TRISTAN MONTOYA

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EDUCATION

University of Toronto Expected completion early 2024
Doctor of Philosophy (PhD), Aerospace Science and Engineering

Direct transfer from Master of Applied Science (MASc) in September 2019

Carleton University 2014 – 2018
Bachelor of Engineering (BEng), Mechanical Engineering

University medalist (highest academic standing of any student completing an engineering degree)

RESEARCH INTERESTS

Numerical methods for partial differential equations; high-performance computing; spectral-element methods; discontinuous Galerkin methods; summation-by-parts operators; split-form and entropy-stable discretizations; data-driven analysis of dynamical systems; Koopman operator methods

RESEARCH EXPERIENCE

University of Toronto September 2018 – Present
Graduate Student Researcher

Thesis: "Discontinuous spectral-element methods with the summation-by-parts property: A unifying framework for provably stable discretizations of conservation laws"
Advisor: David W. Zingg

National University of Singapore August 2022
Visiting Researcher

Project: Data-driven stability analysis and control of numerical schemes using the Koopman operator
Advisor: Gianmarco Mengaldo

University of Toronto May 2017 – August 2017
Undergraduate Student Researcher

Projects: Optimization of finite-difference operators with the summation-by-parts property on non-uniform nodal distributions; comparison of pseudo-transient and homotopy-based continuation methods with application to aerodynamic shape optimization
Advisor: David W. Zingg

McGill University May 2016 – August 2016
Undergraduate Student Researcher

Project: Algorithms for robust deformation of unstructured grids in computational fluid dynamics
Advisor: Siva Nadarajah

Carleton University May 2015 – August 2015
Undergraduate Student Researcher

Projects: Optimal estimation of uncertain parameters in models of welding processes; novel interpolation techniques for stress and strain tensor fields using quaternions
Advisor: John A. Goldak

PUBLICATIONS IN PEER-REVIEWED JOURNALS

T. Montoya and D. W. Zingg, "A unifying algebraic framework for discontinuous Galerkin and flux reconstruction methods based on the summation-by-parts property." *Journal of Scientific Computing* 92(3), 2022. [pdf]

PUBLICATIONS IN CONFERENCE PROCEEDINGS

T. Montoya and D. W. Zingg, "Stable and conservative high-order methods on triangular elements using tensor-product summation-by-parts operators." *Eleventh International Conference on Computational Fluid Dynamics*, 2022 **(Awarded best student paper).** [pdf]

INVITED AND CONTRIBUTED TALKS (EXCLUDING ABOVE PROCEEDINGS)

T. Montoya and D. W. Zingg, "Efficient tensor-product spectral-element methods with the summation-by-parts property on triangles and tetrahedra." Accepted minisymposium presentation, *SIAM Conference on Computational Science and Engineering*, 2023. [abstract]

T. Montoya and D. W. Zingg, "Efficient and robust spectral-element methods on triangles using tensor-product summation-by-parts operators." Invited talk, *NASA Advanced Modeling and Simulation (AMS) Seminar Series*, 2022. [abstract]

T. Montoya and D. W. Zingg, "Unified analysis of discontinuous Galerkin and flux reconstruction methods based on the summation-by-parts property." Contributed talk, *International Conference on Spectral and High-Order Methods*, 2021. [abstract]

T. Montoya and D. W. Zingg, "Unified analysis of high-order methods based on the summation-by-parts property: Application to discontinuous Galerkin and flux reconstruction discretizations." Minisymposium presentation, *SIAM Conference on Computational Science and Engineering*, 2021. [abstract]

POSTER PRESENTATIONS

T. Montoya and S. Nadarajah, "Robust deformation of unstructured grids." *Summer Undergraduate Research in Engineering (SURE) Poster Presentation Fair*, McGill University, 2016.

AWARDS AND SCHOLARSHIPS

Best Student Paper, International Conference on Computational Fluid Dynamics	2022
Ontario Graduate Scholarship	2019 – 2020, 2022 – 2023
Kenneth Molson Fellowship	2021 – 2022
Queen Elizabeth II Graduate Scholarship in Science and Technology	2020 – 2021, 2021 – 2022
Douglas Patton Hogg Memorial Award	2021
NSERC Canada Graduate Scholarship - Master's	2018 – 2019
University Medal in Engineering	2018
Canadian Society for Mechanical Engineering Gold Medal	2018
Rajesh Ahluwalia Memorial Scholarship	2017 – 2018
NSERC Undergraduate Student Research Award	2015, 2017
McGill University Summer Undergraduate Research in Engineering Award	2016
Allan Buchanan Undergraduate Scholarship	2015 – 2016
Deans' Honour List	2014 – 2018
Faculty Scholarship	2014 – 2018

TECHNICAL SKILLS

Programming languages	Julia, Python, C, C++, MATLAB, Fortran, Bash, LaTeX
Parallel computing	OpenMP, MPI
Development tools	Unix shell, Git, GNU Make, Anaconda, Jupyter Notebook, VS Code, Vim, Emacs

SERVICE AND MENTORSHIP

Canadian Science Fair Journal June 2022 – Present
Editor, Physics and Mathematics Section

Volunteer editor and mentor for an open-access journal showcasing science projects by students at primary and secondary schools across Canada

Centre for Computational Science and Engineering December 2021 – Present
Lab Representative

Member of the student organizing committee for an interdepartmental group of researchers at the University of Toronto across various disciplines of computational science and engineering

Supervision of undergraduate research May 2019 – Present

Yewon Lee (BASc summer student, engineering science): A comparative evaluation of energy- and entropy-stable discontinuous Galerkin and summation-by-parts methods

Ruilin (Jerry) Bai (BASc summer student, engineering science): Optimization of summation-by-parts operators for minimal solution error

Reviewer for academic journals August 2022 – Present

Advances in Continuous and Discrete Models

OPEN-SOURCE SOFTWARE DEVELOPMENT

CLOUD.jl: Conservation Laws on Unstructured Domains October 2021 – Present

Julia implementation of provably stable discontinuous spectral-element methods on general element types based on multidimensional and tensor-product formulations; emphasis on dynamically dispatched strategies for matrix-based and matrix-free operator evaluation [link to GitHub repository]

GHOST: Generalized High-Order Solver Toolbox June 2019 – December 2021

Python implementation of discontinuous Galerkin and flux reconstruction schemes in one or two spatial dimensions with various design choices [link to GitHub repository]

OTHER ACTIVITIES

Music (performing guitarist and bassist), hiking, cycling, alpine skiing (former ski instructor)

REFERENCES

Available upon request