

Curriculum Vitae et Studiorum

Michele Curatolo

Position

- 2022-Present RTDA at Architecture Department, Roma Tre University.
Research project: Housing settlements and water desalination; a response in nanostructured membranes.
- 2020-2021 RTDA at Structural and Geotechnical Engineering Department, Sapienza University of Rome.
Research projects: Extra fast and accurate simulation of complex structural systems & Integrated mechanobiology approaches for a precise medicine in cancer treatment.
- 2019-2020 Post-Doc at Structural and Geotechnical Engineering Department, Sapienza University of Rome.
Research project: Morphing of soft elastic anisotropic thin structures.
Tutor: Prof. P. Nardinocchi

Fields of Interest

My current research involves the investigation of graphene membranes for water desalination. My primary interest is on innovative topics such as diffusion in solids, mechanical instabilities, shape-shifting mechanisms and smart materials. Other fields of interest include meta-hydrogels and problems of fluid-solid interaction. I work among engineering, mathematics and physics and I am interested in analytical, numerical methods and occasionally experiments.

Education

- Oct. 2015-Mar. 2019 Ph.D. in Civil Engineering,
Roma TRE University,
Thesis: Smart Materials as Energy Transducers
Advisors: Dr. P. Prestininzi & Prof. L. Teresi
- Oct. 2013-Oct. 2015 Master's Degree in Civil Engineering: Protection from Natural Hazards,
Roma TRE University, 110/110 *cum laude*.
Thesis: Fluid-structure interaction for an elastic beam
Advisor: Prof. L. Teresi
- Oct. 2010-Dec. 2013 Bachelor's Degree in Civil Engineering,
Roma TRE University, 106/110.
Thesis: Elastic waves in anisotropic materials
Advisor: Prof. L. Teresi

Appointments & Visiting Positions

- Fall 2019 Visiting at Virginia Polytechnic Institute and State University, USA.
Research project: mathematical modeling of the material response and active biological tissue.
Host: Prof. Raffaella De Vita
- Fall 2018 Visiting at Technical University of Dresden, Germany.
Research project: numerical investigation on the electro-chemo-mechanical model for thin Nafion membranes employed in batteries and fuel cells.
Host: Prof. Thomas Wallmersperger
- Fall 2017 Visiting at Technical University of Dresden, Germany.
Research project: numerical investigation on the interaction between mechanical and electrochemical field within an electrochemical cell.
Host: Prof. Thomas Wallmersperger
- Apr.-Jul. 2017 Visiting scholarship at Boston University, USA.
Research project: experiments and simulations on swelling and adhesion of gels.
Advisor: Prof. D. P Holmes

Teaching Activity

- Oct. 2021-Dec. 2021 Course: Building Science at Environmental and Industrial Engineering (3 CFU - 30 hours)
- Nov. 2020-Dec. 2021 Course: Building Science at Project Management in Building Construction (6 CFU - 48 Hours)
- Mar. 2020-Dec. 2021 Subject Expert of the examination board at Civil and Industrial Engineering for the course: Building Science.

Participation to National and International Research Projects as Principal Investigator (PI) and Member (I)

I: Research Project Grant, "Giovani Ricercatori", INdAM (€ 3150,00), "Cellular diffusion via Phase Field Methods: Blebbing & Plastic Remodeling of ECM", protocol number: U-UFMBAZ-2021-000074, 2021.

I: PRIN 2017: Extra fast and accurate simulation of complex structural systems, prot. 20173C478N_006, CUP: B88D19001150001, 2020-2021.

I: PRIN 2017: Integrated mechanobiology approaches for a precise medicine in cancer treatment, prot. 20177TTP3S_006, CUP: B88D19001060001, 2020-2021.

PI: Research Project Grant, "Progetti per Avvio alla Ricerca - Tipo 2", Sapienza University of Rome (€ 3150,00), "Morphing of soft elastic anisotropic thin structures", protocol number: AR21916B698F2037, 2019.

I: Research Project Grant, "Progetti di Ricerca (Piccoli Medi) - Progetti Medi", Sapienza University of Rome, (€ 15000,00), "Mechanical insights into volume overloaded left heart: two-chamber diastolic-systolic functional diseases", protocol number: RM1181642B2FDE85, 2018.

I: Research Project Grant, "great!*ipid4all*", Technical University of Dresden Graduate Academy (€ 5216,80),

"numerical investigation on the electro-chemo-mechanical model for thin Nafion membranes employed in batteries and fuel cells", protocol number: 2018_84, 2018.

I: Research Project Grant, "Giovani Ricercatori", INdAM (€ 2500,00), "Attuatori idrogel", protocol number: U-UFMBAZ-2018-000356, 2018.

I: Research Project Grant, "great!*ipid4all*", Technical University of Dresden Graduate Academy (€ 3761,44), "numerical investigation on the interaction between mechanical and electrochemical field within an electrochemical cell", protocol number: 2017_74, 2017.

I: Research Project Grant, "Progetti di Ricerca Grandi - Progetti Grandi", Sapienza University of Rome, (€ 40000,00), "Mechanics of Soft Fibered Active Materials", protocol number: RG11715C7CE2C1C4, 2017.

I: Research Project Grant, "Giovani Ricercatori", INdAM (€ 3000,00), "Mathematical modeling of bio-hybrid and bio-inspired soft robots", protocol number: U2016/000191, 2016.

Awards and Honours

- ISIMM Junior Prize, given by The International Society for the Interaction of Mechanics and Mathematics (ISIMM) for the engagement in the interaction of mechanics and mathematics, 2020.

- Merit Grant for Maximum Score in the Academic Title, given by Fiumicino City (€ 1000,00), 2016.

- "Best Paper Award" for the paper *The Virtual Aquarium: Simulation of Fish Swimming* presented at the European COMSOL Conference, Grenoble, France, October 2015.

- "Best Poster Award" (popular choice), for the poster *The Virtual Aquarium: Simulation of Fish Swimming* presented at the European COMSOL Conference, Grenoble, France, October 2015.

Research Activity

A short description

My primary research focus is now on graphene membranes for water desalination. My past activity was on the study of diffusion and swelling in soft solids (see [1, 3, 7]). This research line, includes: the design of innovative meta-hydrogels (hydrogels with unusual properties given by internal structure rather than composition) (see [9]), the prediction of hydrogels shape after swelling or de-hydration (see, [5, 6]), the study of diffusion and instabilities in gel micro-capsules and the investigation of active gels using a mathematical model which couples mechanics, diffusion and active contraction or growth (see [4, 13]). Finally, I work also on multi-physics problems such as bending of piezoelectric materials and fluid-solid interactions (see [8, 14]).

Summary of Scientific Achievements

Articles in International Journals

1. **M. Curatolo**, G. Napoli, P. Nardinocchi, S. Turzi.

Dehydration-induced mechanical instabilities in active elastic spherical shells. *Proceedings of the Royal Society A*, vol. 477, 2254, (2021).

Doi:10.1098/rspa.2021.0243

2. **M. Curatolo**, P. Nardinocchi, L. Teresi.

Mechanics of active gel spheres under bulk contraction. *International Journal of Mechanical Sciences*, vol. 193, pp. 106147, (2021).

Doi:10.1016/j.ijmecsci.2020.106147

3. **M. Curatolo**, P. Nardinocchi, L. Teresi.

Modeling solvent dynamics in polymers with solvent-filled cavities. *Mechanics of Soft Materials*, vol. 2, pp. 2-13, (2020).

Doi:10.1007/s42558-020-00029-0

4. **M. Curatolo**, P. Nardinocchi, L. Teresi.

Dynamics of active swelling in contractile polymer gels. *Journal of the Mechanics and Physics of Solids*, vol. 135, pp. 103807, (2020).

Doi:10.1016/j.jmps.2019.103807

5. D. Battista, **M. Curatolo**, P. Nardinocchi.

Enforcing shaping of thin gel sheets by anisotropic swelling. *Mechanics of Materials*, vol. 139, pp. 103199, (2019).

Doi:10.1016/j.mechmat.2019.103199

6. D. Battista, **M. Curatolo**, P. Nardinocchi.

Swelling-induced eversion and flattening in naturally curved gel beams. *International Journal of Mechanical Sciences*, vol. 161-162, pp. 105071, (2019).

Doi:10.1016/j.ijmecsci.2019.105071

7. **M. Curatolo**, P. Nardinocchi, L. Teresi, D. P. Holmes.

Swelling effects on localized adhesion of an elastic ribbon. *Proceedings of the Royal Society A*, vol. 475, pp. 20190067, (2019).

Doi:10.1098/rspa.2019.0067

8. **M. Curatolo**, M. La Rosa, P. Prestininzi.

On the validity of plane state assumptions in the bending of bimorph piezoelectric cantilevers. *Journal of Intelligent Material Systems and Structures*, vol. 30(10), pp. 1508–1517, (2019).

Doi:10.1177/1045389X19835959

9. **M. Curatolo**.

Effective negative swelling of hydrogel-solid composites. *Extreme Mechanics Letters*, vol. 25, pp. 46-52, (2018).

Doi:10.1016/j.eml.2018.10.010

10. **M. Curatolo**, P. Nardinocchi.

Swelling-induced bending and pumping in homogeneous thin sheets. *Journal of Applied Physics*, vol. 124(8), pp. 085108, (2018).

Doi:10.1063/1.5043580

11. **M. Curatolo**, P. Nardinocchi, L. Teresi.

Driving water cavitation into a hydrogel cavity. *Soft Matter*, vol.14, pp. 2310-2321, (2018).

Doi:10.1039/C8SM00100F

12. **M. Curatolo**, P. Nardinocchi, E. Puntel, L. Teresi.

Transient instabilities in the swelling dynamics of a hydrogel sphere. *Journal of Applied Physics*, vol. 122(14), pp. 145109, (2017).

Doi:10.1063/1.5007229

13. **M. Curatolo**, S. Gabriele, L. Teresi.
Swelling and Growth: a Constitutive Framework for Active Solids. *Meccanica*, vol. 52(14), pp. 3443-3456, (2017).
Doi: 10.1007/s11012-017-0629-x.
14. **M. Curatolo**, L. Teresi.
Modeling and Simulation of Fish Swimming with Active Muscles. *Journal of Theoretical Biology*, vol. 409, pp. 18-26, (2016).
Doi: 10.1016/j.jtbi.2016.08.025.

Contributions to Books and Conferences Proceedings

1. **M. Curatolo**, V. Lombardi, P. Prestininzi.
Enhancing flow induced vibrations of a thin piezoelectric cantilever: experimental analysis, *River Flow 2020*, 2403-2409, (2020).
2. **M. Curatolo**, M. La Rosa, P. Prestininzi.
Energy harvesting in a fluid flow using piezoelectric materials, *Proceedings of the European COMSOL Conference*, Lausanne, Switzerland, (2018).
3. **M. Curatolo**, L. Teresi.
The Virtual Aquarium: Simulation of Fish Swimming, *Proceedings of the European COMSOL Conference*, Grenoble, France, (2015).

Conferences, Meetings and Workshops Presentations

1. STAMM 2020 + 1 (online) meeting, 17 September 2021.
Invited talk: Swelling-induced instabilities in gels
2. 56th Society of Engineering Science (SES) Technical Meeting, St Louis, USA, 13 October - 15 October 2019.
Talk: Instabilities driven by controlled release in spherical microcapsules.
3. 24th AIMETA (Italian Association of Theoretical and Applied Mechanics) Conference, Rome, Italy, 15 September - 19 September 2019.
Invited talk: Elasto-active instabilities of spherical shells.
4. Meeting at the Technical University of Dresden, Germany, 11 December 2018.
Invited talk: Soft Active Gels modeling, numerical simulations and new perspectives
5. European COMSOL Conference, Lausanne, Switzerland, 22 October - 24 October 2018.
Talk: Energy Harvesting in a Fluid Flow Using Piezoelectric Materials.
Poster: Energy Harvesting in a Fluid Flow using Piezoelectric Materials.
6. 55th Society of Engineering Science (SES) Technical Meeting, Madrid, Spain, 10 October - 12 October 2018.
Invited talk: Effective negative swelling of hydrogel-solid composites.
7. Solvay Workshop on "Mechanics of slender structures in physics, biology and engineering: from failure to functionality", Université Libre de Bruxelles, Brussels, Belgium, 27 August - 29 August 2018.
Invited poster: Swelling and adhesion of elastic solids.
8. 10th European Solid Mechanics Conference (ESMC), Bologna, Italy, 2 July - 6 July 2018.
Talk: High-power mechanics in gel structures driven by physics.

9. Ph.D. Examination, Roma TRE University, Roma, Italy, 9 November 2017.
Poster: Fluid-Solid Interaction with Applications on Energy Harvesting and Active Solids.
10. INdAM Meeting "Mathematical Physics of Living Systems", Cortona, Italy, 27 August - 2 September 2017.
Invited talk: Modeling of Carangiform Swimming.
11. Ph.D. Examination, Roma TRE University, Roma, Italy, 14 November 2016.
Poster: Energy Harvesting and Active Solids in Multiphysics Problems.
12. Summer school in Physics and Mechanics of Soft Complex Materials, Cargese Institute of Scientific Studies, Cargese, France, 8 August - 20 August 2016.
Poster: A Simple Model for Volume Transitions in Slide-Ring Gels,
13. European COMSOL Conference, Grenoble, France, 14 October - 16 October 2015.
Talk: The Virtual Aquarium: Simulations of Fish Swimming.
Poster: The Virtual Aquarium: Simulations of Fish Swimming.

Short Advanced Courses, Schools and Workshops

- Recent Advances in Mechanics and Mathematics of Materials Workshop, Rome, Italy, 30 September - 1 October 2021.
- Recent Advances in Mechanics and Mathematics of Materials Workshop, Rome, Italy, 18-20 November 2019.
- Summer school of Mathematical Physics, INdAM, Ravello, Italy, 10-22 September 2018.
- Course "Non-linear Propagation and Non-equilibrium Thermodynamics", Catholic University of the Sacred Heart, Brescia, Italy, 23-25 January 2017.
- COMSOL Training Courses, Structural Analysis, Thermal Analysis, Computational Fluid Dynamics, Roma, Italy, 25-27 October 2016.
- Summer school in Multiscale Bioengineering: from Molecules to organs (μ MBioEng), University of Perugia, Perugia, Italy, 6-10 June 2016.
- Course "Introduction to geostatistical analysis, with applications using Mathematica", Roma TRE University, Italy, May-June 2016.
- Seminars series "Mechanics and Mathematics of (soft) Materials and Structures", Sapienza University, Roma, Italy, March-July 2016.
- Course "Numerical solution of research problems in Civil Engineering", Roma TRE University, Roma, Italy, February-March 2016.
- Course "Nonlinear Elasticity for Rubber-like Materials and Soft Tissues", Catholic University of the Sacred Heart, Brescia, Italy, 1-3 February 2016.
- Workshop "Physics and Mathematics of Materials: current insights - on the occasion of the 75th birthday of Paolo Podio-Guidugli", Gran Sasso Science Institute, Aquila, Italy, 20 January - 22 January 2016.

Skills, Qualifications and Scientific Experience

- Very good knowledge of the Finite Element Method software Comsol Multiphysics
- Very good knowledge of Wolfram Mathematica
- Good knowledge of Matlab
- Very good knowledge of Latex

- Expert in modeling multi-physics non-linear problems in continuum mechanics

Languages

English: Fluent

Italian: Mothertongue

Other Interests and Activities

I am interested in many science topics such as astronomy, technology and biology. During my free time I like to play tennis and to do some jogging occasionally. I enjoy also to watch movies and listen to music.