Martina **Iannacito** | Curriculum Vitae

Ph.D. in applied mathematics and scientific computing of the University of Bordeaux
✉ martina.iannacito@unibo.it • 🌐 martinaiannacito.github.io
• born 28th November 1995, Italian citizenship

Research activities

Alma Mater Studiorum - University of Bologna **Italy**
Postdoctoral researcher at the Mathematical Departement *April 2024 - now*
Member of V. Simonicini's research group
Keywords: matrix equations, tensor-based algorithms, iterative solver

Katholieke Universiteit Leuven **Belgium**
Postdoctoral researcher at the Science, Engineering and Technology faculty *May 2023 - March 2024*
Member of L. De Lathauwer's research group
Keywords: canonical polyadic decomposition, blind source separation, algebraic algorithms

Inria center at the university of Bordeaux **France**
Ph.D. student *October 2019 - December 2022*
Member of the Concace and HiePACS team
Keywords: numerical linear algebra, tensor computation, low-rank compression, data science

University of Trento **Italy**
Master's student *January 2019 - July 2019*
Member of the Mathematical Department
Keywords: tensor computation, remote sensing, biodiversity estimate

Education

Inria center at the university of Bordeaux **France**
Ph.D. in applied mathematics and scientific computing *October 2019 - December 2022*
Thesis supervised by O. Coulaud and L. Giraud
Defence date December the 9th, 2022

University of Trento **Italy**
Master's degree in mathematics for life and data science *December 2017 - July 2019*
Thesis supervised by A. Bernardi and D. Rocchini
Defence date July the 17th, 2019, Summa Cum Laude

University of Parma **Italy**
Bachelor in mathematics *October 2014 - December 2017*
Thesis supervised by A. Bandini
Defence date December the 14th 2017, Summa Cum Laude

Scientific High School G. Aselli **Italy**
Maturity diploma *September 2009 - July 2014*
Defence date July the 4th, 2014, Summa Cum Laude

Teaching activities

Alma Mater Studiorun - University of Bologna   **Italy**
Adjunct lecturer, 15 hours   *February 2025 - May 2025*
Computational Mathematics

Alma Mater Studiorun - University of Bologna   **Italy**
Tutor, 20 hours   *December 2025 - June 2025*
Principles of Mathematics II

KU Leuven - Bruges   **Belgium**
Adjunct lecturer, 6 hours   *January 2024 - March 2024*
Applied AI: Academic Perspectives, AI & Tensors

ENSEIRB-MatMeca   **France**
Adjunct lecturer, 47 hours   *March 2021 - May 2022*
Numerical algorithms

University of Trento   **Italy**
Tutor, 50 hours   *Januray 2019 - June 2019*
Statistical Learning: Statistical Models

Evaluation activities

Final Education Project   **ENSEIRB Bordeaux**
External jury member   *September 2022*

Master's students supervision

Kobe Sauwens   **KU Leuven**
Master's degree in mathematical engineering   *September 2023 - March 2024*
Thesis supervised by L. De Lathauwer and V. Rijmen
"Exploration of Polyadic Tensor Decomposition as a tool for public key cryptography"

Andreas Devogel   **KU Leuven**
Master's degree in mathematical engineering   *September 2023 - March 2024*
Thesis supervised by L. De Lathauwer
"Algebraic algorithms for tensor-based signal separation "

Internship students supervision

Léo Bertheas   **ENSEEIHT Toulouse**
Electrical and Electronics Engineering degree   *June 2021 - August 2021*
2nd year stage supervised by O. Coulaud, L. Giraud, and J. R. Poirier
"Solving the heat equation in Tensor Train format"

Publications

Thesis

[1] Iannacito, M. (Dec. 2022). "Numerical linear algebra and data analysis in large dimensions using tensor format". PhD thesis. Inria center at the University of Bordeaux, France. URL: `theses.fr/s349733`.

[2] Iannacito, M. (July 2019). "HOSVD FOR MULTISPECTRAL IMAGES. A numerical approach to the plant biodiversity estimate." thesis. University of Trento, Italy. URL: webapps.unitn.it/Biblioteca/it/Web/RichiestaConsultazioneTesi/365719.

International journals

[1] Thouverai, E., M. Marcantonio, G. Bacaro, D. D. Re, M. Iannacito, E. Marchetto, C. Ricotta, C. Tattoni, S. Vicario, and D. Rocchini (Apr. 2021). "Measuring diversity from space: a global view of the free and open source rasterdiv R package under a coding perspective". In: *Community Ecology* 22.1, pp. 1–11. DOI: 10.1007/s42974-021-00042-x.

[2] Rocchini, D., M. Marcantonio, D. Da Re, G. Bacaro, E. Feoli, G. M. Foody, R. Furrer, R. J. Harrigan, D. Kleijn, M. Iannacito, J. Lenoir, M. Lin, M. Malavasi, E. Marchetto, R. S. Meyer, V. Moudry, F. D. Schneider, P. Šímová, A. H. Thornhill, E. Thouverai, S. Vicario, R. K. Wayne, and C. Ricotta (Mar. 2021). "From zero to infinity: Minimum to maximum diversity of the planet by spatio-parametric Rao's quadratic entropy". In: *Global Ecology and Biogeography* 30.5, pp. 1153–1162. DOI: 10.1111/geb.13270.

[3] Rocchini, D., E. Thouverai, M. Marcantonio, M. Iannacito, D. Da Re, M. Torresani, G. Bacaro, M. Bazzichetto, A. Bernardi, G. M. Foody, R. Furrer, D. Kleijn, S. Larsen, J. Lenoir, M. Malavasi, E. Marchetto, F. Messori, A. Monkeywordhi, V. Moudrý, B. Naimi, C. Ricotta, M. Rossini, F. Santi, M. J. Santos, M. E. Schaepman, F. D. Schneider, L. Schuh, S. Silvestri, P. Šímová, A. K. Skidmore, C. Tattoni, E. Tordoni, S. Vicario, P. Zannini, and M. Wegmann (Feb. 2021). "rasterdiv—An Information Theory tailored R package for measuring ecosystem heterogeneity from space: To the origin and back". In: *Methods in Ecology and Evolution* 12.6, pp. 1093–1102. DOI: 10.1111/2041-210X.13583.

National journals

[1] Bernardi, A., M. Iannacito, and D. Rocchini (Dec. 2021). "High order singular value decomposition for plant diversity estimation". In: *Bollettino dell'Unione Matematica Italiana* 14.4, pp. 557–591. DOI: 10.1007/s40574-021-00300-w.

Under review

[1] Coulaud, O., L. Giraud, and M. Iannacito (Nov. 2022). *On some orthogonalization schemes in Tensor Train format*. Research Report RR-9491. Inria center at the University of Bordeaux. URL: hal.archives-ouvertes.fr/hal-03850387.

[2] Agullo, E., O. Coulaud, L. Giraud, M. Iannacito, G. Marait, and N. Schenkels (Sept. 2022). *The backward stable variants of GMRES in variable accuracy*. Research Report RR-9483. Inria center at the University of Bordeaux, pp. 1–77. URL: https://hal.science/hal-03776837.

[3] Coulaud, O., L. Giraud, and M. Iannacito (Sept. 2022). *A robust GMRES algorithm in Tensor Train format*. Research Report RR-9484. Inria center at the University of Bordeaux, pp. 1–48. URL: https://hal.science/hal-03776529.

Preprints

[1] Coulaud, O., A. Franc, and M. Iannacito (Nov. 2021). *Extension of Correspondence Analysis to multiway data-sets through High Order SVD: a geometric framework*. Research Report RR-9429. Inria center at the University of Bordeaux; INRAE. URL: https://hal.science/hal-03418404.

Invited talks at national conferences

[1] Iannacito, M., O. Coulaud, and L. Giraud (June 2023). "Orthogonalization schemes in Tensor Train format". In: *Approximate computing in numerical linear algebra*. Ed. by N. Higham, X. Liu, and B. Vieublé. University of Strathclyde Glasgow. Glasgow, United Kingdom: 29th Biennial Conference on Numerical Analysis.

Invited talks at international conferences

[1] Iannacito, M., O. Coulaud, and L. Giraud (May 2024). "Orthogonalization schemes in tensor train format". In: *Approximate Computing Techniques for Orthogonalization Processes*. Ed. by B. Vieublé and O. Balabanov. Paris, France: SIAM Conference on Applied Linear Algebra.

[2] – (July 2023). "On Some Orthogonalization Schemes in Tensor Train Format". In: *Geometry in Optimization and Numerical (Multi)Linear Algebra*. Ed. by U. Konstantin and Y. Qi. Eindhoven / Hybrid, Netherlands: SIAM Conference on Applied Algebraic Geometry.

[3] Iannacito, M., O. Coulaud, and A. Franc (Sept. 2022). "Extension of Correspondence Analysis to multiway data-sets through HOSVD: a geometric framework". In: *Tensor Decompositions for Data Science*. Ed. by R. Minster and N. Vannieuwenhoven. San Diego / Hybrid, United States: SIAM Conference on Mathematics of Data Science.

Invited talks at workshops

[1] Iannacito, M., L. De Lathauwer, and I. Domanov (Sept. 2023). "An algebraic algorithm for blind source separation and tensor decomposition". In: *Matrix Equations and Tensor Techniques X*. Ed. by P. Benner, H. Faßbender, L. Grasedyck, D. Kressner, B. Meini, and V. Simoncini. Aachen, Germany.

[2] – (Aug. 2023). "An algebraic algorithm for blind source separation and tensor decomposition". In: *New Directions in Applied Linear Algebra*. Ed. by J. Cockayne, J. Pearson, J. Pestana, D. Silvester, and V. Simoncini. Banff, Canada: Banff International Research Station.

[3] Iannacito, M., E. Agullo, O. Coulaud, L. Giraud, G. Marait, and N. Schenkels (Sept. 2022). "GMRES in variable accuracy: a case study in low rank tensor linear systems". In: *GAMM - Workshop on Applied and Numerical Linear Algebra 2022*. Ed. by E. Carson, I. Hnětynková, S. Pozza, P. Tichý, and M. Tůma. Prague, Czech Republic.

Invited talks at seminars

[1] Iannacito, M. (Apr. 2024). "Potential and applications of tensor-based algorithms". In: Scube. Bologna, Italy: Department of Mathematics, Alma Mater Studiorum.

[2] – (Dec. 2023). "Tensor-based algorithms: applications and challanges". In: Algorithmes Parallèles et Optimisation team. Toulouse, France: ENSEEIHT.

[3] – (Nov. 2023). "Introduzione ai tensori: dalle applicazioni alle sfide contemporanee". In: Pisan Young Seminars in Applied and NUmerical Mathematics. Pisa, Italy: Mathematical departement of Pisa University.

[4] – (Nov. 2023). "Discovering tensors: their challenges and applications". In: TensorDay 2023. Trento, Italy: Mathematical departement of Trento University.

[5] Iannacito, M., L. De Lathauwer, and I. Domanov (Oct. 2023). "From blind source separation to tensor decomposition: an algebraic algorithm". In: NUMA seminars. Leuven, Belgium: Computer science departement of KU Leuven.

[6] Iannacito, M., O. Coulaud, and L. Giraud (Feb. 2022). "Solving linear systems in high dimension with TT-GMRES". In: Working group on tensors. Bordeaux, France: Inria center at the University of Bordeaux.

[7] Iannacito, M., O. Coulaud, and A. Fran (May 2020). "Malabar dataset: data analysis in tensor format". In: Working group on tensors. Bordeaux, France: Inria center at the University of Bordeaux.

Scholarships and awards

Invited speaker at 5-days workshop *2023*
Banff International Research Station

Early Career Travel Awards *2023*
Society of Industrial and Applied Mathematics

Best mathematical Master's thesis *2019*
Mathematics departement at the University of Trento

Resistenza's university scholarship *2015*
City of Cremona

Elide Rossi's university scholarship *2014 - 2018*
Scientific High School Gaspare Aselli of Cremona

Bonus 100 e lode *2014*
Italian Ministry of Education, University and Research

Blood volunteers donors' scholarship *2014*
Associazione Volonari Italiani del Sangue of Cremona

University orientation activity for talented high school students *2014*
Scuola Normale Superiore of Pisa

Andrea Mascherpa's high school scholarship *2010 - 2013*
Scientific High School Gaspare Aselli of Cremona

Blood volunteers donors' children scholarship *2010 - 2013*
Associazione Volonari Italiani del Sangue of Cremona

Training activities

High Performance Numerical Simulation **Inria Bordeaux**
Plenary courses and hands-on sessions *2019*
Simulation of an harmonic wave propagation,
from modelling to implementation in an HPC framework

Software

Rasterdiv   *2020*
Methods to calculate indices of diversity on numerical matrices based on information theory

IT skills

Languages	`python, MATLAB, R`
OS	`Linux, Windows`
Collaborative tools	`GitHub, GitLab`

Languages

English	Read, written, spoken	*Cambridge ESOL FCE (B2) in 2013*
French	Read, written, spoken	*Diplôme d'études en langue française (B1) in 2012*
Italian	Read, written, spoken	*Native*

Leaves

Sickness leave   *January 2023 - May 2023*

Doctorate

Title	Numerical linear algebra and data analysis in large dimensions using tensor format
Defence	December 9th, 2022 in the Inria center at the university of Bordeaux
Advisors	Olivier Coulaud, researcher at the Inria center at the university of Bordeaux Luc Giraud, researcher at the Inria center at the university of Bordeaux
Jury	Alain Franc, researcher at the INRAE center Daniel Kressner, full professor at EPFL, REVIEWER Karl Meerbergen, full professor at KU Leuven, REVIEWER Anthony Nouy, professor at Nantes University Valeria Simoncini, full professor at Bologna University Nick Vannieuwenhove, associate professor at KU Leuven
Key words	tensor calculus, low-rank compression, numerical linear algebra, data analysis

Abstract

This work aims to establish which theoretical properties of classical linear algebra techniques, developed in two different contexts, namely numerical linear algebra and data analysis, are maintained and which are lost when extended to low-rank tensors.

In the numerical linear algebra part, we experimentally study the effects of rounding errors on an iterative solver (Generalised Minimal RESidual) and several orthogonalization methods (Classical and Modified Gram-Schmidt and Householder transformation, among others) when extended to tensors by the Tensor Train (TT) formalism. In all the considered algorithms, we introduce additional rounding steps, with the TT-rounding compression algorithm, to cope with memory constraints, which are always crucial when dealing with tensors. Our experimental tests suggest that for these algorithms, the classical bounds due to the propagation of rounding errors remain valid, replacing the accuracy of the arithmetic with that of the TT-rounding algorithm.

In the data analysis part, we geometrically study the generalization of correspondence analysis to multi-way tables by the Tucker tensor decomposition technique, thus contributing to the understanding of Multi-Way Correspondence Analysis (MWCA). Examples of MWCA applied to datasets complement the theoretical results. In particular, we perform the MWCA on an original ecological dataset provided to us in the framework of the Malabar project of the BioGeCo (INRAE) and Pleiade (Inria) teams.