



FRANCESCO IOLI, PhD

Geomatics Researcher at CNR IRPI

I am a post-doctoral researcher at the **Research Institute for Geo-Hydrological Protection IRPI** at the Italian National Research Council (CNR). I specialize in **photogrammetry and geoinformatics for environmental monitoring**. My research bridges the gap between traditional photogrammetry and modern computer vision, with a focus on leveraging deep learning for image matching and automated 3D reconstruction pipelines. I have experience with multi-scale 4D monitoring, ranging from **low-cost terrestrial sensors** for high-frequency glacier dynamics to **satellite multi-view stereo** for regional mass balance studies (developed at the University of Zurich).

I have proven coding skills and experience with High-Performance Computing (HPC) for processing large-scale geospatial data. As a supporter of open science, I actively develop open-source tools. I have field expertise as a topographer and I am a certified UAV pilot.

1. PERSONAL DETAILS

📍 Turin, Italy

📅 03/09/1995

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🌐 github.com/franioli

🌐 francesco-ioli

🎓 Google Scholar

📈 H-Index: 12

PROGRAMMING

🐍 Python ★★★★★

📊 Matlab ★★★★★

🔧 C++ ★★★★★

📁 Bash/Shell ★★★★★

PHOTOGRAMMETRY & 3D

🖥 Agisoft Metashape

📷 Photomodeler

☁ CloudCompare

🖥 COLMAP · MicMac

📷 OpenMVG · OpenDroneMap

OTHER SOFTWARE

🌐 QGIS · ESRI ArcGIS

🔧 RTKLib · Leica Infinity

🎨 Photoshop · Lightroom

🖥 GIMP · Inkscape

🏠 AutoCAD

2. DEGREES

2021 – 2024 **PhD Environmental and Infrastructure Engineering**
Dept. of Civil and Environmental Engineering, Politecnico di Milano, 📍 Milan, Italy
Major in Geomatics. Grade: Cum Laude.
Thesis: *Multi-scale and Multi-temporal photogrammetry for Alpine Glacier Monitoring*. Supervisor: prof. L. Pinto, co-supervisor: prof. F. Nex.
I developed an image-based system with low-cost stereo cameras for short-term 4D glacier monitoring. I developed a software pipeline for daily 3D reconstruction with extreme-wide baseline between the stereo cameras using deep learning feature matching. I contributed to *Deep-Image-Matching*, a multi-view image matching library with deep learning for SfM. I applied UAV photogrammetry for structural health assessment, including automated crack detection on concrete bridges, and cultural heritage documentation.

2017 – 2020 **MSc Environmental and Land Planning Engineering**
Politecnico di Milano, 📍 Milan, Italy
Major in Land Monitoring and Diagnostics. Grade: 110L/110.
MSc Thesis: *Evaluation of Airborne Image Velocimetry approaches with low-cost UAVs in riverine environments*. Supervisors: Prof. Livio Pinto, Dr. Martin Detert. [Paper]

2014 – 2017 **BSc Environmental and Land Planning Engineering**
Politecnico di Milano, 📍 Milan, Italy
Grade: 102/110.

3. OTHER EDUCATION AND EXPERTISE

04/2022 – 07/2022 **Visiting PhD student**
University of Twente, ITC, 📍 Enschede, Netherlands
Developed a deep learning-based wide-baseline stereo matching workflow for 4D alpine glacier monitoring with low-cost time-lapse cameras. [Paper] [Code]

18 – 24/09/2022 **Summer School of Alpine Research**
University of Innsbruck, 📍 Obergurgl, Austria
Summer School *Close Range Sensing Techniques in Alpine Terrain* organized by Innsbruck University with ISPRS support. [Proceedings]

09/2019 – 02/2020 **Visiting student for MSc Thesis**
Dept. VAW, ETH Zürich, 📍 Zürich, Switzerland
I worked in the River Engineering group of the Laboratory of Hydraulics, Hydrology and Glaciology (VAW) at ETH Zürich to learn basics of Particle Image Velocimetry and the usage of UAVs for estimating river flow discharge by image analysis. Supervisor: Dr. Martin Detert.

2019 **Erasmus Exchange**
Aalto University, 📍 Helsinki, Finland
Exchange semester with courses in laser scanning, remote sensing, image processing, hydrological modelling.

TOOLS

PyTorch · OpenCV
Docker · Django
PostgreSQL · PostGIS
Raspberry Pi · Arduino
Git · LaTeX

OPERATING SYSTEMS

Linux · Windows

HPC INFRASTRUCTURE

Slurm workload manager
Virtualization
Proxmox · OpenStack (client)
Cloud Computing
DigitalOcean · Lambda.ai

4. LANGUAGE SKILLS

Italian: Native

English: Proficient

(IELTS Certificate C1 level in 2018)

5. CURRENT EMPLOYMENT

07/2025 – present **Post-doctoral Researcher - Stage II**
CNR IRPI, 📍 Turin, Italy

Developing automated low-cost image analysis workflows for glacier instability risk management at Planpincieux Glacier (Mont Blanc, Italy). Enhancing the current monitoring systems using terrestrial stereoscopic time-lapse cameras for kinematics detection, ice avalanche monitoring, and velocity computation via Digital Image Correlation and Structure-from-Motion techniques. Results directly support expert decision-making for glacier instability risk mitigation. Working on historical aerial photogrammetry for periglacier debris volume estimation.

6. PREVIOUS WORK EXPERIENCE

07/2025 – 12/2025 **External consultant (20%)**

University of Zurich, Dept. of Geography, 📍 Zurich, Switzerland

Finalized automated pipelines for regional-to-global scale Digital Elevation Model (DEM) reconstruction from satellite multi-view stereo for the Glambie-2 Glacier Mass Balance Intercomparison Exercise using UZH Slurm-based HPC clusters.

10/2024 – 06/2025 **Post-doctoral Researcher**

University of Zurich, Dept. of Geography, 📍 Zurich, Switzerland

Developed automated pipelines for large-scale DEM reconstruction using satellite multi-view stereo for regional glacier mass balance assessments.

2022 **Topographic technical consultant (part-time, 2 months)**

Prof. Alberto Bianchi

Topographic consultant for the Technical Consultant of Office and Part (CTU) R.G. 717/2019

2022 **Topographic technician (part-time, 5 months)**

Gini Telecom (private company)

UAV surveys for telecommunication antennas

2020 **Internship**

Dept. of Civil and Environmental Engineering, Politecnico di Milano, 📍 Milan, Italy

Performed topographic and UAV surveys for infrastructure health monitoring and territorial monitoring. Learnt basics of CAD modeling for technical drawing from 3D point clouds. Obtained A1/A3 and A2 UAV licenses with permission for flying in critical standard scenarios.

7. CAREER BREAKS

➤ No significant career breaks

8. RESEARCH FUNDING AND GRANTS

➤ **MSCA Postdoctoral Fellowships – Seal of Excellence** [2024, 2025]

Proposal Author for the *CryoLens* project proposal (Host institution: University of Twente, Supervisor: Prof. F. Nex; Secondment: Fondazione Montagna Sicura, Italy).

Awarded the MSCA Seal of Excellence in both calls with evaluation scores of 92.8% (2024) and 95.4% (2025). Although unfunded due to budgetary constraints, the evaluation process confirms the proposal's scientific excellence and I gained experience with EU funding schema and in writing competitive grant application.

➤ **MOHYCAM** — *Modified HYdrogeological hazards under complex ClimAte and environmental conditions: Monitoring activities and mitigation strategies* [2025–2027] (Fondazione Cariplo, Grant #2024-3388 *Territori Sicuri*, €677,735; PI: Prof. Livio Pinto, Politecnico di Milano). **Contributed to proposal writing.**

MOHYCAM project aims for addressing hydrogeological vulnerabilities at the Belvedere Glacier (Monte Rosa), by combining advanced glacier dynamics monitoring with community-based risk awareness strategies.

9. RESEARCH OUTPUTS

- **Total number of publications:** 24 (Source: Scopus).
- **Metrics:** H-index: 12, Total Citations: 272+ (as of Feb 2026).

- **Open Science:** 100% of recent research outputs (2020–2025) are available via Open Access (DOI links provided below).

Selected Publications (10 most significant):

1. F. Gaspari, F. Barbieri, R. Fascia, F. Ioli, L. Pinto, and F. Migliaccio. “Strategies for Glacier Retreat Communication with 3D Geo-visualization and Open Data Sharing”. In: *ISPRS International Journal of Geo-Information* 14.2 (2025), p. 75. [10.3390/ijgi14020075](https://doi.org/10.3390/ijgi14020075).
2. F. Ioli, N. Dematteis, D. Giordan, F. Nex, and L. Pinto. “Deep Learning Low-cost Photogrammetry for 4D Short-term Glacier Dynamics Monitoring”. In: *PFG – Journal of Photogrammetry, Remote Sensing and Geoinformation Science* (2024). [10.1007/s41064-023-00272-w](https://doi.org/10.1007/s41064-023-00272-w).
3. L. Morelli, G. Perda, F. Ioli, P. Trybała, A. Sterpin, S. Rigon, N. Sutherland, M. Medici, F. Remondino, and A. Vitti. “Co-registering Laser Scanning Point Clouds and Photogrammetric Images with Deep Learning Multi-Modal Matching”. In: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Vol. XLVIII-2/W8-2024. 2024, pp. 335–342. [10.5194/isprs-archives-XLVIII-2-W8-2024-335-2024](https://doi.org/10.5194/isprs-archives-XLVIII-2-W8-2024-335-2024).
4. L. Morelli, F. Ioli, F. Maiwald, G. Mazzacca, F. Menna, and F. Remondino. “Deep-Image-Matching: a Toolbox for Multi-view Image Matching of Complex Scenarios”. In: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Vol. XLVIII-2/W4-2024. 2024, pp. 309–316. [10.5194/isprs-archives-XLVIII-2-W4-2024-309-2024](https://doi.org/10.5194/isprs-archives-XLVIII-2-W4-2024-309-2024).
5. F. Gaspari, F. Barbieri, R. Fascia, F. Ioli, and L. Pinto. “An Open-Source Web Platform for 3D Documentation and Storytelling of Hidden Cultural Heritage”. In: *Heritage* 7.2 (2024), pp. 517–536. [10.3390/heritage7020025](https://doi.org/10.3390/heritage7020025).
6. L. Morelli, F. Ioli, R. Beber, F. Menna, F. Remondino, and A. Vitti. “COLMAP-SLAM: a Framework for Visual Odometry”. In: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Vol. XLVIII-1/W1-2023. 2023, pp. 317–324. [10.5194/isprs-archives-XLVIII-1-W1-2023-317-2023](https://doi.org/10.5194/isprs-archives-XLVIII-1-W1-2023-317-2023).
7. F. Ioli, A. Bianchi, A. Cina, C. De Michele, P. Maschio, D. Passoni, and L. Pinto. “Mid-Term Monitoring of Glacier’s Variations with UAVs: The Example of the Belvedere Glacier”. In: *Remote Sensing* 14.1 (2022), p. 28. [10.3390/rs14010028](https://doi.org/10.3390/rs14010028).
8. F. Ioli, A. Pinto, and L. Pinto. “UAV-Photogrammetry for Metric Evaluation of Concrete Bridge Cracks”. In: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Vol. XLIII-B2-2022. 2022, pp. 1025–1032. [10.5194/isprs-archives-XLIII-B2-2022-1025-2022](https://doi.org/10.5194/isprs-archives-XLIII-B2-2022-1025-2022).
9. F. Gaspari, F. Ioli, F. Barbieri, E. Belcore, and L. Pinto. “Integration of UAV-LiDAR and UAV-Photogrammetry for Infrastructure Monitoring and Bridge Assessment”. In: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Vol. XLIII-B2-2022. 2022, pp. 995–1002. [10.5194/isprs-archives-XLIII-B2-2022-995-2022](https://doi.org/10.5194/isprs-archives-XLIII-B2-2022-995-2022).
10. C. I. De Gaetani, F. Ioli, and L. Pinto. “Aerial and UAV Images for Photogrammetric Analysis of Belvedere Glacier Evolution in the Period 1977–2019”. In: *Remote Sensing* 13.18 (2021), p. 3787. [10.3390/rs13183787](https://doi.org/10.3390/rs13183787).

For a complete publication list, see [Scopus profile: scopus.com/authid/detail.uri?authorId=57219022961](https://scopus.com/authid/detail.uri?authorId=57219022961)

PhD Thesis:

- **PhD Thesis** (2024): *Multi-temporal and Multi-scale photogrammetry for Alpine Glacier Monitoring*. Politecnico di Milano. Grade: Cum Laude. [\[Handle\]](#)

Software, Datasets & Infrastructure:

- **Deep-Image-Matching** (Core Contributor): Toolbox for multi-view image matching with traditional and deep learning algorithms. [\[GitHub\]](#) [\[Paper\]](#)
- **ICEpy4D** (Lead Developer): Open-source Python toolkit for 4D glacier monitoring using Deep Learning photogrammetry. [\[GitHub\]](#) [\[Paper\]](#)
- **Belvedere Glacier Open Data & Web-GIS Platform**: Curated dataset (Zenodo DOI: [10.5281/zenodo.10817029](https://doi.org/10.5281/zenodo.10817029)) and interactive web platform for glacier documentation and storytelling. [\[Web-app\]](#)
- **Satellite Multi-View Stereo Pipeline**: Automated HPC workflow (Slurm) for regional-scale DEM reconstruction from satellite imagery, with applications in glacier mass balance (University of Zurich).
- **COLMAP-SLAM Framework** (Core contributor): Visual odometry system for real-time photogrammetric positioning. [\[GitHub\]](#) [\[Paper\]](#)

10. RESEARCH SUPERVISION AND LEADERSHIP EXPERIENCE

2024 – present	PhD Student Mentoring University of Zurich & CNR IRPI Mentoring and co-supervision of PhD candidates R. Pedrelli (UZH) and D. Cardone (CNR IRPI). Providing technical guidance on photogrammetric pipelines, satellite multi-view stereo, and glacier monitoring workflows.
2019 – 2024	MSc Thesis Co-supervisor Politecnico di Milano , 📍 Milan, Italy Co-supervised 6 Master’s theses in Environmental and Land Planning Engineering (2020–2024): • L. Cerina (2024): Analisi fotogrammetrica con immagini satellitari dell’evoluzione del Ghiacciaio del Belvedere (2009–2023) e impatto della colata detritica dell’agosto 2023. Supervisor: prof. L. Pinto. [link] • S. Bonora (2024): Progettazione e implementazione di un database georeferenziato per il monitoraggio del Ghiacciaio del Belvedere. Supervisor: prof. F. Migliaccio. [link] • I. Pincolini (2022): Digital image correlation for ice flow velocity estimation: a case study on the Belvedere glacier with UAV derived orthophotos. Supervisor: prof. L. Pinto. [link] • F. Barbieri (2021): Monitoraggio di aree alpine inaccessibili con fotogrammetria UAV low-cost. Supervisor: prof. L. Pinto. [link] • A. Pinto (2021): Tecniche fotogrammetriche da drone per la ricostruzione metrica di fessure su ponti in calcestruzzo. Supervisor: prof. L. Pinto. [link] • F. Ferrario (2020): Triangolazione aerea assistita da DGPS in fotogrammetria da UAV: sperimentazione di una soluzione a basso costo per il DJI Matrice 210 V2. Supervisor: prof. L. Pinto. [link]

2020 – 2021

Tutor for Alta Scuola Politecnica (ASP)

Politecnico di Milano & Politecnico di Torino

ASP is a joint degree program between Politecnico di Milano and Politecnico di Torino restricted to 150 talented students, selected among the applicants to MSc students in Engineering, Architecture and Design at the two universities based on their merits. Tutor for the ASP project KuoLeva Jäätikko focusing on designing and implementing from scratch a monitoring system using a time-lapse camera network using low-cost hardware with (Raspberry and Arduino) to track the volumetric decline of Belvedere Glacier (www.asp-poli.it/kuoleva-jäätikko).

11. TEACHING MERITS

2020 – 2024

Teaching Assistant (TA)

Politecnico di Milano , Milan, Italy

Provided academic support and independent lecturing for the following BSc and MSc courses:

Photogrammetry and UAV Surveying (MSc) | Fall 2024 (10 ECTS)

Professor: Mirko Reguzzoni

Role: 25 hours of independent lectures, material preparation, and student assessment (~50 students).

Activities: Lab and exercises on photogrammetric data acquisition, processing, and statistical evaluation.

Tools: Agisoft Metashape, Photomodeler, Matlab for data processing and visualization.

Statistics – Trattamento delle Osservazioni (BSc) | 2020 – 2023 (8 ECTS)

Professor: Barbara Betti (2020-2021) – Giovanna Venuti (2022-2023)

Role: 21-24 hours/year of frontal lectures and laboratory tutoring (~120-150 students).

Activities: Lectures on probability basics, laboratory on data cleaning, statistical inference, and least-squares model fitting.

Tools: Matlab for data exploration and statistical inference.

3D Modelling for Architecture (BSc/MSc) | 2020 – 2022 (4 ECTS)

Professor: Livio Pinto

Role: 10 hours of independent lectures and field survey coordination (~20 students).

Activities: Methodological and technological aspects of 3D surveying; practical building surveys with UAV and TLS; training on point cloud analysis, 3D representation, and professional terminology.

Tools: Agisoft Metashape, CloudCompare, TLS and UAV instrumentation.

GIS – Sistemi Informativi Territoriali (BSc) | 2020 – 2021 (8 ECTS)

Professor: Federica Migliaccio

Role: 18 hours of laboratory sessions and course assignment reviews (~100 students).

Activities: Laboratory lessons using realistic case studies to teach core GIS software functionalities.

Tools: QGIS, ArcGIS.

2021 – 2025

Tutor in Summer Schools

Politecnico di Milano , Belvedere Glacier, Macugnaga, Italy

Design and Implementation of Topographic Surveys for Territorial Monitoring in Mountain Environments at the Belvedere Glacier aimed at introducing BSc and MSc students to topographic fieldwork in mountain environments.

2023

EGU Higher Education Teaching Grant 2023

EGU

Winner of the [EGU Higher Education Teaching Grant 2023](#) for the open teaching material for the Summer School "Design and implementation of topographic surveys for territorial monitoring in mountain environments" [[Teaching material](#)]

12. AWARDS AND HONOURS

▶ Winner of the prize for young researchers *Premio Giovani 2023 – Sezione Ricerca* organized by the Italian Society of Photogrammetry and Topography SIFET during the congress *65° Convegno Nazionale SIFET*, with the contribution *Monitoraggio 4D ad alta frequenza di ghiacciai alpini tramite camere time-lapse a basso costo e Deep Learning Structure-from-Motion*.

▶ Finalist in the [EGU2024 Photo Competition](#)

13. OTHER KEY ACADEMIC MERITS

Presentations in Scientific Conferences

- **2025:** EGU - Wien (oral) [[Abstract](#)], Alpine Glaciological Meeting - Innsbruck (poster) [[Abstract](#)].
- **2024:** EGU - Wien (oral) [[Abstract](#)].
- **2023:** EGU - Wien (oral) [[Abstract](#)], ISPRS Geospatial Week - Cairo (oral) [[Paper](#)], VGC Dresden (oral) [[Proceedings](#)], SIFET congress - Arezzo (IT) (oral) [[Link](#)], GeoAI - Torino (IT) (oral) [[Link](#)].
- **2022:** EGU - Wien (oral) [[Abstract](#)], ISPRS Congress - Nice (poster) [[Paper](#)].

Memberships & Peer Review

- Reviewer for: *ISPRS Journal of Photogrammetry and Remote Sensing*, *Remote Sensing (MDPI)*, *Drones (MDPI)*, *Earth Surface Dynamics*, *Geoscientific Instrumentation, Methods and Data Systems*
- Member of: EGU (European Geosciences Union), SIFET (Italian Society of Photogrammetry and Topography).

14. SCIENTIFIC AND SOCIETAL IMPACT

Open-science outputs (software, datasets, open-access publications) are reported in Section 9. This section highlights selected outreach and engagement activities.

2025–Present	Scientific Volunteer Active member of the non-profit volunteer organization dedicated to the scientific research and monitoring of the Alpine glacial environment. Contribute to field data collection campaigns for glacier mass balance and retreat in response to climate change in Lombardy (Italy)	Servizio Glaciologico Lombardo (SGL) , 📍 Italy
2025–present	Volunteer (climate advocacy) Contribute to initiatives that promote climate awareness and responsible engagement on climate impacts.	Protect Our Winters (POW)
2024	Open Data Day 2024 Awarded for the Open Data Day 2024 mini-grant for the organization of the webinar Mapping Climate Change in 4D: Belvedere Glacier's Open Geo Data for Education and Research [Event Report]	Open Knowledge Foundation

15. OTHER MERITS

- ▶ UAS License: EASA A2 Open Category with Critical Scenario authorization
- ▶ Driver's license: B
- ▶ Professional qualification: Italian *Esame di Stato* for civil and environmental engineers
- ▶ Volunteer Experience:
 - Apwoyo (Homeless support, 2023–2024);
 - AGESCI Scout Chief (Education, 2017–2023);
 - Operazione Mato Grosso (Charity, 2016–2017);
 - Libera (Anti-mafia association, 2012–2016).

According to the Italian decree 196/2003 and the GDPR 679/2016, I hereby express my consent to process and use my data in this CV and application for recruiting purposes.