Gabriele La Valle

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Place of Birth	Messina (ME), Italy	**Scopus Author ID**	57210145441
Date of Birth	August 26, 1995	**Gender**	Male
Nationality	Italian		

Current Position

2024–Now Assistant Professor (Maître de Conférences, MCF), Université Gustave Eiffel,
Modélisation et Simulation Multi-Echelle (MSME) Laboratory, UMR 8208 CNRS, France

Education and Qualifications

2024 Postdoctoral Researcher
Viterbi School of Engineering – University of Southern California, USA
Supervisor: Prof. Roger Ghanem
Research Topic: High-performance lightweight composites reinforced with polymer fibers for vehicle applications and durability of hydrogen gas turbine thermal coatings, as well as process improvement via novel probabilistic machine learning and uncertainty quantification for experimental analysis of tokamaks and fusion reactor design

2024 Qualification for the position of Assistant Professor (MCF), 60th section (Feb 7, 2024)

2021–2024 Certified Expert in Structural Mechanics (Oct 1, 2021 – Sep 30, 2024),
Issued by the Department of Engineering, University of Messina, Messina, Italy

2020–2023 Ph.D. in Materials and Structural Engineering and Chemistry
University of Messina, Messina (ME), Italy
Advisor: Prof. Giovanni Falsone
Dissertation: Generalized continua – foundations, material modeling, and uncertainty quantification

Honors with distinction and Doctor Europaeus mention

2021 Italian National License for Professional Civil Engineer Practice

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2018–2020 M.Sc. in Civil Engineering (LM-23)
University of Messina, Messina (ME), Italy
Master's Thesis Advisor: Prof. Giovanni Falsone
Thesis: On the Theory of Micropolar Elasticity

Summa cum laude

2014–2018 B.Sc. in Civil Engineering and Construction Systems Engineering (L-7)
University of Messina, Messina (ME), Italy
Bachelor's Thesis Advisor: Prof. Giovanni Falsone
Thesis: Static Analysis of Functionally Graded Beams and a Brief Study on Nonlocal Theories

Summa cum laude

2014 Scientific High School Diploma
Liceo Scientifico Statale "Archimede", Messina, Italy

Summa cum laude

Research Summary

Currently, my research focuses on the modeling of architectured metamaterials and particle-based materials within both deterministic and stochastic frameworks. These types of materials typically require advanced continuum models to accurately characterize their mechanical behavior and to enable robust numerical predictions. In this context, generalized continuum theories, which extend classical (Cauchy) continuum mechanics, have gained significant interest over the past decade. Among these, my primary focus has been on micropolar and higher-order continua.

Within the field of micropolar continua, I proposed a novel strain measure to simplify the analysis of nonlinear deformations. Furthermore, I developed analytical solutions for micropolar beams, addressing both deterministic and stochastic settings, with applications in nano- and micro-mechanical systems.

Regarding higher-order continua, I concentrated on pantographic structures, paradigmatic examples of architected metamaterials, as well as particle-based materials, which are systems where factors such as particle size, shape, and contact topology are typically neglected in conventional modeling.

For pantographic sheets (2D), I introduced a new torsional energy formulation. As for pantographic blocks (3D), I developed a new second-order model that was experimentally validated using digital image correlation techniques. Additionally, I investigated the mechanical response of pantographic sheets with local defects at pivots using a non-informative Bayesian probabilistic model.

With respect to particle-based materials, I conducted studies on the response and parameter identification of random Timoshenko-Ehrenfest beams using a non-informative prior model. I also carried out a sensitivity analysis of a second-order model for such materials using an informative Bayesian model based on the maximum entropy principle. Finally, I developed a novel higher-order nonlocal continuum model suitable for both deterministic and stochastic analysis. This model introduces a tensor that generalizes the Green-Saint Venant strain tensor within a nonlocal framework. One of the main challenges in generalized continua is the identification of constitutive tensors. I demonstrated that the proposed model also yields a symmetric and positive-definite acoustic tensor, which allows for a methodology based on acoustic tensor analysis to identify first- and second-order constitutive parameters.

Finally, I have begun applying uncertainty quantification and probabilistic machine learning techniques, commonly used in solid mechanics, to the field of plasma mechanics, particularly for the design of tokamaks and fusion reactors. , during my postdoctoral fellowship at USC.

More recently, I have become interested in an innovative approach aimed at building continuous models from discrete descriptions for materials characterized by random geometric and physical properties. This methodological framework enables a more rigorous connection between micro/nanoscopic and macroscopic behaviors by explicitly incorporating heterogeneity, underlying structure, surface effects, and scale, which are especially relevant for understanding material behavior and driving technological and industrial developments.

These research efforts have led to the publication of several scientific articles (see Publications) and have been conducted in collaboration with numerous international research partners.

Publications

- G. La Valle, F. Fabbrocino, B. Desmorat. *On the influence of microproperties of elastoplastic hinges on the global behavior of pantographic sheets in bias extensional test,* Continuum Mechanics and Thermodynamics (2024), DOI: 10.1007/s00161-024-01325-0

- G. La Valle, C. Soize. *Identifying Second-Gradient Continuum Models in Particle-Based Materials with Pairwise Interactions Using Acoustic Tensor Methodology*, Journal of Elasticity (2024), DOI: 10.1007/s10659-024-10067-8

- G. La Valle, C. Soize. *Stochastic Second-Gradient Continuum Theory for Particle-Based Materials: Part II,* Zeitschrift für angewandte Mathematik und Physik (2024), DOI: 10.1007/s00033-024-02232-9

- G. La Valle, C. Soize. *A Higher-Order Nonlocal Elasticity Continuum Model for Deterministic and Stochastic Particle-Based Materials*, Zeitschrift für angewandte Mathematik und Physik (2024), DOI: 10.1007/s00033-024-02196-w

- G. La Valle, G. Falsone. *On the Random Axially Functionally Graded Micropolar Timoshenko-Ehrenfest Beams* In: dell'Isola, F., Barchiesi, E., León Trujillo, F.J. (eds) *Advances in Mechanics of Materials for Environmental and Civil Engineering. Advanced Structure.* Advanced Structured Materials, vol 197. Springer, Cham (2023), DOI: 10.1007/978-3-031-37101-1_5

- G. La Valle, B.E. Abali, G. Falsone, et al. *Sensitivity of a homogeneous and isotropic second-gradient continuum model for particle-based materials with respect to uncertainties*, Zeitschrift für angewandte Mathematik und Mechanick (2023), DOI: 10.1002/zamm.202300068

- G. La Valle, M. Spagnuolo, E. Turco, et al. *A new torsional energy for pantographic sheets*, Zeitschrift für angewandte Mathematik und Physik (2023), DOI: 10.1007/s00033-023-01954-6

- G. La Valle, G. Falsone. *Random micropolar beams: response and identification*, International Journal of Non-Linear Mechanics (2023), DOI: 10.1016/j.ijnonlinmec.2023.104367

- A. Ciallella, G. La Valle, A. Vintache, et al. *Deformation mode in 3-point flexure on pantographic block*, International Journal of Solids and Structures (2023), DOI: 10.1016/j.ijsolstr.2023.112129

- G. La Valle, A. Ciallella, G. Falsone. *The effect of local random defects on the response of pantographic sheets*, Mathematics and Mechanics of Solids (2022), DOI: 10.1177/10812865221103482

- G. La Valle. *A new deformation measure for the nonlinear micropolar continuum*, Zeitschrift für angewandte Mathematik und Physik (2022), DOI: 10.1007/s00033-022-01715-x

- G. La Valle, R. Laudani, G. Falsone. *Response probability density function for non-bijective transformations*, Communications in Nonlinear Science and Numerical Simulation (2022), DOI: 10.1016/j.cnsns.2021.106190

- S. Massoumi, G. La Valle. *Static analysis of 2D micropolar model for describing granular media by considering relative rotations*, Mechanics Research Communications, (2022), DOI: 10.1016/j.mechrescom.2021.103812

- G. La Valle, S. Massoumi. *A new deformation measure for micropolar plates subjected to in-plane loads*, Continuum Mechanics and Termodynamics (2022), DOI:10.1007/s00161-021-01055-7

- G. Falsone, G. La Valle. *Dynamic, buckling of functionally graded beams based on a homogenized theory*, Research on Engineering Structures & Materials (2021), DOI:10.17515/resm2021.259st0216

- G. Falsone, G. La Valle. *A homogenized theory for functionally graded Euler–Bernoulli and Timoshenko beams*, Acta Mechanica (2019), DOI:10.1007/s00707-019-02493-w

Presentations at National and International Conferences

- G. La Valle, T. Bernard, R. Ghanem. *Statistical analysis of the full-f gyrokinetic model: Gkeyll simulations vs. Langmuir probe experiments via probabilistic learning.* 18th U.S. National Congress on Computational Mechanics (USNCCM18), July 20–24 2025, Chicago, USA.

- G. La Valle, C. Soize. *Particle-Based Materials: Nonlocal Elasticity, Stochastic Analysis, and Wave Propagation-Based Identification,* META-MEETING MEMOCS 2025, Methods in Metamaterials design: mathematical modelling, mumerical techniques, experiments, March 30–April 4 2025, Arpino, Italy

- G. La Valle, B.E. Abali, G. Falsone, et al. *Sensitivity with respect to uncertainties of a particle-based homogeneous and isotropic second-gradient continuum model,* Engineering Mechanics Institute 2023 International Conference, EMI 2023 IC, August 23–26, 2023, Palermo, Italy

- G. La Valle, B.E. Abali, G. Falsone, et al. *Sensitivity with respect to uncertainties of a particle-based homogeneous and isotropic second-gradient continuum model,* Workshop Mathematical modelling in biology and medicine, May 8–12 2023, Arpino, Italy

- G. La Valle, A. Ciallella, G. Falsone. *The effect of local random defects on the response of pantographic sheets,* Workshop of the IRP Coss&Vita: Metamaterials and biomechanics: from bio-inspiration to bio-metamaterials, October 24–26, 2022, Arpino, Italy

- G. La Valle, G. Falsone. *Response and constitutive identification of random axially functionally graded micromorphic Timoshenko beams,* XXV AIMETA Conference, September 4–8, 2022, Palermo, Italy

- G. La Valle. *Effect of local random defects on the response of non-classical elastic materials,* International Conference on Nonlinear Solid Mechanics (ICoNSoM 2022), June 13–16, 2022, Alghero, Italy

- G. La Valle. *Stochastic response of generalized continua,* Coss&Vita up-comech-2022: Workshop on design and analysis of non-classical architectured materials, May 23–27, 2022, Fréjus, France

Research Talks

- G. La Valle. *Particle-Based Materials: Nonlocal Elasticity, Stochastic Analysis, and Wave Propagation-Based Identification*, Journée MECA, June 13, 2025, Université Gustave Eiffel, France
- G. La Valle. *Mechanics via the Least Action Principle: Deterministic and Stochastic Applications in Pantographic Structures, Particle-Based Materials, and Plasma Mechanics,* Séminaire transverse, Dec 6, 2025, Université Gustave Eiffel, France

International Research Activities – Visiting Scholar

Oct 1, 2022 – Jan 31, 2024	**Probabilistic Approach in Generalized Continuum Models** In collaboration with MSME and Prof. Christian Soize	Université Gustave Eiffel, France
Sep 18–23, 2022	**Numerical Modeling of Generalized Continua** In collaboration with M&MoCS and Prof. Bilen Emek Abali	Uppsala University, Sweden
Nov 21–26, 2021	**Experimental Measurements on Pantographic Structures** In collaboration with M&MoCS and Prof. François Hild	ENS Paris-Saclay, France
Oct 24 – Nov 4, 2021	**3D Printing of Pantographic Structures** In collaboration with M&MoCS and Prof. Tomasz Lekszycki	Warsaw University of Technology, Poland

Additional Training from National and International Courses

July 3, 2023 **Thematic Day on "Probabilistic Approaches in Mechanics" by CNRS F2M**

(8 hours) of lectures on key research topics in probabilistic approaches in mechanics (Université Gustave Eiffel)

June 2, 2023 **MSME Day 2023**

(8 hours) of lectures on Artificial Intelligence / High-Performance Computing / Multiscale Modeling (ESIEE Paris)

Nov 23, 2023 **Thematic Meeting of GDR-GDM**

(4 hours) of lectures by A. Hamdouni, F. Dell'Isola, R. Louis, F. Loiseau, C. Stolz, G. De Saxcé (ENS Paris-Saclay)

May 5 – June 18, 2021 **Introduction to Digital Image Correlation and Parameter Calibration**

(24 hours) by François Hild (ENS Paris-Saclay)

July 12–16, 2021 **Tensor Analysis with Applications in Continuum Mechanics**

(28 hours) by Victor Eremeyev (University of Cagliari, DICAAR)

Teaching Activities

Spring 2025 **Beam Theory, Université Gustave Eiffel / IFSA, France**

(18 hours of lectures + 16 hours of tutorials, Undergraduate level – 3rd year). Course on fundamental concepts of beam theory.

Winter 2025 **Introduction to Fluid and Solid Mechanics, Université Gustave Eiffel / IFSA, France**

(5 hours of lectures + 5 hours of tutorials, Undergraduate level – 1rd year). Course covering motion, equilibrium, and dynamics of rigid bodies.

Winter 2024 **Mechanics of Deformable Bodies, Université Gustave Eiffel / IFSA, France**

(12 hours of lectures + 14 hours of tutorials, Undergraduate level – 3rd year). Course on continuum mechanics.

Fall 2023 & Fall 2024 **Structural Dynamics, Université Gustave Eiffel / IFSA, France**

(15 hours of lectures + 15 hours of tutorials, Master's level – M2). Course on structural dynamics.

Fall 2023 & Fall 2024 **Mechanics of Materials, Université Gustave Eiffel / IFSA, France**

(5 hours of lectures + 5 hours of tutorials, Master's level – M2). Course on beam theory

Fall 2023 **Deformable Solids, Université Gustave Eiffel / ESIEE Paris (France)**

(12 hours of lectures, 2nd-year engineering level). Introductory course in continuum mechanics

Fall 2023 **Mathematical Methods for Mechanics, Université Gustave Eiffel / IFSA, France**

(16 hours of tutorials + 16 hours of lab sessions, Master's level – M1). Responsible for tutorials and practical sessions on mathematical methods for mechanics .

1 oct 2021-1 oct 2022 **Tutoring Activities for the Structural Mechanics Course, University of Messina, Italy**

(Undergraduate level – 2nd year). Theoretical and practical aspects for students at the University of Messina

1 avr 2022-31 déc 2022 **Academic Support for Students with Learning Disabilities (SLD), University of Messina, Italy**

(173H) Physics and signal theory.

6-9 sept 2021 **Tutoring Activities for First-Year Students, University of Messina, Italy**

(9H) Introduction to physics.

Recognition

July 24–29, 2017 **Selected to attend the 2017 Excellence School organized by the University of Messina, Italy**

Training course on "Brain-Inspired Computing" by Prof. Giovanni Finocchio

Languages

- Italian: Native proficiency
- English: Fluent
- French: Fluent