Supervisor Project Idea

Supervisor

Insert a brief CV and/or external link, the total number of publications, the ORCID link, 5 of the most significant/recent publications, and a list of funded projects and awards. Please indicate if you are a MSCA fellow yourself and if you have already been a MSCA Supervisor before. max 300 wordsH

Prof. Eng. Fabrizio Gara graduated at Faculty of Engineering of Ancona (Italy) in 1996 with full marks (with honors), and in 2000 completed his Ph.D. in "Structural Engineering" at the University of Bologna (Italy). From 2002 he was Lecturer at the Università Politecnica delle Marche (UnivPM); from 2015 to 2019 he was Associate Professor, and from 2019 he is Full Professor of Structural Engineering at the Department of Construction, Civil Engineering and Architecture (DICEA) of UnivPM. He was teacher of Analysis and Design of R.C. and Steel Structures, Earthquake Engineering, Material and Structure Testing and Control, and Advanced Structural System; now he teaches Structural Engineering and Design of Bridges for the Master's Degree in Civil Engineering.

His research focuses on steel-concrete composite bridges, soil-structure interaction for seismic design, dynamic testing of buildings and bridges, and existing bridge assessment. He has authored 59 papers in international journals and over 70 presented at international conferences.

He is supervisor of the MSCA fellow won by Dr. Karina Buka-Vaivade with the project titled "Structural Health Assessment of Bridges during and after Flood Events (FLOOD-SHAB – 2024-2026)". He is involved in researches sponsored by the Italian Ministero dell'Università dell'Istruzione e della Ricerca (MIUR). From 2019 he is the Scientific Coordinator for the UnivPM unit within the ReLUIS projects about risks, monitoring and assessment of bridges and isolated structures. He was the Principal Investigator of the Cariverona national research project "PROTECT - maPping the seismic Risk Of straTEgiC consTructions" from 2020 to 2022. He is the UnivPM unit coordinator within two European projects: SERA 2019 ("DYMOBRIS - DYnamic identification and MOnitoring of scoured BRIdgeS under earthquake hazard") and ERIES 2022 ("ERIES- SCOUR&SHAKE - Structural Performance monitoring and evaluation of scoured bridges under dynamic actions").

ORCID:
https://orcid.org/0000-0003-1272-0673

Main recent published papers:
1 – Matos J.C., Nicoletti V., Kralovanec J., Sousa H.S., Gara F., Moravcik M., Morais M.J. *Comparison of Condition Rating Systems for Bridges in Three European Countries*. **Applied Sciences**, 2023, 13(22), article number 12343. SCOPUS: 2-s2.0-85184656800. WOS: 001119945600001. ISSN: 20763417. DOI: 10.3390/app132212343.

2 – Gara F., Nicoletti V., Arezzo D., Cipriani L., Leoni G. *Model Updating of Cultural Heritage Buildings Through Swarm Intelligence Algorithms*. **International Journal of Architectural Heritage**, 2023. SCOPUS: 2-s2.0-85176955883. WOS: 001102593100001. ISSN: 15583058. DOI: 10.1080/15583058.2023.2277324.

3 – Carbonari S., Nicoletti V., Martini R., Gara F. *Dynamics of bridges during proof load tests and determination of mass-normalized mode shapes from OMA*. **Engineering Structures**. 2024, 310, article number 118111. SCOPUS: 2-s2.0-85192186837. WOS: 001238807400001. ISSN: 01410296. DOI: 10.1016/j.engstruct.2024.118111.

4 – Nicoletti V., Quarchioni S., Amico L., Gara F. *Assessment of different optimal sensor placement methods for dynamic monitoring of civil structures and infrastructures*. **Structure and Infrastructure Engineering**. 2024. SCOPUS: 2-s2.0-85198743271. WOS: 001278768000001. ISSN: 15732479. DOI: 10.1080/15732479.2024.2383299.

5 – Gara F., Carbonari S., Nicoletti V., Martini R., Brunetti A., Torsani A., Dall'Asta A. *Assessment and management of existing bridges following the innovative Italian guidelines: A pilot study*. **International Journal of Bridge Engineering, Management and Research (BER)**. 2024, Vol. 2(1), article number 21425008. DOI: 10.70465/ber.v2i1.19.

Research Group Description

Provide the name the reference department and a brief description of the research group, including external links, and available instrumentations and infrastructures. max 300 words

The involved research group is leaded by Prof. Eng. Fabrizio Gara and belongs to the Department of Construction, Civil Engineering and Architecture (DICEA) at the Engineering Faculty of the Università Politecnica delle Marche.

Members:
- Prof. Eng. Fabrizio Gara (Full Professor)
- Prof. Eng. Sandro Carbonari (Associate Professor)
- Prof. Eng. Laura Ragni (Associate Professor)
- Dr. Eng. Vanni Nicoletti (Assistant Professor)
- Dr. Eng. Erica Magagnini (Assistant Professor)
- Dr. Eng. Karina Buka-Vaivade (MSCA Research Fellow)
- 1 post-doc fellow
- 3 PhD students
- 3 MSc research fellowships

Topics:
The research group specializes in bridges, with extensive experience in theoretical studies, modelling, construction, and design, particularly of steel-concrete composite ones. They are involved in inspecting, testing, and assessing existing bridges using new code procedures, including combined structural and hydraulic evaluations. The group also has significant expertise in dynamic testing and monitoring of bridges and other structures in general.

Moreover, the research group is involved in research activities relevant to the soil-structure interaction and the structural seismic protection through base isolation and dissipative devices; these topics are addressed especially in the topic of bridges.

> *Instrumentation and infrastructures:*
> The research group owns high-quality instrumentation for performing dynamic tests on structures (accelerometers, dedicated hardware and software), both on laboratory and on-site. Moreover, it has the possibility to use the Materials and Structure Testing Laboratory of the university, which is equipped with many facilities (e.g. hydraulic pump, actuators and reaction walls for static and dynamic testing, shakers). Additionally, the group has already installed many static and dynamic monitoring systems on real structures (1 bridge, 1 heritage church, 1 strategic tower building, 19 residential buildings).

Research thematic area

Indicate the MSCA panel and keywords that better describe your field of competence and research thematic area of your interest for a MSCA PF supervision – you may add extra keywords and text if necessary.

MSCA Panel Chemistry (CHE) - Economic sciences (ECO) - Information Sciences and Engineering (ENG) - Environmental and Geosciences (ENV) - Life Sciences (LS) - Mathematics (MAT) - Physics (PHY) - Social Sciences and Humanities (SOC)	**MSCA Keywords** MSCA Panels & Keywords.pdf **Link documento**	**Free keywords**	**Free text**
ENG	Artificial intelligence, intelligent systems, multi agent systems	Existing bridge assessment	
	Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video)	Bridge inspection	
	Numerical analysis, simulation, optimisation, modelling tools	Expert knowledge	
	Civil engineering	Digital twin	
	Mobility and transportation		

Contact details (*including email address of the supervisor*)

> Prof. Eng. Fabrizio Gara
>
> Full Professor of Structural Engineering
> Department of Civil and Building Engineering, and Architecture (DICEA)
> Università Politecnica delle Marche
> Via Brecce Bianche, 12 - 60131 Ancona, Italy
> e-mail f.gara@univpm.it

OPTIONAL:

Title and goals

Provide the title of the topic and a short summary if you already have a project idea.
Projects ideas can also be defined and discussed with potential candidates later.

Expert-elicited Bayesian networks to enhance the interpretative capabilities of Digital Twins of bridges

Bridge management is a global concern, with many structures nearing the end of their service life and often in poor state of conservation. Managing and assessing these infrastructures is challenging due to their vast number and widespread locations, a general lack of information about existing structures, and the limitations of current inspection tools, which are often highly time-consuming. The combination of structural health monitoring (SHM) systems and artificial intelligence (AI) tools offers a promising solution for the damage patterns recognition and for predicting future scenarios, thus aiding decision-making.

This project aims to develop a tool for the probabilistic diagnosis and prediction of structural damage in bridges, utilizing Bayesian AI methods while accounting for structural, seismic, and geomorphological contexts. The approach is designed to enable the prompt detection of dangerous patterns that might otherwise go unnoticed or require lengthy expert input, thereby enhancing operational and emergency response capabilities.