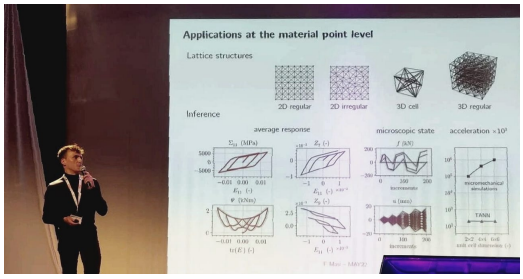
Curriculum Vitae

Filippo Masi

Updated on: Feb 2023

Email:	filippo.masi@sydney.edu.au
Internet website:	filippo-masi.github.io
Profiles:	Google Scholar
	ResearchGate
	OrcidID
Channels:	LinkedIn
	Twitter
	YouTube



1 Career summary

Since late 2022, I joined the Sydney Centre in Geomechanics and Mining Materials (SciGEM) at The University of Sydney, School of Civil Engineering (Australia).
I studied at the School of Mechanical Engineering of the University of Florence (Italy) and did my thesis jointly at Ecole des Ponts ParisTech and Ecole Centrale de Nantes (France), in collaboration with the University of Versailles and St-Quentin and the enterprise Ingerop. My research concerns the development of data-driven and machine learning approaches for the constitutive modeling of materials, the structural and fast-dynamic behavior of masonry structures, geomechanics, and hydrodynamics.

1.1 Scientific interest and research axes

Thermodynamics-based machine learning approaches for material constitutive modeling – Computational mechanics – Multiscale modeling – Structural Mechanics – Masonry – Granular materials – Fast Dynamics – Blast loads – Rocking systems.

2 Employment

01/12/2022 – present	**Postdoctoral research associate**, Sydney Centre in Geomechanics and Mining Materials, School of Civil Engineering, The University of Sydney, Australia.
01/01/2021 – 30/11/2022	**Post-doctoral researcher** under the ERC-StG CoQuake (Controlling Earthquakes) project, Ecole Centrale de Nantes, GeM Laboratory, France.
02/11/2020 – 31/12/2020	**Research Engineer** at Ecole Centrale de Nantes – Centrale Innovation, France.
18/09/2017 – 31/10/2020	**Engineer**, Ingérop Conseil et Ingénierie, France.
24/06/2016 – 24/10/2016	**Research Engineer**, Ecole des Ponts ParisTech, France.

3 Academic degrees

01/10/2017 – 14/12/2020	**PhD**, Mechanics – Ecole Centrale de Nantes, Ecole des Ponts ParisTech, in collaboration with University of Versailles and St-Quentin and Ingerop, France. "Fast-dynamic response and failure of masonry structures subjected to blast loads". Supervisors: Prof I Stefanou, Prof P Vannucci.
01/01/2016 – 17/07/2017	**Master**, Mechanical Engineering, University of Florence, Italy (solemn commendation of the committee – outstanding).
01/10/2013 – 03/12/2015	**Bachelor**, Mechanical Engineering, University of Florence, Italy.

4 Honors and Awards

2022 Early Career Researcher **Award** by EUROMECH (European Mechanics Society), on the occasion of the 18th European Mechanics of Materials Conference, Oxford, UK.

2021 **Award** for the best PhD thesis bringing technological and conceptual breakthroughs in the industry by Centrale Innovation (Ecoles Centrales Group).

2021 **Award** for the best PhD by CSMA (Computational Structural Mechanics Association).

2021 Finalist in the selection for ECCOMAS PhD award, Robert J Melosh Medal by Duke University, I Vardoulakis prize by ALERT Geomaterials.

2017 **Award** for the best Master thesis by the Order of Engineers of Florence, Italy.

5 Scientific production

Author of **11 articles** in major multi-disciplinary scientific journals and leading peer-reviewed international journals.

All contributions, except for [VSM17], are freely available via open-science platforms (HAL and arXiv), indicated by their url address, when not freely available at the provided DOI. The access to [VSM17] is restricted as classified *Confidentiel Défense*.

5.1 Refereed journal articles

[MS23] F Masi and I Stefanou. "Evolution TANN and the identification of internal variables and evolution equations in solid mechanics". In: *J Mech Phys Solids* (*in press*) 105245 (2023). DOI: 10.1016/j.jmps.2023.105245. URL: https://arxiv.org/abs/2209.13269.

[MS22a] F Masi and I Stefanou. "Multiscale modeling of inelastic materials with Thermodynamics-based Artificial Neural Networks (TANN)". In: *Comput Methods Appl Mech Eng* 398 (2022), p. 115190. DOI: 10.1016/j.cma.2022.115190. URL: https://arxiv.org/abs/2108.13137.

[MSMB21] F Masi, I Stefanou, and V Maffi-Berthier. "Scaling laws for rigid-body response of masonry structures under blast loads". In: *J Eng Mech (featured in the Editor's Choice section)* 147.10 (2021), p. 04021078. DOI: 10.1061/(ASCE)EM.1943-7889.0001986. URL: https://arxiv.org/abs/2012.09494.

[Mas+21b] F Masi, I Stefanou, P Vannucci, and V Maffi-Berthier. "Thermodynamics-based Artificial Neural Networks for constitutive modeling". In: *J Mech Phys Solids* 147 (2021), p. 104277. DOI: 10.1016/j.jmps.2020.104277. URL: https://arxiv.org/abs/2005.12183.

[Mas+20a] F Masi, I Stefanou, V Maffi-Berthier, and P Vannucci. "A Discrete Element Method based-approach for arched masonry structures under blast loads". In: *Eng Struct* 216 (2020), p. 110721. DOI: 10.1016/j.engstruct.2020.110721. URL: https://hal.science/hal-02320696v2.

[Mas+20b] F Masi, I Stefanou, P Vannucci, and V Maffi-Berthier. "Resistance of museum artefacts against blast loading". In: *J Cul Her* 44 (2020), pp. 163–173. DOI: 10.1016/j.culher.2020.01.015. URL: https://hal.science/hal-02320029.

[Mas+19c] F Masi, I Stefanou, P Vannucci, and V Maffi-Berthier. "Rocking response of inverted pendulum structures under blast loading". In: *Int J Mech Sci* 157-158 (2019), pp. 833 –848. DOI: 10.1016/j.ijmecsci.2019.05.024. URL: https://hal.science/hal-02132167.

[VMS19] P Vannucci, F Masi, and I Stefanou. "A nonlinear approach to the wind strength of Gothic Cathedrals: The case of Notre Dame of Paris". In: *Eng Struct* 183 (2019), pp. 860 –873. ISSN: 0141-0296. DOI: https://doi.org/10.1016/j.engstruct.2019.01.030. URL: https://hal.science/hal-01458767v5.

[MSV18a] F Masi, I Stefanou, and P Vannucci. "A study on the effects of an explosion in the Pantheon of Rome". In: *Eng Struct* 164 (2018), pp. 259–273. DOI: 10.1016/j.engstruct.2018.02.082. URL: https://hal.science/hal-01493006v2.

[MMV18] F Masi, PM Mariano, and P Vannucci. "Blast actions in aircrafts: An integrated methodology for designing protection devices". In: *Eng Struct* 175 (2018), pp. 895 –911. DOI: 10.1016/j.engstruct.2018.08.082. URL: https://hal.science/hal-01720002v2.

[MSV18b] F Masi, I Stefanou, and P Vannucci. "On the origin of the cracks in the dome of the Pantheon in Rome". In: *Eng Fail Anal* 92 (2018), pp. 587–596. DOI: 10.1016/j.engfailanal.2018.06.013. URL: https://hal.science/hal-01719997v3.

5.2 Reviewed international conferences

[Mas+19e] F Masi, I Stefanou, P Vannucci, and V Maffi-Berthier. "Response of monumental buildings to internal explosions". In: *Proceedings of the 7th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering (COMPDYN 2019), Papadrakakis, Fraiadakis (eds), Crete, Greece*. 2019 (short version of [MSV18a]), pp. 24–26. DOI: 10.7712/120119.6958.19630.

[Mas+19d] F Masi, I Stefanou, P Vannucci, and V Maffi-Bertier. “Rocking response and overturning of museum artefacts due to blast loading”. In: *Proceedings of the 7th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering (COMPDYN 2019), Papadrakakis, Fraiadakis (eds), Crete, Greece*. 2019 (preliminary, short version of [Mas+20b]), pp. 24–26. DOI: 10.7712/120119.7119.19577.

5.3 Other international publications

[MS21] F Masi and I Stefanou. “Thermodynamics-based Neural Networks: a general framework for modeling microstructured materials displaying path-dependency (poster)”. In: *32th Workshop ALERT Geomaterials, Aussois, France*. 2021 (dissemination of [MS22a]).

[Mas+21a] F Masi, I Stefanou, P Vannucci, and V Maffi-Berthier. “Material modeling via thermodynamics-based artificial neural networks”. In: *Geometric Structures of Statistical Physics, Information Geometry, and Learning: SPIGL’20, Les Houches, France, July 27–31*. Ed. by F Barbaresco and F Nielsen. Springer International Publishing (poster later disseminated as short paper), 2021, pp. 308–329. DOI: 10.1007/978-3-030-77957-3_16.

[RMS21] F Rabie, F Masi, and I Stefanou. “Thermodynamics-based Artificial Neural Networks for Nonlinear Seismic Analysis of High-rise Buildings (poster)”. In: *32th Workshop ALERT Geomaterials, Aussois, France*. 2021.

5.4 Reviewed national conferences

[MS22b] F Masi and I Stefanou. “Réseaux de neurones artificiels basés sur la thermodynamique (TANN) pour la mécanique computationnelle et la modélisation multi-échelle”. In: *25eme Congrès Français de Mécanique (CFM), Nantes, France*. 2022 (short version of [MS22a] submitted as application to Paul Germain Prize, organized by *Association Française de Mécanique*). URL: https://cfm2022.fr/themes-scientifiques/s22-approches-multi-echelles-en-mecanique-des-solides.

[Mas+22] F Masi, I Stefanou, A Morsel, and P Kotronis. “Reduced-scaled experiments of masonry structures under blast loads”. In: *25eme Congrès Français de Mécanique (CFM), Nantes, France*. 2022. URL: https://cfm2022.fr/themes-scientifiques/s31-choc-impact-et-explosion.

[Piu+22] G Piunno, F Masi, I Stefanou, and C Jommi. “Multi-scale modelling of natural composites via Thermodynamics-based Artificial Neural Networks”. In: *25eme Congrès Français de Mécanique (CFM), Nantes, France*. 2022. URL: https://cfm2022.fr/themes-scientifiques/s22-approches-multi-echelles-en-mecanique-des-solides.

5.5 Research reports and publications under review

[Mas20] F Masi. “Fast-dynamic response and failure of masonry structures of non-standard geometry subjected to blast loads”. PhD thesis. École centrale de Nantes, 2020. URL: https://theses.hal.science/tel-03217357.

[VSM19] P Vannucci, I Stefanou, and F Masi. *Structural integrity of Notre Dame Cathedral after the fire of April 15th, 2019*. Tech. rep. Paris: UVSQ-ENPC, 2019. URL: https://hal.archives-ouvertes.fr/hal-02105786v2.

[VMS17] P Vannucci, F Masi, and I Stefanou. *A comparative study on the effects of blast actions on a monumental structure*. Tech. rep. Paris: UVSQ-ENPC, 2017. URL: https://hal.science/hal-01720557.

[VSM17] P Vannucci, I Stefanou, and F Masi. *Cathédrales Durables (classified: Confidentiel Défense)*. Tech. rep. Paris: CNRS, 2017.

5.6 Invitations to workshop and seminars

2023 Invited lecture, “*IA: Approches et intérêt pour l’étude des CMC – Atelier”, Groupement de Recherche (CMC)*^{2} – Composites à Matrice Céramique: Conception, Modélisation, Caractérisation, ENS Paris-Saclay, 17 March 2023.

2022 Invited lecture, “ISSMGE TC309 Technical Forum of Young Scholars on Data-driven Modelling of Soil Behaviours with Geotechnical Applications”, Hong Kong Polytechnic University, 25 November 2022.

2022 Invitation to workshop. *Deep learning, simulation temps réel et réduction de modèles*, “5^e Workshop Computational Structural Mechanics Association (CSMA) Junior”. Giens, France, 14-16 May 2022 (workshop material).

2021 Invited lecture, “How Machine Learning can help in earthquake control and fault mechanics?”, Crunch Machine Learning + X Seminars, Brown University, Division of Applied Mathematics, 12 November 2021 (lecture).

2021 Invited lecture, “Can we tame earthquakes?” Data-centric engineering, The University of Sydney, 27 October 2021 (slides – lecture).

5.7 Software development

I contributed to the following software, presented using Inria’s guidelines for software self-assessment.

TANN – “Thermodynamics-based Artificial Neural Networks”

- `Family=research`, `Audience=universe`, `Evolution=lts`, `Duration=2` (years), `Contribution=leader`
- `url=https://github.com/filippo-masi/Thermodynamics-Neural-Networks`
- This is a collection of `Python` scripts implementing Thermodynamics-based Artificial Networks (TANN) at the material point level. The collection includes datasets, data pre-processing, and training of TANN implemented via both `Tensorflow` and `PyTorch` libraries.

h2plasticity – “h^2 plasticity constitutive models”

- `Family=utility`, `Audience=partners`, `Evolution=lts`, `Duration=2`, `Contribution=devel`
- `url=https://github.com/filippo-masi/h2plasticity`
- This an implementation in `Python` in the form of `Jupyter` notebooks of the h^2-plasticity models developed in (*).

  (*) I Einav. “The unification of hypo-plastic and elasto-plastic theories.” *International Journal of Solids and Structures* 49.11-12 (2012): 1305-1315. DOI: 10.1016/j.ijsolstr.2012.02.003.

DLworkshop – “Workshop on Deep Learning and constitutive modelling”

- `Family=vehicle`, `Audience=universe`, `Evolution=lts`, `Duration=1`: recently migrated from deepnote.com, `Contribution=leader`
- `url=https://github.com/filippo-masi/CSMA-Workshop-in-Deep-Learning`
- The repository collects all information, codes, and presentations related to the workshop on deep learning approaches for material constitutive modelling I presented at the 5th CSMA (Computational Structural Mechanics Association) Junior held in Porquerolles Island, France, on 14-15 May 2022. The workshop was originally designed for a group of 30-40 young scholars, mainly PhD candidates and postdoctoral researchers. The repository, composed of `Python` scripts, explains the bases to build artificial neural networks for constitutive modeling and via examples, of increasing difficulty, guide young scholars in understanding the difference between black-box approaches and physics-based ones.

TANN-multiscale – “Multiscale modeling of inelastic materials with Thermodynamics-based Artificial Neural Networks (TANN)”

- `Family=research`, `Audience=universe`, `Evolution=lts`, `Duration<=1`, `Contribution=leader`
- `url=https://github.com/filippo-masi/TANN-multiscale`
- The repository collects `Python` scripts necessary for the validation of the benchmarks presented in [MS22a] and is composed of two parts. The former is a Finite Element code for simulating the response of lattice materials and structures, under several type of prescribed boundary conditions (periodic, Neumann, Dirichlet). The latter is a hands-on for performing Finite Element analyses using TANN as a user-material, relying on the open-source platform `FEniCS`. The scripts of this second part have dependencies within the software `Numerical Geolab` (*), which is, at the time being, under review for publication and will soon be available as open source library.

  (*) A Stathas and I Stefanou. “Numerical Geolab, FEniCS for inelasticity.” *The FEniCS Conference* (2022).

Additional software and data related to the validation of published research outputs are available under request (as mentioned in post-print and published versions of the articles).

6 Supervising and teaching

6.1 Supervision and mentoring

– **PhD students**

- Ahmad Morsel (01/2021 – present) – PhD student, Ecole Centrale de Nantes. PhD in the frame of BLAST (Blast LoAds on STructures) – Connect Talent project, funded by Pays de la Loire and Nantes Metropole (PI Ioannis Stefanou).
  Subject: Experimental testing of masonry structures subjected to extreme loads
  Amount of supervision: 30% (in collaboration with Ioannis Stefanou and Panagiotis Kotronis).
  Significance of the work: This work will provide new insights into the response of blocky (masonry) structures

subjected to fast-dynamic loading (explosions). Through this research, a unique platform for performing reduced-scale experiments of structures under blast loads is being designed. The experiments will convey valuable information for current state-of-the-art knowledge in modelling the fast-dynamic response of blocky structures.

- **Master students**
  - Farah Rabie (02/2021 – 08/2021) – Master internship at Ecole Centrale de Nantes, in the frame of CoQuake (Controlling earthQuakes) – European Research Center (ERC) Starting Grant.
    Subject: Thermodynamics-based Artificial Neural Networks for nonlinear seismic analysis of high-rise buildings.
    Amount of supervision: 60% (in collaboration with Ioannis Stefanou).
    Significance of the work: This work concerns the application of Thermodynamics-based Neural Networks to high-rise buildings, with a in-depth study of machine learning models (in particular deep Learning and model order reduction methods). The study proposed an alternative way to otherwise computationally expensive seismic analyses of civil infrastructures.
    At present: PhD candidate at Heriot-Watt University (supervisors: Dan Arnold, Helen Lewis and Vasily Demyanov)
  - Barbara Abougaye (02/2020 – 08/2020).
    Subject: Scaling laws for the material response under impact loading. Amount of supervision: 60% (in collaboration with Ioannis Stefanou).
    Significance of the work: During this internship, literature review and preliminary studies were carried on the derivation of scaling laws for the material behaviour under impact loading.
    At present: Graduated in Civil Engineering, Ecole Centrale de Nantes.

6.2 Courses taught

- During my PhD at Ecole des Ponts, I was teaching assistant for two undergraduate courses: “Computational mechanics” and “Advanced computational mechanics”. My duties included presenting solutions during problems classes, marking midterm exams, and preparing a short project for a team of four students.
- During my PhD and, later, postdoc at Ecole Centrale de Nantes, I helped with problems solution in the undergraduate course of “Continuum mechanics” and I was responsible (from 2020 to 2022) of the Master’s course on “Experimental imaging analysis for Engineers”. To this end, my duties included all standard duties of a lecturer (course and classes preparation, problem solutions, and exams preparation and marking).
- During my postdoc at the University of Sydney, I continue to teach (virtually) the Master’s course on “Experimental imaging analysis for Engineers”.

7 Service

7.1 Responsibilities

- Invited reviewer for the following international scientific journals (in alphabetical order): Comput Mech – Comput Methods Appl Mech Eng – Def Technol – Eur J Mech A Solids – Géotechnique – Int J Mech Sci – Int J Numer Anal Methods Geomech – Int J Numer Methods Eng – J Mech Phys Solids – Strain.
- Co-organizer of the Minisymposium entitled Scientific Machine Learning techniques for complex engineering systems on the occasion of the next ECCOMAS Young Investigators Conference (YIC2023), to be held in Porto, Portugal (19-21 June, 2023).
- Member of the Direction Board of GeM laboratory, Ecole Centrale de Nantes (03-11/2022).

7.2 Dissemination of scientific knowledge

2023 Coordinator of the "*Explosions, vibrations et patrimoine*" workshop (with Ahmad Morsel, Ioannis Stefanou, Panagiotis Kotronis, Guillaume Racineux, Emmanuel Marche), on the occasion of the 2023 edition of the *Nuit Blanche des Chercheur.es* event hosted by Nantes Université (short video).

2022 Blog on my PhD experience under the form of an interview to outreach young generations about academia, industry, and international exchanges, published by *Docteurs Sciences pour l’Ingénieur (SPI)*.

2022 From 2020, Ambassador of DECLICS Association: *Dialogues Entre Chercheurs et Lycéens pour les Intéresser à la Construction des Savoirs*.[1]

[1] Dialogues between researchers and high school students to interest them in the construction of knowledge.

2021 Popularization of part of the PhD thesis works in the French civil engineering magazine *Cahiers Techniques du Bâtiment (CTB)*, written by Stéphanie Obadia: "*Béton : quelle réaction face à l'explosion ?*", September, 2021.

2020 Webinar for a wide professional (civil engineering) public: "*Comportement des structures maçonnées à l'explosion*", Ingérop, 29 October, 2020.