Paolo Zuzolo

Personal Data

Name:	Paolo Zuzolo
Address:	Via San Felice 131, 40122, Bologna, Italy
Place and Date of Birth:	Benevento, Italy, 08 November 1994
Email:	paolo.zuzolo2@unibo.it

Scientific Education

03/2023 – present	PhD in Mathematics – University of Bologna Funded by UE-PNRR, CN HPC. **Interests:** Numerical Methods for Geometry Processing, Geometric Deep Learning, Spectral Methods, 3D Shape Analysis, Matching and Representation. **Supervisor:** Prof. S. Morigi
09/2016 – 12/2020	Master's Degree in Mathematics (Curriculum Applied Mathematics) – University of Bologna **Thesis (Computer Graphics):** *"Scientific Visualization of Astrophysical Simulations"* **Supervisors:** Prof. S. Morigi, Antonella Guidazzoli (Cineca), Silvano Imboden (Cineca), Dr. Giannandrea Inchingolo (UNIBO) **Graduation date:** 18/12/2020 **Grade:** 110/110 cum laude
09/2013 – 12/2016	Bachelor's Degree in Mathematics – University of Bologna **Thesis (Algebraic Geometry):** *"Punti semplici e doppi nelle curve proiettive piane"* **Supervisor:** Prof. M. Idà **Graduation date:** 21/12/2016 **Grade:** 110/110 cum laude

Abroad Research Activity

08/2025 – 11/2025	Visiting PhD Student, University of Siegen, Germany Research stay at the Computer Vision Group led by Prof. Dr. Michael Möller, in collaboration with the DFG Research Unit "Learning to Sense". Worked on shape matching and neural network training.

Work Experience

12/2020 – 02/2023	Developer and Computer Graphics Programmer, VISIT Lab (CINECA), Casalecchio di Reno, Bologna, Italy. Development of tools and workflows for cinematic and scientific visualizations and web-based 3D/VR/AR applications, including Digital Twin projects.
03/2020 – 09/2020	CG Programmer (Curricular Internship), University of Bologna Internship in preparation of MSc thesis in Cinematic Scientific Visualization at VISIT Lab (CINECA). The developed data processing pipeline model was presented at the Advanced School on Computer Graphics for Cultural Heritage, organized by the same group.

Selected Projects

2025	Multi-Scale Decomposition of Textile Surfaces for Virtual Design Non-structured participant in the INdAM-GNCS Research Project *Sparsification for Large-Scale Data Analysis and Processing*, PI: Martin Huska (UNIBO). Study of numerical methods for hierarchical macro/meso/micro decomposition of textile surfaces based on curvature-driven geometric flows.
03/2020 – 03/2022	Into The Unknown Parent project of *Fiber Of The Universe*, realised with the National Institute for Astrophysics (INAF) in collaboration with University of Bologna and Visit Lab (CINECA). Extended and applied the data processing pipeline, developed during the curricular internship, to new data and storyboards for longer immersive visualizations (yt1 yt2) presented at several italian exhibitions.
03/2020 – 12/2020	Fiber Of The Universe Cinematic Scientific Visualization project using astrophysical simulation data, in collaboration with the VISIT Lab (CINECA) and astrophysicist G. Inchingolo (University of Bologna), done during the curricular internship. Developed a scientific data processing pipeline to produce immersive visualizations for a general public.

Publications

D. Lazzaro, S. Morigi, and P. Zuzolo, "A physics-informed graph neural network for computing laplace–beltrami eigenfunctions on manifolds," *IEEE Access*, vol. 13, pp. 199 647–199 664, 2025. DOI: 10.1109/ACCESS.2025.3636289

D. Lazzaro, S. Morigi, and P. Zuzolo, "Learning intrinsic shape representations via spectral mesh convolutions," *Neurocomputing*, vol. 598, no. C, 2024, ISSN: 0925-2312. DOI: 10.1016/j.neucom.2024.128152

G. Inchingolo, P. Zuzolo, D. De Luca, *et al.*, "Into the (un)known: A science art journey of the cosmos data," in *Memorie della Società Astronomica Italiana*, vol. 94, Jan. 2023, p. 38. DOI: 10.36116/MEMSAIT_94n1.2023.38

A. Guidazzoli, S. Imboden, P. Zuzolo, *et al.*, "A flexible and adaptable workflow to develop and visualise industrial digital twins," in *Human-Computer Interaction – INTERACT 2021*, C. Ardito, R. Lanzilotti, A. Malizia, *et al.*, Eds., Cham: Springer International Publishing, 2021, pp. 259–263, ISBN: 978-3-030-85607-6

Conferences, Talks and Posters

4th International Conference on Subdivision, Geometric and Algebraic Methods, Isogeometric Analysis and Refinability in Italy (SMART) – Reggio Calabria, Italy – 28/09/2025–02/10/2025
Talk: *Geometric methods for analyzing macro-, meso- and micro-structure of textile surfaces.*

Mathematics for Machine Learning: Applications to PDEs and Related Fields – Ferrara, Italy – 24–26/03/2025
Poster: *A Physics-Informed Graph Neural Network for computing Laplace-Beltrami eigenpairs on manifolds.*

Young Applied Mathematicians Conference (YAMC) – Rome, Italy – 16–20/11/2024
Talk: *Spectral Features for 3D Shape Analysis.*

Geometric Deep Learning Workshop – University of Cambridge, UK – 10–12/06/2024
Poster: *G-GNN-based spectral shape descriptors.*

19th School of Computer Graphics for Cultural Heritage: AI and Cultural Heritage – 28/08/2023–01/09/2023
Seminar: *Artificial Intelligence and 3D models.*

SIMAI 2023 – 09/10/2023–13/10/2023
Talk in minisymposium: *GNN-based construction of Laplace-Beltrami Operator basis for intrinsic 3D Shape representation.*

"Realtà Virtuale e Realtà Aumentata per la diffusione della Scienza: nuove frontiere e nuove sfide" – Palermo, Italy – 28/11/2022–02/12/2022
Several talks on cinematic scientific visualization and Digital Twin applications, within the PRIN project *"Virtual Reality and Augmented Reality for Science, Education and Outreach" (VRAR)*.

Interact 2021 – 18th IFIP TC13 International Conference on Human-Computer Interaction – Bari, Italy – 30/08/2021–03/09/2021
Talk: workflow for the development of Digital Twin web applications.

Teaching Activity

2025 | **Co-Supervisor – Master's Degree Thesis in Mathematics**, University of Bologna.
Thesis title: *Normal Total Variation flow on discrete 2-dimensional manifolds and its application to surface decomposition*.

2025 | **Tutor – Student Project on Virtual Reality Application Development with Unity**, University of Bologna.
Supervised a student project on the design and implementation of a VR application using the **Unity** game engine.

2023 – 2025 | **Lecturer & Tutor – Fundamentals of Computer Graphics**, University of Bologna.
Master's level short course focused on usage of 3D Computer Graphics software **Blender**.
Topics included: modelling, shading, texturing, and rendering, with hands-on laboratory sessions.

Spring 2024 | **Tutor – Student Project on Deep Geometric Texture Synthesis**, University of Bologna.
Supervised a student project focused on deep learning techniques for geometric texture synthesis on 3D surfaces.

Spring 2024 | **Tutor – Mathematical and Machine Learning Methods in Imaging**, University of Bologna.
Conducted exercise sessions for MSc students on mathematical modelling and machine learning techniques for imaging.

Technical Skills

Programming and Scripting	**Python**: fair knowledge and autonomy of use **MATLAB**: familiarity with main tools **C++**: basic knowledge **Javascript ES6**: fair knowledge and autonomy of use
Scientific Libraries	`NumPy`, `SciPy`, `OpenCV`, `PyVista`
Graphics Libraries	Basic knowledge of `OpenGL` and `GLSL` Fair experience with `VTK` for scientific visualization Fair experience with `Verge3D` for web-based CG applications Basic knowledge and operational autonomy with `WebXR Device API` Fair experience with `ThreeJS` for optimized 3D web apps Basic knowledge of `D3` for interactive infographics
Web Development	**Python/Django**, `HTML5`, `Bootstrap 4.0`, `jQuery` Basic knowledge of `ReactJS 16`, `NodeJS`, `ExpressJS`, `ElectronJS`, `Socket.IO`
Deep Learning Libraries	Fair knowledge of `PyTorch` and `PyTorch Geometric`
Tools and IDEs	`PyCharm`, `Visual Studio Code` (Remote Development), `Vim` Version control: `SVN`, `Git` (basic knowledge)
Operating Systems & Containers	`Windows`, `Unix/Linux`, `Docker`
Technical Software	**Paraview**: management, filtering and rendering of main data structures; experience with plugin `TTK` (Topological Toolkit) **Blender**: modelling (including code-based), rasterization and ray-tracing, batch rendering, compositing and animation; experience with `BVTK-Nodes` add-on **Unreal Engine**: basic knowledge of tools and plugins for VR animation production
LaTeX	Knowledge of main packages and workflows for scientific writing

Scholarships and Grants

2025	**3-Month Research Scholarship – Center for Sensor Systems (ZESS)**, University of Siegen, Germany. Awarded for a research project on learning-based methods for shape matching and neural network training.

Membership

INDAM (Istituto Nazionale di Alta Matematica) – GNCS (National Group for Scientific Computing)

Language Skills

Italian: Native language
English: Full professional proficiency

Hobbies and Interests

Innovation and technology; visual arts and electronic music; running and cycling.

Date: 01-12-2025 **Signature:**