PyTracer"
Supervisor: Tristan Glatard (50%)

- Marc VICUNA **01/2021 - 05/2021**
  Concordia University - Montreal, QC, Canada
  Subject: "Reducing numerical precision preserves classification accuracy in Mondrian Forests"
  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 PyAFQ

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. **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. In PLOS ONE (2024).
3. **Numerical Stability of DeepGOPlus Inference**
   Ines Gonzalez Pepe, Yohan Chatelain, Gregory Kiar, Tristan Glatard. In PLOS ONE (2024).
4. **PyTracer: Automatically profiling numerical instabilities in Python**
   Yohan Chatelain, Nigel Yong, Gregory Kiar, Tristan Glatard. IEEE Transactions on Computers (IEEE TC) (2022).
5. **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.
6. **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).
7. **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. **The Impact of Hardware Variability on Applications Packaged with Docker and Guix: a Case Study in Neuroimaging**
   Gaël Vila, Emmanuel Medernach, Inés Gonzalez, Axel Bonnet, Yohan Chatelain, Michaël Sdika, Tristan Glatard, and Sorina Camarasu-Pop. 2024 - hal.science
2. **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)
3. **Reproducibility of tumor segmentation outcomes with a deep learning model**
   Morgane Des Ligneris, Axel Bonnet, Yohan Chatelain, Tristan Glatard, Michaël Sdika, Gaël Vila, Valentine Wargnier-Dauchelle, Sorina Pop, Carole Frindel. International Symposium on Biomedical Imaging (ISBI), 2023.
4. **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).
5. **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.
6. **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.
7. **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. **An Analysis of Performance Bottlenecks in MRI Pre-Processing**
   Mathieu Dugre, Yohan Chatelain, Tristan Glatard. arXiv:2405.17650
2. **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.

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, France
4. RAIM 2017: 9èmes Rencontres «Arithmétique de l'Informatique Mathématique», Lyon, France
5. ABIDEV 2017: The 8th ABINIT developer's workshop, Frejus, France

LANGUAGES

- French (Native)
- English (Professional)