# Emanuele Zangrando

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## Academic Interests

My main area of interest is numerical optimization methods for deep learning, with a particular focus on Riemannian and bilevel methods. I also have a strong interest in implicit biases of optimization, mechanisms of feature learning in deep neural networks, global guarantees for non-convex optimization through hidden convexity methods, and Hessian-free methods. On the side of applications, my main interest is deep learning for scientific computing acceleration.

## Education

- **Gran Sasso Science Institute**, PhD program in Mathematics.                    2022-2026 (Expected)
    - Four-year PNRR scholarship on low-parametric and energy-efficient machine learning.
    - Scientific Advisor: Prof. Dr. Francesco Tudisco, in collaboration with Dr. Gianluca Ceruti.
    - Mandatory courses: Numerical Analysis, Computational fluid-dynamics, Statistical mechanics, Continuum mechanics, and PDEs.

- **University of Padova**, MSc in Data Science (Mathematics of Data Science curriculum).                    2020 - 2022
    - Thesis title: "Dynamical low-rank training of neural networks", advised by Prof. Dr. Francesco Rinaldi and Prof. Dr. Francesco Tudisco.

- **University of Padova**, BSc in Mathematics.                    2016 - 2020
    - Thesis title: "Modeling attention dynamics in social networks", advised by Prof. Dr. Marco Formentin.

## Experience

**Visiting period**, University of Edinburgh, UK                    September - January 2024
- Working on implicit biases of common optimization methods in deep learning and Riemannian methods for large-scale optimization.

**Visiting period**, University of Innsbruck, Austria.                    April - July 2024
- Investigating the efficiency of classical time-dependent variational principles coupled with neural network representations to approximate the solution of evolutionary PDEs for plasma physics problems.

**Master thesis internship**, Gran Sasso Science Institute, Italy.                    January - June 2022
- Working on variational methods to efficiently train low-rank compressed neural networks.

## Publications

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| **GeoLoRA: Geometric integration for parameter efficient fine-tuning** ↗ | ICLR 2025 |
| S. Schotthöfer *E. Zangrando*, G. Ceruti, F. Tudisco, and J. Kusch | |
| **dEBORA: Efficient Bilevel Optimization-based low-Rank Adaptation** ↗ | ICLR 2025 |
| *E. Zangrando*, S. Venturini, F. Rinaldi, and F. Tudisco | |
| **Geometry-aware training of factorized layers in tensor Tucker format** ↗ | NeurIPS 2024 |
| *E. Zangrando*, S. Schotthöfer, G. Ceruti, J. Kusch, and F. Tudisco | |
| **Robust low-rank training via approximate orthonormal constraints** ↗ | NeurIPS 2023 |
| D. Savostianova, *E. Zangrando*, G. Ceruti, and F. Tudisco | |
| **HIJACK: Learning-based Strategies for Sound Classification Robustness to Adversarial Noise** ↗ | IEEE SMARTCOMP 2023 |
| D. Sweet, *E. Zangrando*, F. Meneghello | |

**Low-rank lottery tickets: finding efficient low-rank neural networks via matrix differential equations** ⌕

NeurIPS 2022

S. Schotthöfer, *E. Zangrando*, J. Kusch, G. Ceruti, and F. Tudisco

## Preprints

**Provable Emergence of Deep Neural Collapse and Low-Rank Bias in $L^2$-Regularized Nonlinear Networks** ⌕

ArXiv 2025

*E. Zangrando*, P. Deidda, S. Brugiapaglia, N. Guglielmi, and F. Tudisco

**Low-rank adversarial PGD attack** ⌕

ArXiv 2024

D. Savostianova, *E. Zangrando*, and F. Tudisco

## Talks, seminars and Posters

- "Emergence and Stability of Deep Neural Collapse", YAMC, Padua, September 2025.

- "GeoLoRA: Geometric integration for parameter efficient fine-tuning", ICLR poster presentation, Singapore, April 2025.

- "dEBORA: Efficient bilevel optimization-based low-rank adaptation", ICLR poster presentation, Singapore, April 2025.

- "Deep learning for model order reduction in partial differential equations", GIMC-SIMAI young workshop, Naples, July 2024.

- "Online low-rank neural network compression", GIMC-SIMAI young workshop, Naples, July 2024.

- "Dynamical low-rank training of neural networks", SIAM Conference on Applied Linear Algebra (LA24), Paris, May 2024.

- "Robust low-rank training via approximate orthonormal constraints", NeurIPS poster presentation, New Orleans (USA), December 2023.

- "Dynamical low-rank training of neural networks", 2gg Algebra Lineare Numerica, L'Aquila, May 2023.

- "Low-rank lottery tickets: finding efficient low-rank neural networks via matrix differential equations", NeurIPS poster presentation, New Orleans (USA), December 2022.

- "Dynamical low-rank training of neural networks",Sciences - Computing - Data - Mathematics Seminar (SCDM), Karlsruhe Institute of Technology (Germany), November 2022.

- "Dynamical low-rank training of neural networks", GIMC-SIMAI young workshop, University of Pavia (Italy), September 2022.

## Awards

NeurIPS 2025 top reviewer, NeurIPS 2023 scholar award, NeurIPS 2022 scholar award.

## Professional Service

- Reviewing for ICML, ICLR, NeurIPS, AISTATS, AAAI, Scientific Reports, SIAM Journal on Optimization.

- Organization of events: MS in SIAMLA (Paris, May 2024), MS in YAMC (Padua, September 2025).

## Technologies

**Languages:** Python, R, Wolfram Mathematica, Matlab. Basic amatorial knowledge of C. As Markup, good knowledge of LaTeX.

**Technologies:** Torch, JaX, Keras, Tensorflow and TensorFlow Probability, Bash, HPC, Git.