UNIVERSITÀ
POLITECNICA
DELLE MARCHE

Department of Construction and Civil Engineering and Architecture (DICEA)

February, 2025 - www.dicea.univpm.it

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Prof. Francesco Clementi

Research Group Description

Supervisor short CV

Francesco Clementi is Full Professor of Structural Mechanics at Università Politecnica delle Marche (UnivPM), Italy. Previously, Associate (2019-2024) and Assistant Professor (2012-2019), UnivPM. Reviewer for more than 250 papers in about 90 journals and 10 conferences. Editorial Board member in 12 journals and 12 congresses, and organizer of more than 20 mini-symposia in international congresses. He has been a lecturer in 8 summer/winter schools focusing on seismic vulnerability, structural consolidation of historical/monumental structures, and SHM (Structural Health Monitoring). He has developed research and teaching activities at the Universities of Ancona, Camerino, Lublin and Sao Paulo. Since 2019 he is member of Member of board of "Accademia Marchigiana di Scienze, Lettere ed Arti, Classe I". He was (2019-2021) Deputy manager of the Laboratorio Ufficiale Prove Materiali e Strutture of the Department of Civil and Building Engineering, and Architecture (DICEA), faculty of Engineering, UnivPM. He was (2021-2024) Member of the Board of the Italian Society of "Scienza delle Costruzioni" (Solids and Structural Mechanics) (SISCo). He is the founder, CEO, and technical director of the UnivPM spin-off "iSD Egineering" which aims to spread seismic safety and structural control by combining dissipation and structural monitoring in a patent-pending dissipator. (http://www.univpm.it/francesco.clementi)

Research topics

Francesco Clementi specializes in Structural Engineering, focusing on the static and dynamic behavior of structures and materials. His research encompasses structural health monitoring and numerical modeling. Recent projects include developing a quality-based automated procedure for operational modal analysis, long-term health monitoring data analysis, and Bayesian modal updating using surrogate models. He employs both continuous and discontinuous numerical modeling approaches, alongside digital twin technologies enhanced by AI and Machine Learning. His expertise extends to construction materials, including brick, mortar, composites, reinforced concrete, precast, and timber, covering experimental investigations and numerical modeling. He is also skilled in NDT and monitoring for the repair and maintenance of bridges, civil structures, existing masonry buildings, and trees.

Publications

He is the author of 73 scientific papers, collaborating with esteemed international co-authors, including winners of prestigious awards such as the ERC Advanced Grant (1), Consolidator Grant (1), and MSCA (1). 73 papers has been published in leading international journals, with the majority appearing in first quartile journals, and he has presented over 100 proceedings at international conferences. (*ORCID:* https://orcid.org/0000-0002-9705-777X*)*

Italian and European main research projects

2024-2026: Coordinator with Prof. Lenci of UR33 of UnivPM of the Reluis MARS-CARTIS project.

2022-2025: PNRR VITALITY – Innovation Ecosystems "Environmental, economic, and social sustainability of living and working environments." Head of Group 1 - Solutions for self-diagnosing structural health.

2017-2019: Principal Investigator and Coordinator of "Building Resilience to Flood Impact Derived from Global Warming in Europe (BRIDGE)," a strategic UnivPM project with a funded amount of €182,000.

He was participant in several national and international projects (FP6, FP7, PRIN, Pompei Project, CARIVERONA, RELUIS CARTIS, etc.).

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Members of the research group

- Prof. Eng. Fabrizio Davì (Full Professor)
- Prof. Eng. Stefano Lenci (Full Professor)
- Prof. Eng. Francesco Clementi (Full Professor)
- Prof. Eng. Giovanni Lancioni (Associate Professor)
- Prof. Eng. Michele Serpilli (Associate Professor)
- Prof. Eng. Pierpaolo Belardinelli (Associate Professor)
- Prof. Eng. Valeria Settimi (Associate Professor)
- 3 Post-doc fellows
- 2 PhD students
- iSD Engineering s.r.l. Spin-Off of UnivPM, the CEO and founder is Prof. Francesco Clementi

Topics

The Structural Mechanics group conducts cutting-edge research in theoretical and applied mechanics, exploring classical and innovative topics. Their work spans advanced materials, fracture mechanics, metamaterials, and structural optimization, integrating machine learning for predictive modeling and dynamic identification. They pioneer seismic vulnerability assessments, develop energy harvesting solutions, and design monitoring techniques for structural health. With expertise in nonlinear dynamics, computational mechanics, and thermo-mechanical behavior, the group tackles challenges from nanoscale materials to large-scale structures. Their mission is to revolutionize engineering practices, blending innovation, sustainability, and resilience to create safer, smarter, and more efficient structural systems for the future..

https://dicea.univpm.it/en/thematic-sections/structural-mechanics/

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Research Group Description

Infrastructure and tools

The research group is equipped with state-of-the-art instrumentation for advanced dynamic testing of structures, both in the laboratory and on-site. This includes high-precision accelerometers, specialized hardware, and cutting-edge software tailored for structural analysis. Additionally, the group has privileged access to the university's Materials and Structure Testing Laboratory, a facility outfitted with next-generation tools such as hydraulic pumps, actuators, and reaction walls, enabling comprehensive static and dynamic testing under realistic conditions.

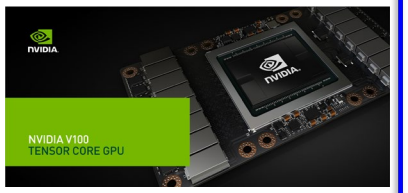
A key strength of the group lies in its computational capabilities: a high-performance cluster with two Dell GPUs supports the execution of extremely demanding numerical and analytical methods. This infrastructure allows the team to tackle complex scenarios with unparalleled precision, from large-scale finite element modeling to advanced simulations of structural behavior under dynamic loads.

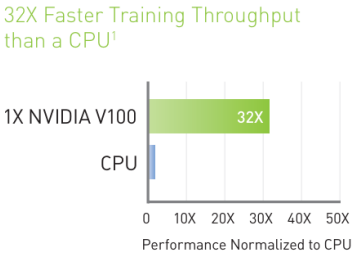
Moreover, the group has extensive experience in real-world applications, having successfully installed numerous static and dynamic monitoring systems on existing structures. This unique combination of cutting-edge instrumentation, computational power, and practical expertise enables the group to address the most challenging problems in structural analysis and monitoring, driving innovation and pushing the boundaries of resilience and safety.

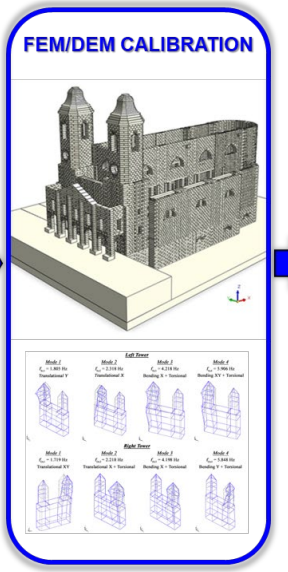
Static

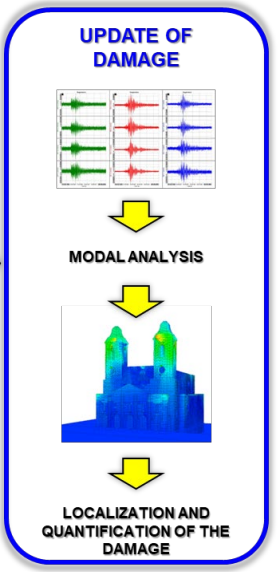
Dynamic

Computation









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Department Description

The **Department of Construction, Civil Engineering and Architecture** (**DICEA**) is among the most active Italian departments of construction and civil engineering, as well as architecture, generating (*research*) and transferring (*training*) knowledge and value of the highest quality on such topics.

DICEA is arranged in 4 main sections: Architecture, Constructions, Infrastructures and Structures.

In 2017, DICEA was ranked among the best University departments of Italy (Department of Excellence) and awarded with a grant of 6,6 M€ in the period 2018-2022.
In 2022, DICEA was again ranked and then awarded with a new Department of Excellence grant (about 6,5 M€) for the period 2023-2027.

DICEA brings together a wide range of disciplines, being leading contributor to the undergraduate programmes in civil and environmental engineering, building engineering, architectural engineering. DICEA also offers postgraduate programmes in civil, environmental, building engineering and architecture.

In 2024, DICEA gathered more than 1.3 M€ of resources from international funded projects.

Coherently with the current global challenges, DICEA has individuated 4 main development axes for the next 5 years: Heritage Science; Safety of structures, infrastructures and natural systems; Digital management of constructions and built environments; Climate change, and constructions and transportation sustainability.

https://www.dicea.univpm.it/

AT A GLANCE

2025

231 Publications

> 3.2 M€ Research income

53 Research staff

75 PhD, Post-doc, Research fellows

Teaching programs for
FIRST CYCLE DEGREE:
Building Engineering, Civil and Environmental Engineering
PROFESSIONAL DEGREE COURSE:
Technics for Territorial Design and Management
MASTER DEGREES:
Civil Engineering, Building Engineering, Environmental Engineering
SINGLE CYCLE DEGREE:
Building Engineering-Architecture

Department of Excellence (from Italian National Agency for the Evaluation of Universities and Research Institutes):
- 2018 - 2022
- 2023 - 2027

1 Digital Education Lab

Research laboratories 8

16 Scientific Areas:
CEAR-01/A, CEAR-01/B, CEAR-03/A, CEAR-03/B, CEAR-04/A, CEAR-06/A, CEAR-07/A, CEAR-08/A, CEAR-08/B, CEAR-09/A, CEAR-10/A, CEAR-11/A, CEAR-11/B, CEAR-12/B, MATH-03/A, GIUR-04/A

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Project idea

SMART+: Beyond Traditional Retrofitting – Creating Structures that Sense, Respond, and Protect

The project envisions a groundbreaking leap in the seismic resilience of existing reinforced concrete (RC) and unreinforced masonry (URM) structures by merging advanced materials with intelligent monitoring technologies. The SMART+ approach introduces "living" retrofitting systems that not only strengthen structures but also sense, adapt, and respond to stress in real time. By embedding cutting-edge SHM technologies -such as optical fibers and miniaturized sensors- directly into high-performance composite materials like fiber-reinforced polymers (FRP) and textile-reinforced mortars (TRM), this project pioneers a dual-function solution that combines durability with intelligence.

Imagine structures that can "talk": reporting strain, detecting cracks, and predicting vulnerabilities before they become critical. This vision goes beyond conventional retrofitting by integrating artificial intelligence and digital twins, enabling continuous learning and optimization of structural performance over time. The project will validate these innovations through advanced simulations (FEM/DEM) and real-world testing, ensuring scalability, cost-effectiveness, and compatibility with both modern and heritage buildings.

SMART+ sets a new benchmark for sustainable cities, aligning with SDG 9 (Innovation and Infrastructure) and SDG 11 (Sustainable Communities). By turning passive structures into active systems, this initiative redefines resilience, offering a future where buildings are not just safer, but smarter and more sustainable—a true paradigm shift for civil engineering and urban living.

Project objectives

- **Innovative Smart Materials for Retrofitting Existing Structures:** We are exploring cutting-edge smart materials designed for retrofitting interventions, enhancing the resilience and longevity of existing structures.
- **Advanced Damage Detection in Passive Structures:** Our research focuses on developing sophisticated damage detection methods for passive structures, particularly in response to climate change. We aim to define critical feature thresholds that indicate unsafe conditions, ensuring proactive maintenance and safety.
- **Creating Smarter and More Sustainable Structures:** We are committed to designing smarter and more sustainable structures that not only meet current engineering demands but also anticipate future challenges, promoting a harmonious balance between innovation and environmental stewardship.