

Ilaria Fontana

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ResearchGate

PROFESSIONAL EXPERIENCE

Visiting Assistant Professor, Northwestern University

2022–present

Department of Engineering Science and Applied Mathematics (ESAM)

- Collaboration with the main developers of the **Dedalus project**: Daniel Lecoanet, Geoff Vasil, Keaton Burns.
- Analysis of different instances of the tau spectral method. In particular, investigation of the qualitative and quantitative properties of the approximate spectrum of two eigenvalues problems with fluid dynamics applications.
- Seminars and talks at several international conferences in Europe and in the US.
- Instructor for six classes of the Northwestern multivariate integral calculus course for engineering students.
- End of the appointment: August 2024

Ph.D. Research Engineer, EDF (main French electric company)

2018–2022

R&D Division Lab Paris-Saclay

- Development of a posteriori error estimation applied to mechanical problems modeled with PDEs, and introduction of a fully adaptive algorithm including stopping criteria for the nonlinear solver and automatic tuning of some parameters. Implementation with **FreeFem++**.
- Development of models for the materials and their cohesive zones, both from a theoretical point of view, and with the creation of tailored FEA tools for the industry. Implementation with Python, Fortran and the numerical simulation tool **code_aster**.
- Collaboration between different divisions (also outside R&D) in order to provide customer-focused solutions to the final users. This taught me how to be autonomous, organized and willing to interact and work closely with diverse audiences.
- Presentation of the results in several international conferences in Europe.

EDUCATION

Ph.D. degree, University of Montpellier and EDF Lab Paris-Saclay (**CIFRE agreement**)

2018–2022

Mathématiques et Modélisation (Mathematics and Modelisation)

Palaiseau (France)

- Thesis title: *Interface problems for dam modeling (Problèmes d'interfaces pour les ouvrages hydrauliques)*
- Topics: Finite element approximation methods for PDEs, Modeling of hydraulic structure joints with cohesive zone model, A posteriori error estimate techniques for contact problems via equilibrated stress reconstruction
- Supervisors: Daniele A. Di Pietro (University of Montpellier), Kyrylo Kazymyrenko (EDF Lab Paris-Saclay)
- Research units: **IMAG - Institut Montpellierain Alexander Grothendieck**, and **IMSIA - Institute of Mechanical Sciences and Industrial Application**

Master degree, University of Udine

2016–2018

Applied Mathematics

Udine (Italy)

- Thesis title: *Numerical Bifurcation of Equations with Infinite Delay via Pseudospectral Collocation*
- Topics: DDEs with infinite delay, Dynamical systems generated by DDEs, Orthogonal polynomials
- Supervisor: Rossana Vermiglio
- Final grade: 110/110 cum laude

Bachelor degree, University of Udine

2013–2016

Mathematics

Udine (Italy)

- Thesis title: *Il teorema del passo di montagna (Mountain Pass Theorem)*
- Supervisor: Rodica Toader
- Final grade: 110/110 cum laude

TEACHING EXPERIENCES

MATH 228-2: Multiple Integration and Vector Calculus, Northwestern University 2023–present

- Winter 2023: Instructor for two sections - Collaboration with Michael Miksis and Petia Vlahovska
- Spring 2023: Instructor for one section
- Fall 2023: Instructor for one section - Collaboration with Daniel Lecoanet
- Winter 2024: Instructor for two sections - Collaboration with Petia Vlahovska

PUBLICATIONS

Articles and Conference Papers

- D. A. Di Pietro, I. Fontana, K. Kazymyrenko, *A posteriori error estimates via equilibrated stress reconstructions for contact problems approximated by Nitsche's method*. Comput. Math. Appl., 2022, 111:61–80. DOI: [10.1016/j.camwa.2022.02.008](https://doi.org/10.1016/j.camwa.2022.02.008).
- Preprint: [arXiv](#), [Hal](#)
- I. Fontana, D. A. Di Pietro, *An a posteriori error analysis based on equilibrated stresses for finite element approximations of frictional contact*.
- Submitted. Preprint: [arXiv](#), [Hal](#)
- I. Fontana, K. Kazymyrenko, D. A. Di Pietro, *Hyperelastic nature of the Hoek–Brown criterion*.
- Submitted. Preprint: [Hal](#)
- I. Fontana, K. Kazymyrenko, *Physics of interfaces: mechanical coupling of plasticity and damage*.
- In preparation. Submission to a journal preview for the beginning of 2024.
- I. Fontana, R. Vermiglio, *An experimental investigation on weighted orthogonal polynomials for equations with infinite delay*.
- In preparation. Submission to a journal preview for the beginning of 2024.

Thesis

- I. Fontana, *Interface Problems for Dam Modeling (Problèmes d'interface pour les ouvrages hydrauliques)*, Ph.D Thesis. [Hal](#) [these](#)

CONFERENCES TALKS & SEMINARS

Scintillae - Talk Alumni at the [Scuola Superiore Universitaria Di Toppo Wassermann](#) December 2023

Metodi numerici per problemi meccanici (Numerical methods for mechanical problems) Udine (Italy)
Invited talk by the Alumni Association

ICCCM 2023, 7th International Conference on Computational Contact Mechanics July 2023

Application of a posteriori error analysis to contact problems Turin (Italy)
Abstract selected for oral presentation

Spring 2023 Finite Element Circus March 2023

Dam modeling: Application of a posteriori error analysis to contact problems Bridgewater, MA (USA)
Volunteer presentation

Seminar in the **Department of Mathematics at Purdue University**
Dam modeling: Application of a posteriori error analysis to contact problems
Invited seminar

December 2022
West Lafayette, IN (USA)

EFEF2020, 18th European Finite Element Fair

September 2021

A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems

Paris (France)

Abstract selected for oral presentation

USNCCM16, 16th U.S. National Congress on Computational Mechanics

July 2021

A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems

Online

Abstract selected for oral presentation

ADMOS 2021, 10th International Conference on Adaptive Modeling and Simulation

June 2021

A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems

Online

Abstract selected for oral presentation

Seminar in the **CDLab** of the University of Udine

June 2021

A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems

Online

Invited seminar

Congrès Français de Mécanique

August 2019

Lois mécaniques pour les ouvrages hydrauliques (Behavioral laws for hydraulic structures)

Brest (France)

Abstract selected for oral presentation

Seminar in the **CDLab** of the University of Udine

October 2018

Numerical Bifurcation of Equations with Infinite Delay via Pseudospectral Collocation

Udine (Italy)

Master student seminar

Seminar in the **CDLab** of the University of Udine

September 2018

Laguerre-type orthogonal polynomials and transformation of the Chebyshev nodes

Udine (Italy)

Master student seminar

Seminar in the **CDLab** of the University of Udine

July 2018

A model describing vapour and droplets

Udine (Italy)

Master student seminar

Conferences Posters

Journées scientifiques du GdR MaNu

October 2021

A posteriori error estimates via equilibrated stress reconstructions for contact problems approximated by Nitsche's method

Le Croisic (France)

Colloque National MECAMAT 2019 – Rupture des Matériaux et des Structures

January 2019

A model describing vapour and droplets

Aussois (France)

GRANTS & SCHOLARSHIPS

CIFRE convention for Ph.D. funding

2018–2022

Industrial Agreements for Training through Research

Thesis Research fellowship

2018

Three months of Master thesis research at the Department of Mathematics and Statistics of the University of Helsinki (Finland) in collaboration with prof. Mats Gyllenberg and with the Biomathematics research group.

“Scuola Superiore” (School for Advanced Studies) fellowship

2013–2018

The [School for Advanced Studies](#) (now “Scuola Superiore Universitaria Di Toppo Wassermann”) of the University of Udine is an institution for higher education besides the university. Admitted students follow additional courses and are examined every year on two occasions. The school covers university student fees and provides a residence for five years (Bachelor and Master degrees).

OUTREACH EXPERIENCES

Student tutor, University of Udine

2017–2018

Student tutor for Bachelor and Master degree in Mathematics of the University of Udine. In charge of teaching assistance and outreach activities.

- Effective communicator, advertising university programs in person and on social media to diverse audiences.
- Improving the customer experience, specifically in the Mathematics Department, by identifying bottlenecks in the course load and by proposing solutions to the department directors.

Student representative, University of Udine

2014–2018

Student representative for Bachelor and Master degree in Mathematics of the University of Udine.

TECHNICAL SKILLS

Programming languages

Python, C/C++, [FreeFem++](#), [Dedalus](#),
[Mathematica](#), [MATLAB](#), Fortran, SQL, R

Other

\LaTeX , Beamer, [code_aster](#), Linux

LANGUAGES

Italian

Mother tongue

English

Workplace - Daily

French

Workplace - Daily

Spanish

High-school

Portuguese

Basic