Ziyad Oulhaj

PhD Student · Statistics and Topology for Data Science

Laboratoire de Mathématiques Jean Leray, Nantes, France

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Research Summary

PhD student in applied mathematics specializing in topological data analysis and statistical learning. My research focuses on the theoretical and computational aspects of the Mapper algorithm. I am particularly interested in the statistical analysis of topological signatures, such as persistent homology, as well as in connecting tools from optimal transport, geometry, and statistics to design robust methods for high-dimensional data analysis.

Education

Nantes Université - École Centrale Nantes - Laboratoire de Mathématiques Jean Leray *Nantes, France*

PhD in Applied Mathematics: *Statistical Contributions to the Mapper Algorithm* *2023 - present*

- Advisors:
  - Bertrand Michel (Nantes Université - École Centrale Nantes)
  - Mathieu Carrière (DataShape - Centre Inria d'Université Côte d'Azur)

Nantes Université - École Centrale Nantes *Nantes, France*

Engineering Degree (Master's degree) *2020 - 2023*

- Statistics
- Machine Learning
- Topological Data Analysis
- Probability theory and Stochastic Processes

Lycée Technique - Mohammédia *Casablanca, Morocco*

Classe préparatoire (Undergraduate) *2018 - 2020*

- Mathematics
- Physics

Professional Experience

Fujitsu Limited *Kawasaki, Japan*

R&D Internship: *Topological data analysis methods for protein dynamics* *2023 (6 months)*

- Topological Data Analysis
- Machine Learning

INRAE - AgroParisTech *Paris, France*

Research Internship: *Late spring frost risk analysis in the context of climate change* *2022 (5 months)*

- Extreme Value Modeling
- Markov Chain Monte Carlo methods

Publications

Published

Ziyad Oulhaj, Mathieu Carrière, and Bertrand Michel. Differentiable Mapper for Topological Optimization of Data Representation. The Forty-first International Conference on Machine Learning (ICML 2024).

Ziyad Oulhaj, Yoshiyuki Ishii, Kento Ohga, Kimihiro Yamazaki, Mutsuyo Wada, Yuhei Umeda, Takashi Kato, Yuichiro Wada, and Hiroaki Kurihara. Deep Mapper: Efficient Visualization of Plausible Conformational Pathways. 27th European Conference on Artificial Intelligence (ECAI 2024).

In Review

Ziyad Oulhaj, Mathieu Carrière, and Bertrand Michel. Gromov-Wasserstein Bound between Reeb and Mapper Graphs.

Presentations

2024. Differentiable Mapper for Topological Optimization of Data Representation.

- International Conference on Machine Learning (ICML 2024) Oral Presentation (Top ∼6%). Vienna, AT
- 55ièmes Journées de Statistique. Bordeaux, FR
- ANR GeoDSIC meeting. Nantes, FR
- DataShape Seminar. Porquerolles, FR

2025. Gromov-Wasserstein Bound between Reeb and Mapper Graphs.

- Geometry in Data Workshop: Statistical Inference and Methodology. Nantes, FR
- DataShape Seminar. Orsay, FR
- Latin American Congress of Probability and Mathematical Statistics. Montevideo, UY

Teaching Experience

2023-2026	**Probability and Statistics - *Graduate***, Teaching Assistant	*École Centrale Nantes*
2024-2026	**Statistical Learning - *Graduate***, Teaching Assistant	*École Centrale Nantes*

Outreach

Paper Review

2024-2025. Paper Review for Symposium on Computational Geometry

Mathematics Mentoring

2024-2026. Guided high school students in mathematics workshops, as part of the *MATh.en.JEANS* initiative.

Conference Organization

2025. Co-organized *les Rencontres Doctorales Lebesgue*, a conference geared towards PhD students in France