CURRICULUM VITÆ

◇ PERSONAL DATA:

- Name and surname: Virginia Agostiniani.
- Place and date of birth: Pistoia, 10 August 1982.
- Nationality: italian.
- Civil status: married and mother of two children.
- Maternity leaves: from 9 December 2014 to 16 May 2015 and from 8 February 2017 to 12 July 2017.
- Address: c/o Department of Computer Science, strada le Grazie 15, 37134 Verona.
- Telephone number: +39 045 8027979 (office).
- E-mail addresses: virginia.agostiniani@univr.it,
  v.agostiniani@pec.it (PEC)
- Institutional webpage: http://www.di.univr.it/?ent=persona&id=49440#tab-presentazione
  personal webpage: https://sites.google.com/site/virginiaagostiniani/

◇ EDUCATION:

- High school diploma, academic year 2000/2001, Liceo Scientifico Statale "Amedeo di Savoia duca d'Aosta", Pistoia; mark: 100/100.
- Bachelor's degree in Mathematics, 17 December 2004, University of Florence; title of the thesis: *Teoremi di metrizzazione*; advisor: Donato Pertici; mark: 110/110 with honours.
- Bachelor's degree in Piano, 29 September 2006, Conservatoire G. Puccini of La Spezia; mark: 10/10 with honours.
- Master's degree in Mathematics, 23 April 2008, University of Florence; title of the thesis: *Un problema sovradeterminato relativo all'operatore di Laplace*; advisor: Rolando Magnanini; mark: 110/110 with honours.
- Ph.D. in Applied Mathematics, 18 September 2012, SISSA; title of the thesis: *Variational results for nematic elastomers and singular perturbations of evolution problems*; advisors: Gianni Dal Maso, Antonio DeSimone. Thesis available at: `http://www.sissa.it/fa/download/phd_theses/Agostiniani.pdf`

◇ ACADEMIC POSITIONS:

- From 1 October 2012 to 30 September 2014, Postdoctoral Research Associate at the Oxford Centre for Nonlinear PDE, Mathematical Institute, University of Oxford.
  ERC project "The Mathematics of Solid and Liquid Crystals", P.I.: Prof. Sir John Ball.
- From 1 October 2014 to 14 January 2018, postdoc at SISSA, Trieste.
  ERC project "Micromotility", P.I: Prof. Antonio DeSimone.
- From 15 January 2018 to 28 February 2018, assistant professor (RTD type a) at the Department of Mathematics, University of Padova.
- From 1 March 2018, assistant professor (RTD type b) at the Department of Computer Science, University of Verona.

◇ ACADEMIC HABILITATIONS:

- National scientific habilitation to the role of associate professor, in the field of *Mathematical Analysis, Probability, and Statistics*. Valid (in Italy) from August 2, 2017 to August 2, 2023.

◇ LANGUAGE SKILLS:

- english (reading: good, writing: good, verbal: good);
- french (reading: good, writing: good, verbal: basic).

◇ COMPUTER SCIENCE SKILLS:

- Maths Softwares: Matlab, Mathematica (good);
- Programming: C++, Fortran 77 (basic).

◇ COMMUNICATIONS:

- `Symmetry and stability in an overdetermined problem referred to the Green's function,`
  Analysis Seminar, University of Florence, 15 May 2009.
- `Symmetry and stability in an overdetermined problem for the Green's function,`
  1st italian-japanese workshop on geometric properties for parabolic and elliptic PDE's, Tohoku University, Sendai (Japan), 15–19 June 2009.
- `Linearization by` Γ`-convergence of finite elasticity problems under minimal hypotheses,`
  XXI Convegno Nazionale di Calcolo delle Variazioni, Levico (TN), 7–11 February 2011.
- `Second order approximations of quasistatic evolution problems in finite dimension,`
  Mini-courses in mathematical analysis 2011, Padova, 13–17 June 2011.
- `Linear elasticity as Gamma-limit of finite elasticity under weak coerciveness conditions,`
  SIAM conference on analysis of partial differential equations, San Diego (California), 14–17 November 2011.
- `Ogden-type energies for nematic elastomers,`
  8th European Solid Mechanics Conference, Graz (Austria), 9–13 July 2012.
- `Variational methods for nematic elastomers`
  Meeting on applied mathematics and calculus of variations, University La Sapienza, Roma, 4–7 September 2012.

- `Variational results for nematic elastomers`,
  OxPDE Lunchtime Seminars, Oxford, 11 September 2012.
- `Variational results for nematic elastomers`,
  University of Sussex, Brighton, 6 December 2012.
- `Rigorous derivation of linearised elasticity for a class of compressible rubbers`,
  University of Warwick, 8 March 2013.
- `On the rigorous derivation of some linearised models for nematic elastomers`,
  Oxbridge PDE Workshop, Oxford, 15 March 2013.
- `From nonlinear to linearized elasticity via Gamma-convergence: the case of multiwell energies satisfying weak coercivity conditions`,
  Augsburg-Munich Seminar on Analysis, University of Augsburg, 17 October 2013.
- `Minimum problems for a class of non-quasiconvex energy densities`,
  Applied Mathematics Seminar, University of Pavia, 10 December 2013.
- `Singularly perturbed gradient flows in infinite-dimensional spaces`,
  Women in PDEs and Calculus of Variations, University of Oxford, 6–8 March 2014.
- `A geometric approach to some overdetermined problems in potential theory`,
  Analysis Seminar, University of Florence, 16 May 2014.
- `Symmetry results in potential theory via conformal geometry`,
  Department of Mathematics, University of Milan, 4 November 2014.
- `Singularly perturbed gradient flows in infinite-dimensional spaces`,
  AJS, SISSA, Trieste, 28 November 2014.
- `Monotonicity formulas in potential theory`,
  17th EWM General Meeting, Cortona, 31 August–4 September 2015.
- `Rigorous derivation of active plate models for thin sheets of nematic elastomers`,
  8th International Liquid Crystal Elastomer Conference, Erice, 2–7 October 2015.
- `Rigorous derivation of active plate models for thin sheets of nematic elastomers`,
  ERC Workshop on Modeling Materials and Fluids using Variational Methods, WIAS, Berlin, 22–26 February 2016.
- `Non-Euclidean plate and rod theories, and their application to nematic elastomers`,
  AJS, SISSA, Trieste, 8 April 2016.
- `The electrostatic potential: monotonicity formulas and geometric inequalities`,
  Geometric aspects of PDE's and functional inequalities, Cortona, 28–30 April 2016.
- `The electrostatic potential: monotonicity formulas and geometric inequalities`,
  Bruxelles-Torino PDE's Conference, "Giuseppe Peano" Maths Department, University of Turin, 2–5 May 2016.
- `Monotonicity formulas for static potentials`,
  Static metrics and Bartnik's quasi-local mass conjecture, University of Tübingen, 17–20 May 2016.
- `Monotonicity formulas for electrostatic potentials and static metrics: part I`, WIAS, Berlin, 6 July 2016.
- `Dimensionally reduced models for soft active materials`,
  Women and Research in Mathematics: SISSA's Contribution, SISSA, 7–9 September 2016.
- `Plate models for thin soft active materials`,
  Analysis seminar, Università la Sapienza, Roma, 30 January 2017.
- `Heterogeneous elastic plates with lateral modulation of the target curvature`,
  Material Theories, Oberwolfach, 17 July 2017.
- `A Willmore inequality for manifolds with nonnegative Ricci curvature`,
  Geometric Aspects of PDEs, Florence, 10 November 2017.

- `Splitting principles, monotonicity formulas, and geometric inequalities,`
  Differential Equations and Applications Seminar, Department of Mathematics, University of Padova, 13 November 2017.
- `A Willmore inequality on ALE manifolds,`
  "Young in PDE's@Roma", Università la Sapienza, Roma, 20 February 2018.
- `Heterogeneous elastic plates with in-plane modulation of the target curvature and applications,`
  "5th Workshop on Thin Structures", Napoli, 13 September 2018.
- `Monotonicity formulas in linear and nonlinear potential theory,`
  "The mathematical design of new materials" programme, Isaac Newton Institute, Cambridge, 20 February 2019.
- `Minkowski inequality for mean convex domains and sharp constant for nearly umbilical estimates,`
  "Mathematical design of new materials: strategies and algorithms for the design of alloys and metamaterials" workshop, ICMS Edinburgh, 12 March 2019.
- `Modellare con l'analisi matematica oggetti sottili che si arricciolano: dalla natura alla tecnologia,`
  lecture/seminar for the students of *Scuola Superiore*, Università degli Studi di Udine, 1 April 2019.
- `Minkowski inequality and nonlinear potential theory - part II,`
  "Nonlinear Geometric PDEs" workshop, BIRS Banff (Canada), 6 May 2019.
- `An extended Minkowski inequality,`
  "Variational and PDE problems in Geometric Analysis II", Dipartimento di Matematica, Università di Bologna, 24 May 2019.
- `Minkowski inequality and nonlinear potential theory - part 2,`
  "12th ISAAC Conference - session *Geometric and regularity properties of solutions to elliptic and parabolic PDEs*", University of Aveiro, 29 July 2019.
- `Sharp geometric inequalities for closed hypersurfaces in manifolds with nonnegative Ricci curvature,`
  "XXI UMI Conference - session *Calculus of Variations and Control*", Università di Pavia, 4 September 2019

◇ CONFERENCE ORGANIZATION:

- "INdAM workshop on geometric properties for parabolic and elliptic PDE's",
  with C. Bianchini, G. Ciraolo, and P. Salani. Cortona, 20–24 June 2011.
- "Women in Nonlinear PDEs and Calculus of Variations",
  with A. Garroni and Endre Süli. Oxford, 6–8 March 2014, .
- "8th International Liquid Crystal Elastomer Conference",
  with A. DeSimone and P. Pasini. Erice (Majorana Centre), 2–7 October 2015.

◇ ATTENDED SCHOOLS AND CONFERENCES:

- "Interuniversity Mathematics Summer School"
  28 July–29 August 2008, Perugia.
- "First italian-japanese workshop on geometric properties for parabolic and elliptic PDE's"
  15–19 June 2009, Tohoku University, Sendai (Japan).
- "Summer Graduate Workshop on Inverse Problem"
  19 July–1 August 2009, MSRI, Berkeley.

- Workshop“Material Theories”
  14–18 December 2009, Oberwolfach (Germany).
- “XX Convegno Nazionale di Calcolo delle Variazioni”
  21–26 February 2010, Levico (TN).
- “Meeting in Calculus of Variations and Applied Mathematics”
  10–12 June 2010, University La Sapienza, Roma.
- “GNAMPA-ERC Summer School”
  14–18 June 2010, Ischia.
- “Frontiers of mathematics and applications”
  9–13 August 2010, Santander (Spain).
- “XXI Convegno Nazionale di Calcolo delle Variazioni”
  7–11 February 2011, Levico (TN).
- “Mini-courses in mathematical analysis 2011”
  13–17 June 2011, Padova.
- “INdAM workshop on geometric properties for parabolic and elliptic PDE’s”
  20–24 June 2011, Cortona.
- “Mathematical principles for and advances in continuum mechanic”
  7–11 November 2011, Pisa.
- “SIAM conference on analysis of partial differential equations”
  14–17 November 2011, San Diego (California).
- “Variational methods for evolution”
  4–10 December 2011, Mathematisches Forschungsinstitut Oberwolfach.
- “XXII Convegno Nazionale di Calcolo delle Variazioni”
  5–10 February 2012, Levico (TN).
- “8th European Solid Mechanics Conference”
  9–13 July 2012, Graz (Austria).
- “Meeting on applied mathematics and calculus of variations”
  4–7 September 2012, University La Sapienza, Roma.
- “Symmetry, Bifurcation and Order Parameters”
  7–11 January 2013, Newton Institute, Cambridge.
- “XXIII Convegno Nazionale di Calcolo delle Variazioni”
  3–8 February 2013, Levico (TN).
- “Analytical and Computational Paths from Molecular Foundations to Continuum Descriptions”
  18–22 March 2013, Newton Institute, Cambridge.
- “Nonlinear Analysis of Continuum Theories: Statics and Dynamics”
  8–12 April 2013, Newton Institute, a satellite meeting at the University of Oxford.
- “Seventh Summer School in Analysis and Applied Mathematics”
  17–21 June 2013, University La Sapienza, Roma.
- “Liquid Crystals Defects and their Geometry, Active and Solid Liquid Crystals, and Related Systems”
  24–28 June 2013, Newton Institute, Cambridge.
- “Evolution Problems for Material Defects: Dislocations, Plasticity, and Fracture”
  30 September–4 October 2013, SISSA, Trieste.
- “Material Theories”
  15–21 December 2013, Mathematisches Forschungsinstitut Oberwolfach.
- “XXIV Convegno Nazionale di Calcolo delle Variazioni”
  27–31 January 2014, Levico (TN).

- “Women in PDEs and Calculus of Variations”
  6–8 March 2014, University of Oxford.
- “New Trends in Differential Geometry 2014”
  18–20 September 2014, Villasimius, Cagliari.
- “Eighth Summer School in Analysis and Applied Mathematics”
  15–19 June 2015, University La Sapienza, Roma.
- “17th EWM General Meeting”
  31 August–4 September 2015, Cortona (Palazzone).
- “8th International Liquid Crystal Elastomer Conference”
  2–7 October 2015, Erice (Majorana Centre).
- “XXVI Convegno Nazionale di Calcolo delle Variazioni”
  18–22 January 2016, Levico (TN).
- “ERC Workshop on Modeling Materials and Fluids using Variational Methods”
  22–26 February 2016, WIAS, Berlin.
- “Geometric aspects of PDE’s and functional inequalities”
  28–30 April 2016, Cortona (Palazzone).
- “Bruxelles-Torino PDE’s Conference”
  2–5 May 2016, Giuseppe Peano Maths Department, University of Turin.
- “Static metrics and Bartnik’s quasi-local mass conjecture”
  17–20 May 2016, University of Tübingen.
- “Advances in the Mathematical Analysis of Material Defects in Elastic Solids”
  6–10 June 2016, SISSA.
- “Women and Research in Mathematics: SISSA’s Contribution”
  7–9 September 2016, SISSA.
- “XXVII Convegno Nazionale di Calcolo delle Variazioni”
  6–10 February 2017, Levico (TN).
- “Material Theories”
  17–21 July 2017, Mathematisches Forschungsinstitut Oberwolfach.
- “Geometric aspects of PDEs”
  10–11 November 2017, Palazzo Nonfinito, Florence.
- “Young in PDE’s@Roma”
  19–22 February 2018, Università la Sapienza, Roma.
- “Nonlinear PDEs in Geometry and Physics”
  11-15 June 2018, Cortona.
- “5th Workshop on Thin Structures”
  13-15 September 2018, Napoli.
- “Mathematical design of new materials: strategies and algorithms for the design of alloys and metamaterials” workshop, 11–15 March 2019, ICMS Edinburgh.
- “Nonlinear Geometric PDEs” workshop, 5–10 March 2019, BIRS Banff (Canada).
- “Variational and PDE problems in Geometric Analysis II”, 23–24 May 2019, Dipartimento di Matematica, Università di Bologna.
- “12th ISAAC Conference” 29 July–2 August 2019, University of Aveiro (Portugal).
- “XXI UMI Conference”, 2–7 September 2019, Università di Pavia.

⋄ TEACHING:

- *Music classes*, 25 January–16 March 2008 at Scuola media statale“Leonardo da Vinci”, Pistoia, and 8 May–1 June 2008 at Scuola media statale“Galileo Galilei”, Pieve a Nievole (PT).

- *Mathematics classes* (14 hours of remedial lessons), July 2008, Istituto Statale d'Arte"P. Petrocchi", Pistoia.
- course *Dynamics and energy minimization - exercises* (theory held by J. Ball), 20 hours, Michaelmas Term 2012, University of Oxford.
- course *Dynamical systems and energy minimization - exercises* (theory held by J. Ball), 20 hours, Michaelmas Term 2013, University of Oxford.
- course *Partial differential equations*, 48 hours, Master's degree in Mathematics, academic years 2017/2018 and 2018/2019, Department of Computer Sciences, University of Verona.
- course *Mathematical Analysis II - exercises* (theory held by G. Orlandi and S. Baldo), 48 hours, Bachelor's degree in Applied Mathematics, academic years 2018/2019 and 2019/2020, Department of Computer Sciences, University of Verona.
- course *Mathematical Analysis I* (final part of the course - introduction to ODEs and some elements of topology of the real line -, rest of the course held by S. Baldo), 24 hours, Bachelor's degree in Applied Mathematics, academic years 2018/2019 and 2019/2020, Department of Computer Sciences, University of Verona.

◇ STUDENTS:

- "OxPDE Undergraduate Summer Research Projects 2013". Together with K. Koumatos, I have been supevisor of the student Mycchaka Kleinbort. Title of the project: *Quasiconvexity-related topics in the modelling of nematic elastomers and solid crystals.* Period: 1 July 2013–23 August 2013.
- Joint supervision, together with A. DeSimone, of the SISSA Ph.D. student Danka Lučić. Title of the thesis: *Dimension reduction problems in the modelling of hydrogel thin films.* Thesis defence: 27 September 2018, SISSA Trieste.
- Joint supervision, together with C. Mantegazza, of the Ph.D. student Francesca Oronzio, enrolled in the Ph. D. School of the Department of Mathematics and Applications "Caccioppoli", Università degli Studi di Napoli Federico II. Academic years 2018/2019 and 2019/2020.

◇ INSTITUTIONAL RESPONSABILITIES:

- Member of the committee for the confirmation of status of the Ph.D. student Stephen Bedford, University of Oxford. May 2014.
- Member of the committee for the transfer of status of the Ph.D. student Michaela Nieuwenhuis, University of Oxford. January 2014.
- Member of the committee for the assignment of scholarships to non-UE students, for the Master Degree in Mathematics - Computer Science Department, University of Verona - in the academic year 2018/2019. May 2018.
- Member of the Committee for the Student's Practices (learning agreements, credits' transfers,...) of the Mathematics Educational Board - Computer Science Department, University of Verona -, since the academic year 2018/2019.

◇ RESEARCH PROJECTS:

- participant to the PRIN 2010/11 *Calculus of Variations*, national coordinator G. Dal Maso.
- participant to the GNAMPA project *Tecniche analitico-geometriche per ottimizzazione di energie elastiche*, coordinator Chiara Bianchini, 2013.

- participant to the GNAMPA project *Regolarizzazioni ellittiche e perturbazioni singolari di flussi gradiente in spazi di Banach e spazi metrici*, coordinator Riccarda Rossi, 2015.
- coordinator of the GNAMPA project *Principi di fattorizzazione, formule di monotonia e disuguaglianze geometriche*, 2016.
- participant to the GNAMPA project *Problemi sovradeterminati e questioni di ottimizzazione di forma*, coordinator Ilaria Fragalà, 2017.
- coordinator of the GNAMPA project *Aspetti geometrici in teoria del potenziale lineare e nonlineare*, 2019.

◇ BRIEF DESCRIPTION OF THE RESEARCH ACTIVITY:

My research activity is in the field of the Calculus of Variations and of the Analysis of PDEs. In particular, I study variational problems arising in the modelling of soft-active materials, either in a purely theoretical setting or with a specific focus on the applications. A big part of my research is also devoted to the study of geometric properties of elliptic PDEs, in the Euclidean setting as well as in the context of General Relativity.

◇ PUBLICATIONS:

- **Symmetries in an overdetermined problem for the Green's function**,
with R. Magnanini, *Discrete and Continuous Dynamical Systems–Series S* 4 n. 4 (2011), 791–800.
Abstract. We consider in the plane the problem of reconstructing a domain from the normal derivative of its Green's function with pole at a fixed point in the domain. By means of the theory of conformal mappings, we obtain existence, uniqueness, (non-spherical) symmetry results, and a formula relating the curvature of the boundary of the domain to the normal derivative of its Green's function.
- **Stability in an overdetermined problem for the Green's function**,
with R. Magnanini, *Annali di Matematica Pura ed Applicata* 190 n. 1 (2011), 21–31.
Abstract. In the plane, we consider the problem of reconstructing a domain from the normal derivative of its Green's function (with fixed pole) relative to the Dirichlet problem for the Laplace operator. By means of the theory of conformal mappings, we derive stability estimates of Hölder type.
- **Γ-convergence of energies for nematic elastomers in the small strain limit**,
with A. DeSimone, *Continuum Mechanics and Thermodynamics* 23 n. 3 (2011), 257–274.
Abstract. We study two variational models recently proposed in the literature to describe the mechanical behaviour of nematic elastomers either in the fully nonlinear regime or in the framework of a geometrically linear theory. We show that, in the small strain limit, the energy functional of the first one Γ-converges to the relaxation of the second one, a functional for which an explicit representation formula is available.
- **Second order approximations of quasistatic evolution problems in finite dimension**,
Discrete and Continuous Dynamical Systems–Series A 32 n. 4 (2012), 1125–1167.
Abstract. In this paper, we study the limit, as ε goes to zero, of a particular solution of the equation $\varepsilon^2 A\ddot{u}^\varepsilon(t) + \varepsilon B\dot{u}^\varepsilon(t) + \nabla_x f(t, u^\varepsilon(t)) = 0$, where $f(t,x)$ is a potential satisfying suitable coerciveness conditions. The limit $u(t)$ of $u^\varepsilon(t)$ is piece-wise continuous and verifies $\nabla_x f(t, u(t)) = 0$. Moreover, certain jump conditions characterize the behaviour of $u(t)$ at the discontinuity times. The same limit behaviour is obtained by considering a different approximation scheme based on time discretization and on the solutions of suitable autonomous systems.

- **Ogden-type energies for nematic elastomers**,
  with A. DeSimone, *International Journal of Non-Linear Mechanics* 47 n. 2 (2012), 402–412.
  Abstract. Ogden-type extensions of the free–energy densities currently used to model the mechanical behavior of nematic elastomers are proposed and analyzed. Based on a multiplicative decomposition of the deformation gradient into an elastic and a spontaneous or remanent part, they provide a suitable framework to study the stiffening response at high imposed stretches. Geometrically linear versions of the models (Taylor expansions at order two) are provided and discussed. These small strain theories provide a clear illustration of the geometric structure of the underlying energy landscape (the energy grows quadratically with the distance from a non–convex set of spontaneous strains or energy wells). The comparison between small strain and finite deformation theories may also be useful in the opposite direction, inspiring finite deformation generalizations of small strain theories currently used in the mechanics of active and phase-transforming materials. The energy well structure makes the free–energy densities non–convex. Explicit quasi–convex envelopes are provided, and applied to compute the stiffening response of a specimen tested in plane strain extension experiments (pure shear).

- **Linear elasticity obtained from finite elasticity by Γ-convergence under weak coerciveness conditions**,
  with G. Dal Maso and A. DeSimone, *Annales de l'Institut Henri Poincaré (C) Analyse Non Linéaire* 29 n. 5 (2012), 715–735.
  Abstract. The energy functional of linear elasticity is obtained as Γ-limit of suitable rescalings of the energies of finite elasticity. The quadratic control from below of the energy density $W(\nabla v)$ for large values of the deformation gradient ∇v is replaced here by the weaker condition $W(\nabla v) \geq |\nabla v|^p$, for some $p > 1$. Energies of this type are commonly used in the study of a large class of compressible rubber-like materials.

- **From nonlinear to linearized elasticity via Γ-convergence: the case of multiwell energies satisfying weak coercivity conditions**,
  with T. Blass and K. Koumatos, *Mathematical Models and Methods in Applied Sciences* 25 n. 1 (2015), 1–38.
  Abstract. Linearized elasticity models are derived, via Γ-convergence, from suitably rescaled nonlinear energies when the corresponding energy densities have a multiwell structure and satisfy a weak coercivity condition, in the sense that the typical quadratic bound from below is replaced by a weaker p bound, $1 < p < 2$, away from the wells. This study is motivated by, and our results are applied to, energies arising in the modeling of nematic elastomers.

- **On the transversality conditions and their genericity**,
  with R. Rossi and G. Savaré, *Rendiconti del Circolo Matematico di Palermo* 64 n. 1 (2015), 101–116.
  Abstract. In this note we review some results on the *transversality conditions* for a smooth Fredholm map $f : \mathsf{X} \times (0,T) \to \mathsf{Y}$ between two Banach spaces X, Y. These conditions are well-known in the realm of bifurcation theory and commonly accepted as "generic". Here we show that under the transversality assumptions the sections $\mathcal{C}(t) = \{x : f(x,t) = 0\}$ of the zero set of f are discrete for every $t \in (0,T)$ and we discuss a somehow explicit family of perturbations of f along which transversality holds up to a residual set.

  The application of these results to the case when f is the X-differential of a time-dependent energy functional $\mathscr{E} : \mathsf{X} \times (0,T) \to \mathbb{R}$ and $\mathcal{C}(t)$ is the set of the critical points of $\mathscr{E}$ provides the motivation and the main example of this paper.

- **Attainment results for nematic elastomers**,
  with G. Dal Maso and A. DeSimone, *Proceedings of the Royal Society of Edinburgh: Section A Mathematics* 145 n. 4 (2015), 669–701.
  Abstract. We consider a class of non-quasiconvex frame indifferent energy densities which includes Ogden-type energy densities for nematic elastomers. For the corresponding geometrically linear problem we provide an explicit minimizer of the energy functional satisfying a nontrivial boundary

condition. Other attainment results, both for the nonlinear and the linearized model, are obtained by using the theory of convex integration introduced by Müller and Šverák in the context of crystalline solids.

- **Riemannian aspects of potential theory**,
with L. Mazzieri, *Journal de Mathématiques Pures et Appliquées* 104 n. 3 (2015), 561–586.
Abstract. In this paper we provide a new method for establishing the rotational symmetry of the solutions to a couple of very classical overdetermined problems arising in potential theory, in both the exterior and the interior punctured domain. Thanks to a conformal reformulation of the problems, we obtain Riemannian manifolds (M, g) with zero Weyl tensor satisfying the same quasi-Einstein type equation
$$\mathrm{Ric}_g + \nabla^2 f + \frac{df \otimes df}{n-2} \;=\; \frac{|df|_g^2}{n-2},$$
for some f fulfilling the condition $\Delta_g f = 0$. Exploiting these geometric properties, we conclude via a splitting argument that the manifolds obtained are half cylinders. In turn, the rotational symmetry of the potential is implied. To the authors' knowledge, some of the overdetermining conditions considered here are new.

- **Shape programming for narrow ribbons of nematic elastomers**,
with A. DeSimone and K. Koumatos, *Journal of Elasticity* 127 n. 1 (2017), 1–24.
Abstract. Using the theory of Γ-convergence, we derive from three-dimensional elasticity new one-dimensional models for non-Euclidean elastic ribbons, i.e. ribbons exhibiting spontaneous curvature and twist. We apply the models to shape-selection problems for thin films of nematic elastomers with twist and splay-bend texture of the nematic director. For the former, we discuss the possibility of helicoid-like shapes as an alternative to spiral ribbons.

- **Comparing monotonicity formulas for electrostatic potentials and static metrics**,
with L. Mazzieri, *Rendiconti Lincei Matematica e Applicazioni* 28 n. 1 (2017), 7–20.
Abstract. In this note we survey and compare the monotonicity formulas recently discovered by the authors in the context of classical potential theory and in the study of static metrics, respectively. In both cases we discuss the most significant implications of the monotonicity formulas in terms of sharp analytic and geometric inequalities. In particular, we derive the classical Willmore inequality form smooth compact hypersurfaces embedded in Euclidean space and the Riemannian Penrose inequality for static Black Holes with connected horizon.

- **Dimension reduction via Γ-convergence for soft active materials**,
with A. DeSimone, *Meccanica* 52 n. 14 (2017), 3457–3470.
Abstract. We present a rigorous derivation of dimensionally reduced theories for thin sheets of nematic elastomers, in the finite bending regime. Focusing on the case of *twist* nematic texture, we obtain 2D and 1D models for wide and narrow ribbons exhibiting spontaneous flexure and torsion. We also discuss some variants to the case of twist nematic texture, which lead to 2D models with different *target curvature* tensors. In particular, we analyse cases where the nematic texture leads to zero or positive Gaussian target curvature, and the case of bilayers.

- **Rigorous derivation of active plate models for thin sheets of nematic elastomers**,
with A. DeSimone, *Mathematics and Mechanics of Solids* (2017), doi: 10.1177/1081286517699991.
Abstract. In the context of finite elasticity, we propose plate models describing the spontaneous bending of nematic elastomer thin films due to variations along the thickness of the nematic order parameters. Reduced energy functionals are deduced from a three-dimensional description of the system using rigorous dimension-reduction techniques, based on the theory of Γ-convergence. The two-dimensional models are nonlinear plate theories in which deviations from a characteristic target curvature tensor cost elastic energy. Moreover, the stored energy functional cannot be minimised to zero, thus revealing the presence of residual stresses, as observed in numerical simulations. The following three nematic textures are considered: *splay-bend* and *twisted* orientation of the nematic director, and uniform director perpendicular to the mid-plane of the film, with variable

degree of nematic order along the thickness. These three textures realise three very different structural models: one with only one stable spontaneously bent configuration, a bistable one with two oppositely curved configurations of minimal energy, and a shell with zero stiffness to twisting.

- **On the geometry of the level sets of bounded static potentials**,
with L. Mazzieri, *Communications in Mathematical Physics* 355 n. 1 (2017), 261–301.

  Abstract. In this paper we present a new approach to the study of asymptotically flat static metrics arising in general relativity. In the case where the static potential is bounded, we introduce new quantities which are proven to be monotone along the level set flow of the potential function. We then show how to use these properties to detect the rotational symmetry of the static solutions, deriving a number of sharp inequalities. As a consequence of our analysis, a simple proof of the classical 3-dimensional Black Hole Uniqueness Theorem is recovered and some geometric conditions are discussed under which the same statement holds in higher dimensions.

- **Singular vanishing-viscosity limits of gradient flows: the finite-dimensional case**,
with R. Rossi, *Journal of Differential Equations* 263 n. 11 (2017), 7815–7855.

  Abstract. In this note we study the singular vanishing-viscosity limit of a gradient flow set in a finite-dimensional Hilbert space and driven by a smooth but possibly *nonconvex*, time-dependent energy functional. We resort to ideas and techniques from the variational approach to gradient flows and rate-independent evolution to show that, under suitable assumptions, the solutions to the singularly perturbed problem converge to a curve of stationary points of the energy, whose behavior at jump points is characterized in terms of the notion of *Dissipative Viscosity* solution. We also provide sufficient conditions under which Dissipative Viscosity solutions enjoy better properties, which turn them into *Balanced Viscosity* solutions. Finally, we discuss the *generic character* of our assumptions.

- **Heterogeneous elastic plates with in-plane modulation of the target curvature and applications to thin gel sheets**,
with A. Lucantonio and D. Lučić, ESAIM: COCV 25 (2019), article 24.

  Abstract. We rigorously derive a Kirchhoff plate theory, *via* Γ-convergence, from a three-dimensional model that describes the finite elasticity of an elastically heterogeneous, thin sheet. The heterogeneity in the elastic properties of the material results in a spontaneous strain that depends on both the thickness and the plane variables x'. At the same time, the spontaneous strain is h-close to the identity, where h is the small parameter quantifying the thickness. The 2D Kirchhoff limiting model is constrained to the set of isometric immersions of the mid-plane of the plate into $\mathbb{R}^3$, with a corresponding energy that penalizes deviations of the curvature tensor associated with a deformation from a x'-dependent target curvature tensor. A discussion on the 2D minimizers is provided in the case where the target curvature tensor is piecewise constant. Finally, we apply the derived plate theory to the modeling of swelling-induced shape changes in heterogeneous thin gel sheets.

- **Foldable structures made of hydrogel bilayers**,
with A. DeSimone, A. Lucantonio and D. Lučić, *Mathematics in Engineering* 1 n. 1 (2018), 204–223.

  Abstract. We discuss self-folding of a thin sheet by using patterned hydrogel bilayers, which act as hinges connecting flat faces. Folding is actuated by heterogeneous swelling due to different cross-linking densities of the polymer network in the two layers. Our analysis is based on a dimensionally reduced plate model, obtained by applying a theory recently developed by three of us, which provides us with an explicit connection between (three-dimensional) material properties and the curvatures induced at the hinges. This connection offers a recipe for the fabrication and design of the bilayers, by providing the values of the cross-linking density of each layer that need to be imprinted during polymerization in order to produce a desired folded shape upon swelling.

◇ PREPRINTS:

- **Monotonicity formulas in potential theory** (new version),
  with L. Mazzieri, *arXiv–preprint server 2018.*

  Abstract. Using the electrostatic potential u due to a uniformly charged body $\Omega \subset \mathbb{R}^n$, $n \geq 3$, we introduce a family of monotone quantities associated with the level set flow of u. The derived monotonicity formulas are exploited to deduce a new quantitative version of the classical Willmore inequality.

- **Sharp geometric inequalities for closed hypersurfaces in manifolds with non-negative Ricci curvature**,
  with M. Fogagnolo and L. Mazzieri, *arXiv–preprint server 2018.*

  Abstract. In this paper we consider complete noncompact Riemannian manifolds (M, g) with nonnegative Ricci curvature and Euclidean volume growth, of dimension $n \geq 3$. We prove a sharp Willmore-type inequality for closed hypersurfaces $\partial\Omega$ in M, with equality holding true if and only if $(M \setminus \Omega, g)$ is isometric to a truncated cone over $\partial\Omega$. An optimal version of Huisken's Isoperimetric Inequality for 3-manifolds is obtained using this result. Finally, exploiting a natural extension of our techniques to the case of parabolic manifolds, we also deduce an enhanced version of Kasue's non existence result for closed minimal hypersurfaces in manifolds with nonnegative Ricci curvature.

- **Minkowski Inequalities via Nonlinear Potential Theory**,
  with M. Fogagnolo and L. Mazzieri, *arXiv–preprint server 2019.*

  Abstract. In this paper, we prove an exended version of the Minkowski Inequality, holding for any smooth bounded subset $\Omega \subset \mathbb{R}^n$, $n \geq 3$. Our proof relies on the discovery of *effective monotonicity formulas* along the level set flow of the p-capacitary potentials associated with Ω, in the limit as $p \to 1^+$. These formulas also testify the existence of a link between the monotonicity formulas derived by Colding and Minicozzi for the level sets flow of Green's functions and the monotonicity formulas employed by Huisken, Ilmanen and several other authors in studying the geometric implications of the Inverse Mean Curvature Flow.

◇ OTHER PUBLICATIONS:

- **Mum and postdoc at SISSA**,
  Newsletter of the European Mathematical Society n. 99, March 2016, p. 41.