

GABRIEL TRINDADE

Holding a bachelor's degree in Physics from the Institute of Physics of São Carlos (IFSC-USP), the student completed the master's degree at the Institute of Mathematical and Computational Sciences (ICMC-USP) in the area of differential geometry. Currently, he is a PhD candidate in Physics at the Fresnel Institute and Aix-Marseille University (AMU), working on geometric information theory and its applications in light polarization. His experience includes research in Ricci flow on surfaces, information geometry, and real hyperbolic geometry.

CONTACT

- ✉ gabriel.trindade@etu.univ-amu.fr
- ✉ trindade@fresnel.fr
- 📍 Aix-Marseille Université, Institut Fresnel Laboratory Phyti
52, Av. Escadrille Normandie Niemen
13013 - Marseille, France
- 🌐 gabrielrtrindade.com
- 📘 LinkedIn
- 🔗 Google Scholar
- 🆔 Orcid - 0000-0001-5476-6771
- 🔑 Lattes - 6409479129700945

LANGUAGES

Portuguese	Native
English	Advanced
French	Intermediate
Spanish	Basic

TECHNICAL SKILLS

Mathematica	Version 14.3
Python 3	Version 3.9.6
InkScape	Version 1.4.2
Zotero	Version 7.0.29
LaTeX	

TOPICS OF INTEREST

- Geometric information theory and information geometry
- Computational geometry
- Learning on manifolds
- Affine-invariant geometry
- Matrix information geometry
- Statistical manifolds
- Geometric statistics for light polarization
- Light polarization theory
- Real hyperbolic geometry

EDUCATION

Bachelor in Physics

- 📅 2017 - 2021
- 📍 University of São Paulo (USP)
Institute of Physics of São Carlos - Brazil
- 📖 **Final work:** An introduction to Ricci flow on surfaces
- 👤 **Advisor:** Prof. Dr. Carlos Henrique Grossi Ferreira

Master's degree in Mathematics

- 📅 2021 - 2023
- 📍 University of São Paulo (USP)
Institute of Mathematics and Computer Sciences - Brazil
- 📖 **Master's thesis:** From statistical models to α -connections: an overview of information geometry
- 👤 **Advisor:** Prof. Dr. Carlos Henrique Grossi Ferreira

Ph.D. in Physics and Materials Science

Specialization in Theoretical and Mathematical Physics

- 📅 2024 - present
- 📍 University of Aix-Marseille (AMU)
Fresnel Institute - France
- 📖 **Ph.D. project:** Extrinsic statistics for complex covariance matrices and partially polarized light
- 👤 **Advisors:** Prof. Dr. Emmanuel Chevallier
Prof. Dr. André Nicolet

Professional Course in Information Technology

- 📅 2014 - 2016
- 📍 Paula Souza State Center for Technological Education (CEETEPS) - Brazil

PROJECTS AND RESEARCH ACTIVITIES

Introduction to Ricci flow

- 📅 2020 - 2020
- 📍 University of São Paulo (USP)
Institute of Physics of São Carlos - Brazil
- 📖 **Description:** This undergraduate project focused on studying prerequisites for understanding the Ricci flow, covering results from analysis on smooth manifolds, tensor calculus, and Riemannian geometry.
- 👤 **Advisor:** Prof. Dr. Carlos Henrique Grossi Ferreira
- 🏛️ Funded by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

An introduction to Ricci flow on surfaces

📅 2020 - 2021

📍 University of São Paulo (USP)

Institute of Physics of São Carlos - Brazil

📖 **Description:** This project aimed to study results of the Ricci curvature flow on surfaces, focusing on those with non-positive Euler characteristic and providing qualitative insights into this flow in three dimensions

👤 **Advisor:** Prof. Dr. Carlos Henrique Grossi Ferreira

🏛️ Funded by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)

From statistical models to α -connections: an overview of information geometry

📅 2021 - 2023

📍 University of São Paulo (USP)

Institute of Mathematics and Computer Sciences - Brazil

📖 **Description:** This project consisted of a presentation on the information geometry, organized as a compilation of fundamental concepts and results in the field, as well as applications in quantum information theory for the calculation of geometric quantum speed limits. Thus, statistical models were studied from Riemannian geometry. Furthermore, finite information geometry was explored, starting from an extrinsic approach and introducing the α -geometry. Additionally, dualistic manifolds and statistical manifolds were investigated, and through this intrinsic approach to information geometry, flat information geometry was studied.

👤 **Advisor:** Prof. Dr. Carlos Henrique Grossi Ferreira

🏛️ Funded by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)

Extrinsic statistics for complex covariance matrices and partially polarized light

📅 2024 - present

📍 University of Aix-Marseille (AMU)

Fresnel Institute - France

📖 **Description:** This PhD research aims to develop new statistical tools for analyzing the polarization state of partially polarized light, represented by 2×2 complex Hermitian matrices. Traditional Euclidean methods are inadequate as they do not respect the transformations induced by Jones matrices modeling material interactions. To address this, the study will explore non-isometric embeddings into Euclidean spaces that align with these transformations. This approach will be applied to polarization and covariance matrices - including block-Toeplitz matrices from radar signal processing - to tackle problems involving random electromagnetic wave.

👤 **Advisors:** Prof. Dr. Emmanuel Chevallier

Prof. Dr. André Nicolet

🏛️ Funded by AMU - Ministère Enseignement Supérieur

TEACHING EXPERIENCE

Short course taught: An introduction to information geometry

📅 2023

🕒 Course load: 8 h

📍 University of São Paulo (USP)

Institute of Mathematics and Computer Sciences - Brazil

- Short course held during the Summer Program in Mathematics at ICMC-USP.
- The goal was to disseminate basic knowledge about information geometry among undergraduate students.
- The candidate produced introductory lecture notes on the topic, presents here.

AWARDS AND TITLES

Medal in the Brazilian Public School Mathematics Olympiad

🌟 2011 - Silver

🌟 2012 - Bronze

🌟 2013 - Silver

Medal in the Brazilian Public School Physics Olympiad

🌟 2014 - Bronze

🌟 2015 - Bronze

Honorable Mention in the Brazilian Public School Mathematics Olympiad

🌟 2014

🌟 2015

🌟 2016

REFERENCES

Emmanuel Chevallier

Professor at University of Aix-Marseille

PhD supervisor

✉️ emmanuel.chevallier@univ-amu.fr

André Nicolet

Professor at University of Aix-Marseille

Director of Ph.D. thesis

✉️ andre.nicolet@univ-amu.fr

Carlos Henrique Grossi Ferreira

Senior researcher at NeoSpace AI

Undergraduate, graduate, and master's thesis supervisor

✉️ grossi@icmc.usp.br

Diogo de Oliveira Soares Pinto

Professor at University of São Paulo

Undergraduate professor

✉️ dosp@ifsc.usp.br

COMPLEMENTARY FORMATION

➤ 2×2 matrices or split-quaternions: applied to the study of hyperbolic space

 Brazilian Mathematical Society (SBM)

 2024

 Course load: 4 h

➤ Generating functions and the counting of symmetric $(0, 1)$ Matrices

 Brazilian Mathematical Society (SBM)

 2024

 Course load: 4 h

➤ The differential geometry of domes: from ancient Western architecture to Brazilian indigenous constructions

 Brazilian Mathematical Society (SBM)

 2024

 Course load: 4 h

➤ Great Moments in the History of Mathematics

 University of São Paulos (USP)

 2022

 Course load: 15 h

➤ An Introduction to Percolation

 University of São Paulos (USP)

 2022

 Course load: 14 h

➤ Real Analysis

 University of São Paulos (USP)

 2021

 Course load: 60 h

➤ Differential geometry of curves and surfaces in Minkowski space

 Federal University of Paraíba (UFPB)

 2021

 Course load: 14 h

➤ Hyperbolic geometry without coordinates

 University of São Paulos (USP)

 2020

 Course load: 12 h

➤ Linear structures in geometry

 University of São Paulos (USP)

 2019

 Course load: 12 h

➤ Solution of the LSM for a (seemingly) insolvable problem

 University of São Paulos (USP)

 2019

 Course load: 6 h

➤ Introduction to general relativity

 Federal University of São Carlos (UFSCar)

 2018

 Course load: 4 h

➤ Junior Scientific Initiation Program

 Brazilian Olympiad of Public School Mathematics (OBMEP)

 2013

 Course load: 80 h

➤ Junior Scientific Initiation Program

 Brazilian Olympiad of Public School Mathematics (OBMEP)

 2012

 Course load: 80 h

EVENTS

➤ 7th International Conference on Geometric Science of Information

 Oral presentation: Fast equivariant k -means on SPD matrices using log-extrinsic means

 2025

... Type: Congress

 Saint-Malo - France

➤ 35th Brazilian Mathematical Colloquium

 2025

... Type: Meeting

 Rio de Janeiro - Brazil

➤ Fête de la Science

 Outreach presentation: La lumière et ses applications

 2025

... Type: Outreach event

 Marseille - France

➤ XXVIII Brazilian School of Probability

 2025

... Type: Congress

 Belo Horizonte - Brazil

➤ XI Biennial of Mathematics

 2024

... Type: Meeting

 São Carlos - Brazil

› XXI School of Differential Geometry

📅 2024

••• Type: Congress

📍 Diamantina - Brazil

› XXVII Brazilian School of Probability

📄 **Poster presentation:** Information geometry: when statistics meets geometry

📅 2024

••• Type: Congress

📍 Salvador - Brazil

› Geometry in Algebra and Algebra in Geometry VII

📄 **Poster presentation:** An overview of finite information geometry

📅 2023

••• Type: Congress

📍 Belo Horizonte - Brazil

› Workshop on Algebraic Topology and Applications

📅 2023

••• Type: Workshop

📍 São Carlos - Brazil

› XXIII Symposium on Mathematics for Undergraduate Students

📄 **Poster presentation:** Introduction to Ricci flow

📅 2020

••• Type: Symposium

📍 São Carlos - Brazil

› 10th Integrated Week of Undergraduate and Graduate Studies at the São Carlos Institute of Physics

📄 **Poster presentation:** An introduction to Ricci flow on surfaces

👤 Member of the organizing committee

📅 2020

••• Type: Symposium

📍 São Carlos - Brazil

“ PUBLICATIONS

Fast Equivariant K-Means on SPD Matrices Using Log-Extrinsic Means

Trindade, G., Chevallier, E., Nicolet, A., Nielsen, F. (2025, October). Fast Equivariant K-Means on SPD Matrices Using Log-Extrinsic Means. In International Conference on Geometric Science of Information (pp. 263-270). Cham: Springer Nature Switzerland.

📅 2025

[DOI](#)