

Curriculum vitae di Anna Marina Pandolfi

Sottosettori ERC primari (max 3): *PE8_4 Computational engineering*,
PE3_1 Structure of solids, material growth and characterisation,
PE3_16 Physics of biological systems

PERSONAL DETAILS

Family name, First name: **Pandolfi, Anna Marina**

Birthdate: **January 23, 1960**

Researcher unique identifiers: ORCID **0000-0002-7084-7456**, Researcher ID **E-1481-2013**

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• Education and key qualifications

07/12/2007 PhD in Mechanics

Mechanical Engineering Dept, University Paul Verlaine of Metz
(now University of Lorraine), France

1984

Master in Civil Engineering, Structural track
Structural Engineering Dept, Politecnico di Milano, Italy

• Current position(s)

2017 - 2026 Professor of Structural and Solid Mechanics

Civil and Environmental Engineering Dept, Politecnico di Milano, Italy

1996 - 2026 Visiting Associate in Aerospace (till 2020) and in Civil & Mechanical Engineering (since 2021),
Engineering and Applied Sciences Div, Caltech, Pasadena, CA USA

• Previous position(s)

2001 - 2016 Associate Professor of Structural and Solid Mechanics

Civil and Environmental Engineering Dept, Politecnico di Milano, Italy

1995 - 2001 Assistant Professor of Structural and Solid Mechanics

Structural Engineering Dept, Politecnico di Milano, Italy

RESEARCH ACHIEVEMENTS AND PEER RECOGNITION

Facts: **101 papers** on international peer reviewed journals, **h-index 39**, **5790 citations** (Scopus, April 2026).

Publications

The following 10 publications in international peer reviewed journals are representative of the excursus of my research activity, focused on biomechanics of soft tissues and computational mechanics for inelastic material behaviours. Every publication in the following list has implied the implementation, done by myself, of a computational code for the solution of stationary or evolutive boundary value problems¹. My major achievements in biomechanics are the development of innovative computational models for the human cornea (#1, #5, #9), the conception of stochastic material models for fibrous tissues (#7), and the ideation of microstructural models for stromal collagen (#3). In other fields, my research led to the definition of a class of cohesive elements in finite kinematics (#10), the development of a new variational method for fracture tracking (#8), the invention of an enhanced concrete metamaterial (#6), the development of a microstructural porous brittle material model (#4), and new advanced meshless approaches to diffusion problems (#2).

1. A. Bonfanti and A. **Pandolfi**. A predictive model of UV-A-riboflavin crosslinking treatment on porcine corneas. *Proceedings of the Royal Society of London A*, 479(2279):1–17, 2023 (**OA**, **IF 3.8**, **cit 2**).
A successful attempt to model the progressive corneal stiffening due to therapeutic crosslinking validated against experimental results on porcine cornea. An effective analytical model of stiffening diffusion is applied to a multilayered and anisotropic finite element model of the cornea. The research is fruit of the

¹ Acronym **OA** denotes Open Access contribution, **IF** the journal impact factor, **cit** the number of citations (April 2026).

combination of numerical models and identification procedures developed in a decade of activity on the cornea.

2. **A. Pandolfi**, L. Stainier, and M. Ortiz. An optimal-transport finite-particle method for mass diffusion. *Computer Methods in Applied Mechanics and Engineering*, 416:116385, 2023 (**OA, IF 7.3, cit 4**). *An alternative approach for the solution of mass diffusion problems, based on the optimal transport theory combined with a finite-width particle spatial discretization. The method predicts the diffusion of species in closed and open domains, with localized density sources or sinks and Neumann boundary conditions.*
3. **A. Pandolfi**, A. Gizzi, and M. Vasta. A microstructural model of cross-link interaction between collagen fibrils in the human cornea. *Phil. Transactions of Royal Society A*. 377:20180079 2019 (**OA, IF 4.7, cit 34**). *A new microstructured discrete model of the corneal collagen architecture describes realistically the geometrical changes observed in the development of keratoconus, in contrast with the minor predictability shown by continuum models embedding reinforcing collagen fibrils.*
4. M.L. DeBellis, G. DellaVecchia, M. Ortiz, and **A. Pandolfi**, A linearized porous brittle damage material model with distributed frictional-cohesive faults, *Engineering Geology*, 215:10, 2016 (**IF 8.8, cit 26**). *A brittle damage model of fracture consisting of nested families of microstructures in the form of planar parallel and equidistant faults (Pandolfi et al, JMPS 2006) is extended to porous media. Faults are characterized by cohesive and frictional behaviours and are suitable to describe complex fracturing processes occurring in geomaterials. Subsequent works were able to model fracking in open fields.*
5. I. Simonini, M. Angelillo, and **A. Pandolfi**, Theoretical and numerical analysis of the corneal air puff test, *J. of the Mechanics and Physics of Solids*, 93:118, 2016 (**OA, IF 6, cit 52**). *The air puff test, that uses an air jet to estimate the intraocular pressure through the deformation of the human cornea, is for the first time in the literature correctly described as a dynamic test, pointing out that during the test the mechanical response of the cornea is also affected by the presence of viscous fluids.*
6. S. J. Mitchell, **A. Pandolfi** and M. Ortiz. Metaconcrete: Designed aggregates to enhance dynamic performance, *Journal of the Mechanics and Physics of Solids* 65:69, 2014 (**OA, IF 6, cit 182**). *An innovative design of concrete aggregates, consisting of a heavy core coated with soft material, has been proposed to attenuate the mechanical energy due to blast and mechanical vibration in civil engineering structures. Metaconcrete efficiency has been proved through numerical and experimental tests.*
7. **A. Pandolfi** and M. Vasta, Fiber distributed hyperelastic modeling of biological tissues, *Mechanics of Materials*, 44:151, 2012 (**IF 4.1, cit 113**). *Classical dispersed fiber material models based on structure tensors (à la Spencer) are revisited and improved with the inclusions of second order statistics (variance) to better describe the tissue engagement for fibers with a high dispersion of the spatial orientation. Variance-based models provide a more realistic estimate of the stress distribution in human corneas.*
8. **A. Pandolfi** and M. Ortiz. An eigenerosion approach to brittle fracture, *International Journal for Numerical Methods in Engineering* 92:694-714, 2012 (**IF 2.9, cit 137**). *A variational element erosion approach based on energy optimization and Gamma-convergence arguments is proposed to model crack propagation in brittle materials. The approach is highly competitive with respect to more popular methods like phase-field and peri-dynamics, in terms of implementation, computational cost, and predictability.*
9. **A. Pandolfi** and F. Manganiello. A model for the human cornea. *Constitutive behavior and numerical analysis. Biomechanics and Modeling in Mechanobiology*, 5:237–246, 2006 (**IF 3.2, cit 222**). *A pioneering, worldwide acknowledged, to-date unsurpassed model of the human cornea accounting for the presence of collagen reinforcement and the local variability in anisotropy. The study led to the implementation of a finite element code addressing specifically the human and animal corneas, including patient specific features.*
10. M. Ortiz and **A. Pandolfi**. Finite-deformation irreversible cohesive elements for three-dimensional crack propagation analysis. *International Journal for Numerical Methods in Engineering*, 44:1267–1282, 1999 (**OA, IF 2.9, cit 1,347**). *This is a leading paper in computational fracture mechanics, presenting the first finite kinematics cohesive element to describe the formation and the evolution of free discontinuities. It has been a reference for many subsequent works, and it is still one of the best approaches to describe fine fragmentation processes in brittle and ductile materials.*

Research achievements

The following 7 items are related to technology transfer and to the collaboration with industrial partners.

11. **US Patent**: US009464001B2, October 11, 2016: “Engineered aggregates for metamaterials”, Mitchell, Pandolfi, and Ortiz, California Institute of Technology. *Metaconcrete led to a large interest in the community of metamaterials, with 76 follow-up papers from the scientific community that has used the resonance concept in several practical applications.*

12. Research grant from **TecLens**, Connecticut USA “Experimental Assessment and Computational Prediction of Refractive Outcomes from On-eye Corneal Crosslinking”, (2024-2025) **122 K Euro**, TecLens reference: Dr. Patrick D. Lopath and Dr. Tom Dunlap. *The spin-off company is proposing a new concept of personalized corneal crosslinking (a non-invasive stroma-stiffening procedure) that addresses refractive correction in common problems like myopia and hyperopia. The success of the idea may revolutionize the current treatment of refractive issues, characterized by invasive procedures.*
13. Research Grant from **Cathie Associates**, Paris, France “Pile tip dynamic buckling during pile driving in hard soils”, (2018-2019) **28 K Euro**, Cathie reference Dr. Emilio Nicolini. *The research implied the adoption of advanced numerical tools to understand the interaction of large diameter piles with hard soils in marine environment, calling for multiphysics approaches in finite kinematics.*
14. Research Grant from **iVis Technologies**, Taranto, Italy “Numerical modelling of the in-vivo mechanical behavior of the human cornea”, (2018-2019) **28 K Euro**, iVis reference Dr. Giuseppe D’Ippolito. *The grant was used to complete and improve the model of human cornea previously developed. The model was made fully patient-specific from the geometrical viewpoint and extended to model laser refractive surgery with the creation of embedded interfaces.*
15. Research Contract with Ente Nazionale Idrocarburi (**ENI**), San Donato Milanese, Italy, “Development of a stress and fracture analysis software for the planning and the design of hydraulic fracture campaigns in non-conventional shale gas and shale oil fields”, Grant: **137 K Euro** (2014-2016), ENI reference Dr. Marco Sciortino. *The fund has been used to develop a coupled code to model the process of hydraulic fracturing in a fully 3D setting, that was very innovative for the oil industry.*
16. Research contract with Ente Nazionale Idrocarburi (**ENI**), San Donato Milanese, Italy “Determination of the initial stress state at bore-hole level through inverse analysis”, **Grant: 50 K Euro** (2010-2011), ENI reference Dr. Gaia Capasso. *The fund led to the publication of a paper “An analytical expression for the determination of in situ stress state from borehole data accounting for breakout size”, well received from the industry, with 17 follow-up papers.*
17. From 1987 to 1995, I have been the co-owner of a Software House located in Milano (Alphard Srl), specialized in the development of technical-scientific software for industry and management. I have produced and commercialized finite element codes for static and dynamic analysis of slender structures, thermal conduction, and graphic tools for visualization of software outcomes.

Peer recognition

Mainly demonstrated by honorary speeches in International Conferences and Congresses, invited Seminars in prestigious research institutions, and participation to Commission of Trust.

Honorary Lectures: Between 2010 and 2026, I delivered **18 Plenary** and **2 Semi-Plenary lectures** in International Conferences. (ECCM-ECFD, COMPLAS, ECCOMAS, GAMM, ACOMEN, ASCE-EMI, and others), and **15 Key-Note lectures** in International Conferences, Colloquia and Workshops (WCCM, SES, EMI, WCCM, USNCTAM15, and others).

Invited Seminars: Since 1996, I have been invited to deliver **88 Seminars** in renowned International Scientific Institutions, among which: **Caltech, Harvard MT, Stanford, UCSD, UCLA, Postech (So. Korea), Oxford UK, EPFL, Paris VI, MOX Polimi, Stokholm, Glasgow**, and many others.

In June 2024, I was invited to deliver the distinguished **AnneLiese Niethammer Lecture** in **Stuttgart**.

Visiting professor positions: From July to October 2008 I held the position of Chercheur Associé CNRS, at the Laboratoire Soils, Solids, Structures - Risques (3S-R), **Institut National Polytechnique de Grenoble**.

Commissions of Trust: Since 2021, I have served as **Chair of the Solid Mechanics Prize and Fellowship** committee of the **European Society of Mechanics**, and as a member of the Advisory Board of the same society.

In the period 2016-2021, I have served as an elected member of the **Euromech Council**.

From 2016 to 2019 I have served as elected **Coordinator** of the Italian Computational Mechanics Group (**GIMC-AIMETA**); in the same society I served as elected **Member** of the GIMC Committee from 2013 to 2015.

Grant reviewer: I have been invited to participate in several review panels for active research projects and proposals.

From 2020 to 2024 I served as **scientific advisor** for **MSCA-ITNETN** project, “Opto-Biomechanical Eye

Research”, in Cambridge UK.

In 2018 I served as **project review panel member** for the EPSRC grant to SolMech center, Glasgow UK. Since 2021, I have been serving several times as a **proposal reviewer** for the European Community, for **ERC StG, ERC CoG, H2020 OPEN FET RIA, HORIZON-EIC Pathfinder** project proposals.

I have been **member of review panels** of national proposal in **Sweden** (2014, 2021) and **Denmark** (2024). Since 2009 I have been serving as **individual proposal reviewer** for numerous NSF (USA, Switzerland, Luxemburg, Poland, Israel, Canada, and others.).

Editor and reviewer activity

From 2021 I am the **Editor in Chief** of **Meccanica** Springer (Italian Theoretical and Applied Mechanics Journal).

In 2025 I served as **Guest Editor** of a Special Issue of the “**Mechanics of Materials**” in honor of the 70th birthday of Professor Michael Ortiz.

In 2024 I served as **Guest Editor** of a Special Issue of the “**Meccanica**” to celebrate 100 years of ICTAM conference.

In 2014 I served as **Guest Editor** of a Special Issue of the “**Journal of the Mechanics and Physics of Solids**” in honor of the 60th birthday of Professor Michael Ortiz.

From 2017, I have served as **Associate Editor in peer reviewed Journals**: International Journal of Fracture; Modelling and Artificial Intelligence in Ophthalmology (OA); Journal of Theoretical, Computational and Applied Mechanics (OA); Scientific Reports (OA); PlosOne (OA), and a few more.

From 1996 I have acted regularly as **peer reviewer for many journals**, among which: Mathematical Reviews, Acta Biomaterialia, International Journal of Engineering Science, Journal of the Royal Society Interface, Journal of Plasticity, Journal of the Mechanics and Physics of Solids, Investigative Ophthalmology & Visual Science, Journal of Structural Biology, Biomechanics and Modelling in Mechanobiology, Annals of Biomedical Engineering, Journal of Biomechanics, Experimental Eye Research.

Other contributions to the research community

I have stimulated the ambition of eye surgeons to use advanced numerical and intelligent technology by exploiting its potential in personalized treatments by co-founding the **International Society of High-Technology in Ophthalmology** (ISHO) where I interact with expert ophthalmologists.

I have been one of the co-chairman in the organization of five international meetings:

- **VII Soft tissue Workshop** (SOFTMECH, Centre of Mathematics for Healthcare in Glasgow), with Christian Vergara, Francesco Migliavacca and Luca Dedè, June 11-13, 2025, Milano, Italy (30 participants).
- **IUTAM Symposium** on Computational fracture mechanics in multi-field problems, Bad Honnef, Germany, December 8-13, 2024 (60 participants).
- **Workshop** on Fracture as an Emergent Phenomenon, at the **Mathematisches Forschungsinstitut Oberwolfach**, Germany, January 7-12, 2024 (45 participants).
- **First GACM-GIMC Workshop** on Common Research Interests in Computational Mechanics, CISM Udine, Feb 28-Mar 1, 2018 (29 participants).
- **IUTAM Symposium** on Innovative numerical approaches for materials and structures in multi-field and multi-scale problems, September 1-4, 2014, Burg Schnellenberg, Germany (51 participants).

Beside them, I have been co-organizing more than 30 mini-symposia or special sessions within international conferences and congress, among which: European Society of Biomechanics, World Congress on Computational Mechanics, European Community on Computational Methods in Applied Sciences Eccomas Congress, Euromech Solid Mechanics Conference, Computational Conference on Fracture, Eccomas Congress on Computational Mechanics, Word Congress in Biomechanics.

I have a strong international network of collaborators, here the most relevant:

Caltech, CA USA: **Michael Ortiz** (34 papers, grants, conference mini-Symposia).

Siegen, Germany: **Kerstin Weinberg** (4 papers, 1 JMPS special issue, 1 Thematic Collection, grants, 2 IUTAM symposia, multiple international conferences mini-Symposia).

Dresden, Germany: **Michael Kaliske** (2 papers, PhD students co-tutoring, an International Workshop).

Glasgow, UK: Xiaoyu Luo, **Nick Hill** (1 paper, EPSRC research center).