Milad Panahi

Milan, Italy / Berlin, Germany | milad.panahi@polimi.it / milad.panahi@tauw.com

+39 347 821 85 93 | miladpnh.github.io | linkedin.com/in/miladpanahi

https://orcid.org/0000-0002-8776-5297

Education

Politecnico di Milano, Milan, Italy, PhD in Environmental and Infrastructure Engineering — Feb 2022 – Present (Expected by Sep 2025)

- **Early Stage Researcher:** @REMEDI MSCA-ITN-EID a European Commission Horizon2020 Industrial Doctorate on "Competitive Use of Water Resources within an Industry Centered Environment, Targeting the Problem of Water Scarcity due to Contamination by Emerging Contaminants in general and Pharmaceuticals specifically."
- **Research Focus:** Uncertainty-Aware Scientific Machine Learning
- **Project Title:** Studying the effect of Fe addition to sediments on the sedimentary geochemical processes
- **Supervisors:** Prof. Alberto Guadagnini, Prof. Giovanni Porta

University of Arizona, Tucson, United States, M.Sc. in Hydrology and Atmospheric Sciences – Hydrometeorology — Aug 2018 – July 2020

- **Thesis Title:** Global Assessment of Rain Gauge Undercatch Correction Factors and Comparative Analysis of Snowfall Accumulation Using Diverse Data Sets: In-situ, Satellite, and Reanalysis
- **Supervisors:** Prof. Hoshin Vijai Gupta, Prof. Ali Behrangi

Sharif University of Technology, Tehran, Iran, B.Sc. in Civil and Environmental Engineering — Aug 2012 – May 2017

- **Project Title:** Assessment of Changes in Hydrologic Fluxes under Changing Climatic Conditions in Urmia Lake Watershed via PySWAT (An OOP based Python Tool)
- **Supervisor:** Prof. Mehdi Ahmadi

Research Interests

- Scientific Machine Learning (SciML)
- Uncertainty Quantification
- Dynamical Earth Systems Modeling
- Geohydrochemistry and Reactive Transport
- Hydroinformatics
- Satellite Remote Sensing

Academic Experiences

Research Experiences

Scientific Researcher - *Scientific Machine Learning* @ MiPore Research Center, Politecnico di Milano – Milan, Italy — Aug 2021 – Present

- Developed scientific machine learning tools utilizing physics-informed neural solvers to address parametric uncertainty in high-dimensional Stochastic Partial Differential Equations (SPDEs), focusing on hydrogeological systems and contaminant transport dynamics.
- Conducted research on the dynamics of X-Ray Contrast Media (CMA) migration in sediments and

porous media under uncertainty, contributing to the REMEDI project funded by the European Commission under Horizon2020.

- Collaborated with international partners, including TAUW GmbH, Germany, and the University of Warwick, UK, to develop advanced in-situ treatment and recovery technologies for X-ray Contrast Media Agents (CMAs), enhancing the understanding of trapping and removal mechanisms of CMAs in water resources.
- Developed an attention-enabled Transformer-based ML pipeline to downscale a coarse-resolution global pesticide model (Pest-Chemgrids, 50 km) to a finer European grid (10 km), incorporating key environmental variables (e.g., agricultural indicators, soil properties, hydrologic and climatic variables). This approach yielded a high-resolution pesticide residue and leaching rate distribution estimate, enabling more accurate risk assessments for agricultural landscapes across Europe.

Graduate Research Assistant - *Geospatial Data Processing & Remote Sensing* Aug 2018 – July 2020
@ RSWatCH Group, University of Arizona – Arizona, US

- Conducted research on precipitation bias correction and snow water equivalent (SWE) variability, leveraging GRACE mass change observations to evaluate the impact of gauge undercatch correction methodologies in cold regions. Assessed two popular correction factor frameworks (GPCC & GPCP) under varying atmospheric conditions, providing insights into precipitation product accuracy.
- Conducted quantitative/qualitative analysis and review on gauge undercatch correction factor methodologies using remotely-sensed/reanalysis products and in-situ measurements.
- Developed image segmentation tools to extract geometric and statistical properties of cloud clearing events, contributing to an advanced structured database for evaluating cloud dynamics. Implemented an Adaptive Gradient Boosting Regressor Tree to perform multivariate analysis, identifying key drivers of cloud clearing occurrence and atmospheric behavior.
- Developed a spatio-temporal prolongation method for an Airborne Gamma Radiation SWE dataset using ConvLSTM deep learning over CONUS for bias correction of UA-SWE product.

Undergraduate Research Assistant, Sharif University of Technology – Tehran, IR June 2015 – May 2018

- Developed an ML-based meta-model for analyzing the impacts of land use change on the hydrologic cycle of the Urmia Lake watershed using the SWAT model.
- Designed and implemented an environmental information system and a web-based spatial data infrastructure for dissemination of spatial data and time series to researchers working on Urmia Lake restoration.
- Planned and initiated a task for developing a hydrologic decision support system for Urmia Lake watershed management, including databases, data analysis tools, integrated hydrologic models, optimization methods, scenario analysis, and decision-making tools.
- Collaborated on developing a student fleet tracking software named PANDA for organizing arrival and departure times of students.
- Developed a database for organizing collected data on impacts of weather forcings aimed at suggesting a cordon dynamic pricing model to reduce air pollution using a Markov Chain Monte Carlo (MCMC) Simulation.

Teaching Experiences

Co-Lecturer, Entrepreneurship Workshop – REMEDI ITN Dec 2024

- Co-led an interactive workshop on Entrepreneurship: From Innovative Idea to Business Plan, guiding young researchers in transforming scientific research into viable business ventures.
- Designed practical exercises to enhance participants' ability to communicate complex research to

non-academic audiences, fostering industry impact and interdisciplinary collaboration.

- Collaborated with experts from TAUW Deutschland to provide real-world case studies and insights on bridging academia and industry.

Invited Lecturer, TAUW Soil Webinar on Large Data Analytics – TAUW Environmental Consultancy Group Academy Oct 2024

- Delivered a specialized webinar for water sector professionals on advanced data-driven water quality assessment, integrating machine learning and uncertainty quantification techniques to enhance decision-making in water remediation and environmental monitoring.

Co-Lecturer, International Festival of Engineering, Milan, IT Sep 2024

- Presented at Festival Internazionale dell'Ingegneria on the environmental impact of pharmaceuticals, engaging audiences on sustainable water engineering solutions.
- Collaborated with TAUW Germany and Lario Reti Holding to promote science outreach through interactive sessions and industry discussions.

Course Designer, Uncertainty-Aware ML in Environmental Science, Politecnico di Milano, IT Feb 2023

- Developed a structured E-Learning Module, curating materials on statistical learning, Bayesian inference, and physics-constrained deep learning for environmental applications.

Invited Lecturer, Information Theory in the Geosciences (**GeoInfoTheory**) – Climate Ecosystems Division, Lawrence Berkeley National Laboratory, US Fall 2021

- Delivered a technical lecture on Physics-Informed Bayesian Neural Networks (PI-BNNs), illustrating their role in probabilistic uncertainty quantification within geophysical and climate modeling.

Invited Lecturer, Deep Learning Reading Group – University of Arizona, US Fall 2019

- Conducted an expert session on Gradient-Boosted Regression Trees (GBRT), emphasizing its application in environmental data modeling and predictive analytics.

Co-Instructor, Climate Change and Global Warming – Sharif University of Technology, Iran Fall 2017

- Designed and delivered a module on remote sensing techniques, contributing to climate change and global warming mitigiation strategies.

Industrial Experiences & Internships

Research Engineer, TAUW GmbH, Berlin, Germany Aug 2024 – Aug 2025

- Collaborating on sustainability enhancement through the integration of machine learning and data-driven rational decision-making, optimizing environmental management strategies economically.
- Developing and implementing physics-informed neural networks for PFAS contaminant source identification, enabling precise modeling of contaminant transport dynamics and early detection in soil and water systems.
- Designing software solutions that leverage advanced environmental data analytics to support EU regulatory compliance.
- Engaging with multidisciplinary teams to create innovative approaches that bridge AI-driven sustainability solutions with real-world environmental challenges

Visiting Researcher, TAUW GmbH, Milan, Italy Feb 2024 – May 2024

- Applied machine learning techniques to model and predict environmental impacts, aiding in the formulation of effective mitigation strategies.

- Engaged with local stakeholders to integrate scientific findings into practical environmental solutions, enhancing community engagement and project outcomes.

Visiting Researcher, BIOAZUL, Malaga, Spain Oct 2023 – Jan 2024

- Contributed to the P2GreeN project as a part of European Bioeconomy Network (EuBioNet), focusing on developing eco-innovative solutions for wastewater treatment and resource recovery, under supervision of Dr. Antonia López
- Employed scientific machine learning and data fusion to integrate multi-sensor observations of nutrient dynamics in soil irrigated with treated wastewater, thereby optimizing the frequency, depth, and positioning of sensor deployments. This approach enhanced irrigation practices and improved overall agricultural outcomes.
- Collaborated with international partners to advance the project's objectives, promoting sustainable agriculture through the use of bio-based fertilizers derived from human sanitation waste.

Visiting Researcher, Lario Reti Holding, Lecco, Italy Feb 2023 – May 2023

- Data on water quality from regional rivers and lakes were analyzed to identify factors influencing the spikes in heavy metal concentrations.
- Applied machine learning and causal analytics to model environmental variables, providing actionable insights for water resources management.
- Developed predictive tools to assist in the proactive management of water quality, supporting Lario Reti Holding's mission to ensure safe and sustainable water services.

Peer-Reviewed Publications

Parameterized PINNs as Differentiable Solvers for Heterogeneous Darcy Flow: Learning Solution Manifolds with Encoded Conductivity Fields — August 2025
Milad Panahi, Giovanni Porta, Monica Riva, Alberto Guadagnini
Manuscript Submitted to PNAS Nexus

Hybrid Experimental and Computational Analysis of Iodinated Contrast Media on Polymer-Coated Fe_3O_4 Nanomaterials: A Latent-Modulated Bayesian Differentiable Solver Approach — July 2025
Ashfeen Ubaid Khan, ***Milad Panahi***, Giovanni Porta, Monica Riva, Alberto Guadagnini
Manuscript Submitted to Water Research

Modeling Parametric Uncertainty in PDEs Models via Physics-Informed Neural Networks — March 2024
Milad Panahi, Giovanni Michele Porta, Monica Riva, Alberto Guadagnini
10.1016/j.advwatres.2024.104870

Comparative Analysis of Snowfall Accumulation and Gauge Undercatch Correction Factors from Diverse Data Sets: In Situ, Satellite, and Reanalysis — Jan 2020
Milad Panahi, Ali Behrangi
10.1007/s13143-019-00161-6

Stratocumulus Cloud Clearings: Statistics from Satellites, Reanalysis Models, and Airborne Measurements — April 2020
Dadashazar, H., Crosbie, E., Majdi, M.S., ***Panahi, M.***, Moghaddam, M.A., Behrangi, A., Brunke, M., Zeng, X., Jonsson, H.H., Sorooshian, A.
10.5194/acp-20-4637-2020

Assessing Gauge Undercatch Correction in Arctic Basins in Light of GRACE Observations — Oct 2019
Ali Behrangi, Alka Singh, Yang Song, ***Milad Panahi***

10.1029/2019gl084221

Conference Proceedings

A Transfer-Learning Pinn Framework for High-Dimensional Parametric PDEs in Subsurface Flow and Contaminant Transport — July 2025

Milad Panahi, Giovanni Porta, Monica Riva, Patrick Jacobs, Alberto Guadagnini

2025 SIAM Annual Meeting (AN25), Montréal, Québec, Canada

A Transfer-Learning PINN Framework to Simulate Fluid Flow and Contaminant Transport Under Uncertainty — April 2024

Milad Panahi

European Geophysical Union (EGU), Spring Meeting 2025, Vienna, Austria - egusphere-egu25-12117

Staged Learning in Physics-Informed Neural Networks to Model Contaminant Transport under Parametric Uncertainty — April 2024

Milad Panahi, Giovanni Michele Porta, Monica Riva, Alberto Guadagnini

European Geophysical Union (EGU), Spring Meeting 2024, Vienna, Austria - egusphere-egu24-2211

Modeling Solute Transport Under Uncertainty via Physics Informed Neural Networks (PINNs) — May 2023

Milad Panahi, Giovanni Michele Porta, Alberto Guadagnini, Monica Riva

InterPore2023, 15th Annual International Conference on Porous Media, Edinburgh, Scotland

Using Diverse Data Sets to Assess Satellite-Based Snowfall Accumulation and Gauge Undercatch Correction Factors — Dec 2019

Milad Panahi, Ali Behrangi

American Geophysical Union (AGU), Fall Meeting 2019, San Francisco, United States - 2019AGUFM.H51V1823P

Stratocumulus Cloud Clearings: Statistics from Satellites, Reanalysis Models, and Airborne Measurements — Dec 2019

H. Dadashazar, E. Crosbie, M.S. Majdi, ***M. Panahi***, M.A. Moghaddam, A. Behrangi, M. Brunke, X. Zeng, H. Jonsson, R.C. Flagan, J. Seinfeld, A. Sorooshian

American Geophysical Union (AGU), Fall Meeting 2019, San Francisco, United States - 2019AGUFM.A11L2775D

Professional Service

Reviewer: **Journal of Hydrology** (2023, 2024, 2025) - **Computer Methods in Applied Mechanics and Engineering (CMAME)** (2025) - **Water Resources Research (WRR)** (2025) – Elsevier Editorial

Research Mentor: Advisory for 2 Master and 1 Bachelor students (2022–2024)

Open-Source Contributor: Maintainer of GeoHydroML, an ML framework for hydrology

Science Communication: Wrote public articles on AI for hydrology in Medium/LinkedIn

Guest Speaker: Invited talk on Uncertainty Quantification, TAUW group Water Summit 2024

Courses, Certifications & Licenses

University Courses

Machine Learning & AI: Machine Learning, Deep Learning, Imitation/Reinforcement Learning, Advanced Statistical Learning

Numerical Methods: Advanced Numerical Methods, Risk Assessment, Systems Analysis, Complexity Reduction in Scientific Computing

Hydrology & Fluid Mechanics: Groundwater Modeling Under Uncertainty, Surface and Subsurface Hydrology, Fluid Mechanics, Groundwater Hydraulics

Experimental Science: Particle-Laden Flows: Theory and Engineering Applications, Modern Views on Crystal Dissolution, Growth, and Reactive Transport

Science Communication: Science Diplomacy for Researchers, Power of Images and Visual Communication for Research Dissemination

Professional Development: Advanced Interaction Skills for Academic Professionals

Online Certifications

Convolutional Neural Networks: DeepLearning.AI (Nov 2021) *View Credential*

Visualizing Filters of a CNN using TensorFlow: Coursera Project Network (Nov 2021) *View Credential*

Improving DNNs: Regularization and Optimization: DeepLearning.AI (August 2021) *View Credential*

Neural Networks and Deep Learning: DeepLearning.AI (Jun 2020) *View Credential*

Technical Skills

Programming Languages & Softwares:: Python, Julia, R, MATLAB, C++, MySQL, Bash, HTML, Django, Git

Hydro-Geo-Chemical Modeling:: MODFLOW, HYDRUS, COMSOL Multiphysics, SWAT, PHREEQC

Machine Learning: TensorFlow, PyTorch, Scikit-learn, JAX

Geospatial & Big Data Tools: ArcGIS, QGIS, Apache Spark, Xarray

Cloud & DevOps: Docker, Linux (LPIC-1)

Computational Methods: HPC & Parallel Processing (Dask), FEM/FDM, ROMs, BayesOpt, UQ, GSA

Soft Skills

Consulting & Advisory: Ability to translate complex technical insights into actionable strategies for data-driven decision-making.

Communication: Skilled in conveying scientific concepts to both technical and non-technical stakeholders.

Project Management: Experience in leading multidisciplinary teams, managing timelines, and aligning research with industry needs.

Problem-Solving: Expert in designing AI-driven solutions for complex environmental and sustainability challenges.

Stakeholder Engagement: Strong collaboration skills with government agencies, private firms, and research institutions.

Adaptability: Quick to integrate into new environments, address diverse challenges, and develop tailored solutions.

Hobbies and Interests

Music: Amateur Piano player with a passion for classical and jazz improvisation.

Sports: Enjoy skiing in alpine regions and hiking challenging trails.

Adventure: Passionate about outdoor exploration, including camping, mountaineering, and foraging for wild fruits.

Creative Arts: Interested in photography and visual storytelling, particularly capturing landscapes and environmental phenomena.

Reading: Avid reader of scientific literature, philosophy, and history.

Travel: Enjoy discovering new cultures and experiencing diverse culinary traditions.

Funding and Scholarships

Marie Skłodowska-Curie Actions (MSCA) Fellowship: Awarded as part of the REMEDI ITN project under the European Commission's Horizon2020 Industrial Doctorate, supporting research on contaminant transport and hydrogeological modeling exploiting scientific machine learning. (2022–2025)

Graduate Research Assistantship, University of Arizona: Funded research assistantship supporting work on remote sensing-based hydrological modeling, precipitation bias correction, and deep learning for cloud dynamics analysis. Funded by the U.S. National Aeronautics and Space Administration (NASA) and U.S. Department of Defense (DoD). (2018–2020)

European Commission Funding - P2GreeN Project: Research funding received through Bioazul for contributions to the Horizon Europe P2GreeN project, focusing on machine learning-based soil nutrient dynamics analysis for sustainable wastewater irrigation. (2023)

Sharif University of Technology Merit Scholarship: Awarded for outstanding academic performance during undergraduate studies in Civil and Environmental Engineering. (2012–2017)

References

Prof. Giovanni Porta
Associate Professor
Politecnico di Milano, Italy
giovanni.porta@polimi.it
(+39) 02-23996256
porta.faculty.polimi.it

Prof. Alberto Guadagnini
Full professor & Vice Rector for Research
Politecnico di Milano, Italy
alberto.guadagnini@polimi.it
(+39) 02-23996263
mipore.polimi.it

Prof. Mohammad Asadzadeh
Professor of Applied Mathematics
Chalmers University of Technology, Sweden
mohammad@chalmers.se
(+46) (31) 772 3517
www.math.chalmers.se/~mohammad

Prof. Hoshin Gupta
Regents Professor
University of Arizona, USA
hoshin@arizona.edu
(+1) 520-626-9712
profiles.arizona.edu/person/hoshin

Prof. Mohaddeseh Mousavi Nezhad
Professor of Geomechanics
University of Liverpool, United Kingdom
m.mousavi-nezhad@liverpool.ac.uk
(+44) 151-794-5296
liverpool.ac.uk/people/mohaddeseh-mousavi-nezhad

Dr. Patrick Jacobs
Business Unit Manager
TAUW GmbH, Germany
patrick.jacobs@tauw.de
(+49) 15209395641
linkedin.com/in/patrick-jacobs-environment