Curriculum Vitae

Matteo Negri
Associate Professor in Mathematical Analysis
Department of Mathematics - University of Pavia
Via A. Ferrata 1 - 27100 Pavia - Italy
email: matteo.negri@unipv.it
web: http://matematica.unipv.it/negri

Graduate Studies and Academic Positions

1996-2001 Ph.D. in Functional Analysis and Applications. SISSA, Trieste.

2001-2002 Post Doc at the Max Planck Institute for Mathematics in the Sciences, Leipzig.

2002-2014 Researcher in Mathematical Analysis, University of Pavia.

2014-present Associate Professor in Mathematical Analysis, University of Pavia.

Research Overview

Field. Calculus of Variations.

Subjects. Free-discontinuity problems, Γ-convergence, BV and BD functions, Rate-Independent Evolutions, Finite Element Methods.

Applications. Mathematical Models for Fracture and Damage, Continuum Mechanics (Finite and Linearized Elasticity), Computational Mechanics, Image Segmentation.

Publications by subject.

Approximation of Free Discontinuity Problems by Γ-convergence [1, 2, 4, 5, 6, 7, 9, 10, 13]

Quasi-static Evolutions for Brittle and Cohesive Fracture [8, 11, 14, 15, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 31, 30]

Finite and Linearized Elasticity [3]

Equilibrium configuration of liquid droplets [12]

Error Estimates for Discontinuous Finite Elements [16]

Abstract BV-evolutions [24]

Publications

Published

[1] M. Negri: The anisotropy introduced by the mesh in the finite element approximation of the Mumford-Shah functional. *Numer. Funct. Anal. Optim.* **20**(9-10) 957–982 (1999)

[2] M. Negri, M. Paolini: Numerical minimization of the Mumford-Shah functional. *Calcolo* **38**(2) 67–84 (2001)

[3] G. Dal Maso, M. Negri, D. Percivale: Linearized elasticity as Γ-limit of finite elasticity. *Set-Valued Anal.* **10**(2-3) 165–183 (2002)

[4] M. Morini, M. Negri: Mumford-Shah functional as Γ-limit of discrete Perona-Malik energies. *Math. Models Methods Appl. Sci.* **13**(6) 785–805 (2003)

[5] M. Negri: A finite element approximation of the Griffith's model in fracture mechanics. *Numer. Math.* **95**(4) 653–687 (2003)

[6] M. Negri: A discontinuous finite element approximation of free discontinuity problems. *Adv. Math. Sci. Appl.* **15**(1) 283–306 (2005)

[7] M. Negri: A non-local approximation of free discontinuity problems in SBV and SBD. *Calc. Var. Partial Differential Equations* **25**(1) 33–62 (2006)

[8] C. Comi, S. Mariani, M. Negri, U. Perego: A 1d variational formulation for quasi-brittle fracture. *Journal of Mechanics of Materials and Structures* **1**(8) 1323–1343 (2006)

[9] M. Negri: Convergence analysis for a smeared crack approach in brittle fracture. *Interfaces Free Bound.* **9**(3) 307–330 (2007)

[10] L. Lussardi, M. Negri: Convergence of non-local finite element energies for fracture mechanics. *Numer. Funct. Anal. Optimization* **28**(1-2) 83–109 (2007)

[11] M. Negri, C. Ortner: Quasi-static propagation of brittle fracture by Griffith's criterion. *Math. Models Methods Appl. Sci.* **18**(11) 1895–1925 (2008)

[12] M. Negri, R. Rosso: On the stability of liquid droplets with line tension. *Cont. Mechanics Thermodyn.* **21** 173–194 (2009)

[13] F. Fraternali, M. Negri, M. Ortiz: On the convergence of 3d free discontinuity models in variational fracture mechanics. *Int. J. Fract.* **166** 3–11 (2010)

[14] M. Negri: A comparative analysis on variational models for quasi-static brittle crack propagation. *Adv. Calc. Var.* **3** 149–212 (2010)

[15] M. Negri: From rate-dependent to rate-independent brittle crack propagation. *J. Elasticity* **98**(2) 159–178 (2010)

[16] A. Lew, M. Negri: Optimal convergence of a discontinuous-galerkin-based immersed boundary method. *Math. Model. Numer. Anal.* **45** 651–674 (2011)

[17] M. Negri: Energy release rate along a kinked path. *Math. Meth. Appl. Sci.* **34** 384–396 (2011)

[18] A. Khludnev, M. Negri: Crack on the boundary of a thin elastic inclusion inside an elastic body. *ZAMM Z. Angew. Math. Mech.* **92** 341–354 (2011)

[19] A. Khludnev, M. Negri: Equilibrium of Elastic Solids with Thin Elastic Inclusions. *Dokl. Phys.* **57** 140–144 (2012)

[20] M. Negri: Crack propagation by a Regularization of the Principle of Local Symmetry. *Discrete Contin. Dyn. Syst. Ser. S* **6** (2013) 147–165

[21] A. Khludnev, M. Negri: Optimal rigid inclusion shapes in elastic bodies with cracks. *Z. Angew. Math. Phys.* **64** (2013) 179–191

[22] M. Negri: From phase-field to sharp crack: convergence of quasi-static evolutions in a special setting. *Appl. Math. Lett.* **26** (2013) 219–224

[23] M. Negri, C. Zanini: From finite to linear elastic fracture mechanics by scaling. *Calc. Var. Partial Differential Equations* **50** (2014) 525–548

[24] M. Negri: Quasi-static rate-independent evolutions: characterization, existence, approximation and application to fracture mechanics. *ESAIM Control Optim. Calc. Var.* **20** (2014) 983–1008

[25] M. Negri, R. Toader: Scaling in fracture mechanics by Bazant's law: from finite to linearized elasticity. *Math. Models Methods Appl. Sci.* **25** (2015) 1389–1420

[26] M. Negri: Quasi-static evolutions in brittle fracture generated by gradient flows: sharp crack and phase-field approaches. *Lect. Notes Appl. Comput. Mech.* **81** (2016) 197–216

[27] M. Negri: A simple derivation and classical representations of energy variations for curved cracks. *Appl. Math. Optim.* **75** (2017) 99-116

[28] D. Knees, M. Negri: Convergence of alternate minimization schemes for phase field fracture and damage. *Math. Models Methods Appl. Sci.* (to appear)

[29] M. Negri: A unilateral L^2-gradient flow and its quasi-static limit in phase-field fracture by alternate minimization. *Adv. Calc. Var.* (to appear)

[30] M. Negri, R. Scala: A quasi-static evolution generated by local energy minimizers for an elastic material with a cohesive interface. *Nonlinear Anal. Real World Appl.* (to appear)

Submitted

[31] M. Negri, E. Vitali: Approximation and characterization of quasi-static H^1-evolutions for a cohesive interface with different loading-unloading regimes.

Plenary and Keynote Lectures

1. Fast and quasi-static propagation of a fracture in brittle materials. *GIMC 2008, XVII Convegno Italiano di Meccanica Computazionale* (Alghero, 2008)
2. Consistency of phase-field with sharp crack evolutions in brittle fracture. *CFRAC 2013* (Prague, 2013)

Lectures at National and International Conferences

1. Finite element approximation of free-discontinuity problems. *Giornate di Lavoro su Questioni di Teoria Geometrica della Misura e di Calcolo delle Variazioni* (Levico Terme, 2000)

2. Finite element approximation of the Mumford-Shah functional. *SIMAI 2000* (Ischia, 2000)

3. Linear elastic energies as Γ-limit of non-linear energies. *Giornate di Lavoro su Questioni di Teoria Geometrica della Misura e di Calcolo delle Variazioni* (Levico Terme, 2001)

4. A discontinuous finite element approach for the approximation of free discontinuity problems. *Workshop on Computational and Variational Problems in Fracture Mechanics* (Trieste, 2002)

5. On the relationship between Mumford-Shah functional and Perona-Malik equation. *Giornate di Studio Politecnico di Milano - Università di Pavia* (Pavia, 2003)

6. Non-local approximation of free-discontinuity problems and applications. *Incontro di Lavoro su Questioni di Teoria Geometrica della Misura e di Calcolo delle Variazioni* (Levico Terme, 2004)

7. Finite element discretizations of the Griffith energy. *First Workshop on Contact Mechanics and Free Discontinuity Problems* (Salerno, 2004)

8. A discontinuous finite element approach for brittle fracture. *SIMAI 06* (Ragusa, 2006)

9. Fracture energies as limit of non-local damage energies. *VII World Congress on Computational Mechanics* (Los Angeles, 2006)

10. Quasi-static propagation and Griffith's criterion. *XVII Giornate di Lavoro su Questioni di Teoria Geometrica della Misura e di Calcolo delle Variazioni* (Levico Terme, 2007)

11. Quasi-static crack propagation in a brittle material. *Mathematical Modeling, Mechanics and Materials* (Brixen, 2007)

12. Quasi-static crack propagation in a brittle material. *SIAM Conference on Mathematical Aspects in Materials Science* (Philadelphia, 2008)

13. Quasi-static evolutions of a brittle crack: analytical and numerical aspects in a model case. *Fracture: modelling, analysis and computation* (Oxford, 2008)

14. Rate-independent evolutions in fracture mechanics *Rate-independent systems: Modeling, Analysis, and Computations* (Banff, 2010)

15. Mixed Mode Crack Propagation by the Principle of Local Symmetry *XXI Convegno Nazionale di Calcolo delle Variazioni* (Levico Terme, 2011)

16. Crack Propagation by PLS *Mathematical Models, Analysis, and Numerical Methods for Dynamic Fracture* (Oberwolfach, 2011)

17. Rate-dependent and rate-independent crack propagation. *CFRAC 2011* (Barcelona, 2011)

18. Crack Propagation in Mode I-II by a regularization of PLS. *Phase Separation, Damage and Fracture* (Berlin, 2011)

19. Brittle Crack Propagation in Mixed Mode. *Variational Methods in Evolutions* (Oberwolfach, 2011)

20. From finite to linear elastic fracture mechanics by scaling. *Evolution Problems in Damage, Plasticity and Fracture* (Udine, 2012)

21. Analysis of finite and linear elasticity in quasi-static brittle fracture. *IUTAM Symposium: Fracture Phenomena in Nature and Technology* (Brescia, 2012)

22. Scaling in fracture mechanics by Bazant's law: from finite to linearized elasticity. *IX Giornata di Studio Università di Pavia - Politecnico di Milano* (Pavia, 2013)

23. Energy based rate-independent evolutions: existence and convergence. *10th AIMS Conference on Dynamical Systems, Differential Equations and Applications* (Madrid, 2014)

24. Quasi-static evolutions for phase field models in fracture. *IUTAM Symposium on Innovative Numerical Approaches for Materials and Structures in Multi-field and Multi-scale Problems* (Burg Schennelberg, 2014)

25. BV evolutions in phase field fracture. *AMS-EMS-SPM International Meeting* (Porto, 2015)

26. Phase-field approach for quasi-static evolutions in fracture mechanics. *International Congress on Industrial and Applied Mathematics* (Beijing, 2015)

27. Full characterization of quasi-static H^1-evolutions for a cohesive interface model. *International Congress on Industrial and Applied Mathematics* (Beijing, 2015)

28. Convergence in time of discrete evolutions generated by alternate minimizing schemes. *Variational Models of Fracture* (Banff, 2016)

29. Flussi gradiente ed evoluzioni quasi-statiche per il funzionale di Ambrosio-Tortorelli: aspetti teorici ed applicazioni. *Convegno GNAMPA* (Montecatini, 2016)

30. Parametrized evolutions for cohesive fracture generated by local minimizers and equilibria. *Miniworkshop on Dislocations, Plasticity and Fracture.* (SISSA, 2017)

31. Rate-independent unilateral evolutions for Ambrosio-Tortorelli functionals and applications. *Control of state constrained dynamical systems* (Padova, 2017)

Seminars at Universities and Research Centers

1. Finite element approximation of free discontinuity problems. (Max Planck Institute for Mathematics in the Sciences, 2001)

2. Linearized elasticity as Γ-limit of finite elasticity. (Max Planck Institute for Mathematics in the Sciences, 2002)

3. Linear elastic energies as Γ-limit of non-linear energies. (Università di Pavia, 2002)

4. Approximation of free-discontinuity problems. (Università di Pavia, 2003)

5. Linearization of elastic energies by Γ-convergence. (Università di Salerno, 2003)

6. A mathematical model for crack propagation: formulation as a free-discontinuity problem and its embedded crack discretization. (Politecnico di Milano, 2003)

7. Il modello di Griffith per la propagazione delle fratture: una formulazione variazionale e una approssimazione con elementi finiti discontinui. (Politecnico di Milano, 2004)

8. A nonlocal approach for the Perona-Malik equation and the Mumford-Shah functional. (SISSA, 2004)

9. Un approccio non-locale per l'equazione di Perona-Malik e il funzionale di Mumford-Shah. (Università di Trieste, 2004)

10. Un modello per la propagazione di fratture fragili: formulazione come problema con discontinuità libere e discretizzazione con elementi finiti smeared-crack. (Università Statale di Milano, 2004)

11. Mathematical models for material damage and fracture. (Università di Salerno, 2005)

12. Approssimazione di problemi con discontinuità libere: applicazioni al danneggiamento e alla frattura. (Università di Ferrara, 2006)

13. Stability of liquid droplets with line tension. (SISSA, 2007)

14. Comparing quasi-static evolutions of a brittle crack. (Universidad Complutense, 2007)

15. Analytical and numerical aspects of quasi-static crack propagation. (Technische Universität München, 2007)

16. From rate-dependent to quasi-static crack propagation. (Stanford, 2008)

17. Analysis of crack propagation by the Principle of Local Symmetry. (Stanford, 2010)

18. Propagazione di fratture in Modo I: analisi, discretizzazione ed applicazioni. (Politecnico di Milano, 2011)

19. Propagazione di Fratture in Modo Misto secondo il Principio di Locale Simmetria. (Università di Salerno, 2011)

20. Scaling finite to linearized elasticity in quasi-static brittle fracture. (SISSA, 2012)

21. Quasi-static rate-independent evolutions: characterization, existence and application to fracture. (SISSA, 2013)

22. Quasi-static evolutions by graph parametrization: existence, approximation and application to fracture. (WIAS, 2014)

23. A general approach to BV-solutions by parametrized minimising movements: theoretical results and applications (TU Eindhoven, 2014)

24. Gradient flows and quasi-static evolutions in phase-field fracture. (Kanazawa University, 2016)

25. Quasi-static evolutions for elastic materials with cohesive interfaces. (Kanazawa University, 2017)

Reviewer

Referee

- *Adv. Calc. Var.*
- *Arch. Rational Mech. Anal.*
- *Comput. Math. Appl.*
- *Comp. Mech.*
- *Discrete Contin. Dyn. Syst-S*
- *Eur. J. Mech. A-Solids*
- *ESAIM Control Optim. Calc. Var.*
- *Interfaces Free Bound.*
- *Int. J. Fracture*
- *J. Elast.*
- *J. London Math. Soc.*
- *J. Mech. Phys. Solids*
- *J. Nonlinear Sci.*
- *Math. Methods Appl. Sci.*
- *Math. Model. Numer. Anal.*
- *Math. Models Methods Appl. Sci.*
- *Mech. Res. Comm.*
- *Nonlinear Anal. - Real World Appl.*
- *Z. Angew. Math. Mech.*
- *Z. Angew. Math. Phys.*

Reviewer

- Mathematical Reviews: 49J45, 49S05, 74G65, 74R10, 74R20
- Czech Science Foundation (GACR)
- Banff International Research Station (BIRS)

Funded projects

- CNR Short-Term Mobility Program 2006
- CARIPLO Landau Network Fellowship 2012 (with Prof. A.Khludnev)
- INdAM GNAMPA 2014

Visiting

- California Institute of Technology (June 26 - July 30, 2007)
- Timoshenko Visiting Scholarship, Stanford (Nov 6 - Nov 12, 2010)

Congress Organization

Variational Views in Mechanics and Materials (Pavia, 2013)

Committee

Jury "rapporteur" for the Ph.D. thesis of P. Sicsic (Ecole Polytechnique, 2013)
Member of the committee for an "Assegno di Ricerca" (Postdoc Position) in Analysis (Pavia, 2015)

Teaching: courses

B.Sc. in Mathematics and B.Sc. in Physics

- i) Basic Mathematical Analysis (teaching assistant) (AY 03/04)
- ii) Analysis A (3 ECTS) (AY 08/09)
- iii) Analysis D (6 ECTS) (AY 09/10, 10/11)
- iv) Analysis 4 (9 ECTS) (AY 11/12)

M.Sc. in Mathematics

- i) Variational Methods (3 ECTS) (AY 04/05)
- ii) Advanced Mathematical Analysis (3 ECTS) (AY 05/06)
- iii) Calculus of Variations (3 ECTS) (AY 06/07)
- iv) Functional Analysis and Differential Equations (3 ECTS) (AY 07/08, 12/13) and (6 ECTS) (AY 14/15, 15/16, 16/17)
- v) Calculus of Variations (6 ECTS) (AY 12/13)

B.Sc. in Biotechnologies

- i) Mathematical Analysis and Computing (teaching assistant) (AY 02/03)
- ii) Mathematical Analysis and Computing (9 ECTS) (AY 03/04, 04/05, 05/06, 06/07, 07/08, 09/10)

B.Sc. in Engineering

- i) Mathematical Methods in Engineering (1 ECTS) (AY 10/11, 11/12, 12/13)
- ii) Analysis 1 (9 ECTS) (AY 13/14, 14/15, 15/16, 16/17)

Summer School

Frontiers in Partial Differential Equations Analysis and Solvers (May 22-25/17)

Analysis and numerics for sharp crack and phase-field fracture

Stages

Matematica Attiva (June 13-16/17)

Piece-wise polynomial functions and applications (splines and design)

Thesis

B.Sc. Thesis in Mathematics

  i) I. Luppino: Hausdorff measure: Minkowski content and rectifiable sets (AY 09/10)
  ii) C. Simoncini: An introduction to Control Theory (AY 10/11)
  iii) E. Cavallotto: Functions of Bounded Variation (AY 10/11)
  iv) P. Ferrari: Action of groups and paradoxical sets in Euclidean spaces (AY 11/12)
  v) F. Bertagnoglio: Scalar conservation laws (AY 11/12)
  vi) T. Dondè: Area and co-area formula for Sobolev functions (AY 12/13)
  vii) M. Sessi: Hausdorff measure and fractal sets (AY 12/13)
  viii) M. Bariselli: Bochner integrals (AY 14/15)

M.Sc. Thesis in Mathematics

  i) M. Bendotti: Linear and non-linear elasticity: existence of minimizers and Euler-Lagrange equations (AY 13/14)
  ii) M. Bergamaschi: Obstacle problems: analysis and numerical methods (AY 15/16)
  iii) M. Sessi: Gradient flows in Euclidean and metric spaces (AY 16/17)

Pavia, July 11, 2017