Decreto Rettore Università di Roma "La Sapienza" n. 2525/2019 dell'07.08.2019

NADIA ANSINI
Curriculum Vitae ai fini della pubblicazione

Il presente Curriculum Vitae e' stato redatto (in inglese) secondo lo schema-tipo suggerito dal bando di upgrade PA (Allegato B)

Place: Rome
Date: 03/09/2019

Part I – General Information

Full Name	NADIA ANSINI
Citizenship	Italian
Spoken Languages	English, French, Spanish, Italian
Current position	Researcher in Mathematical Analysis (MAT/05) since 30th of December 2008
National Scientific Qualification 2012	**01/A3, Associate Professor (30/12/2013-30/12/2019)**
webpage	http://www1.mat.uniroma1.it//people/ansini/ http://cvgmt.sns.it/person/133/

Research Experience

The researcher has a deep expertise in the area of multiscale problems in mathematical materials science. Her body of work focuses on the derivation of a *rigorous mathematical justification of macroscopic energy*. She has dealt with many different complex structures whose multi-scale nature may be

- structural (such as in composite materials),
- or due to the presence of structures of various dimensions (such as in multi-porous media),
- or be derived as a scaling property (as in thin film theory),
- or as an interplay between different competing energies (as for phase transitions).

These and a wealth of other problems can be studied as the asymptotic limit of families of energies depending on one or more small parameters. A fundamental tool for the analysis is Gamma-convergence, as introduced by De Giorgi, which has proven to be a flexible and natural concept for variational problems.

Since her first published paper in 1999, her activity has been steady and constant (taking into account two children born in 2007 and 2009): her scientific publications include 22 original papers (excluding proceedings and monographs) with subjects ranging from perforated domains, thin films, perimeter functionals and phase transitions, periodic multi-dimensional structures, integral and supremal functional under differential constrain, lower semicontinuous problems, local minimisation and variational evolution problems. *She is motivated by the development of a general mathematical framework at support of applications*. The main achievements of the researcher are described in Part IX– Summary of Scientific Achievements and Part X- Research Activities.

She was trained at a number of leading institutions in Europe: after completing her **PhD at SISSA** (a leading centre in Calculus of Variations and Gamma-convergence techniques, Trieste, Italy), the researcher worked as a postdoc at University Paris 6 (Paris, France), CNR-IAC (Istituto per le Applicazioni del Calcolo), Sapienza (Rome) and EPFL (Switzerland).
During her PhD she worked on perforated domains, thin films and periodic multi-dimensional structures [1],[2],[3],[4], [5]. In [5] a new variational method is introduced to study the asymptotic behaviour of Dirichlet problem in perforated domains in alternative to the energy method of Tartar applied by the french school as in the seminal paper by Cioranescu and Murat. The method turns out to be flexible and therefore relevant in many other context as in

homogenisation [4], thin films [7], [10] and more recently in interacting particles model [17]. In [2] a general theory for the homogenisation of non-convex energies defined on sets with oscillating boundaries is developed and applied to thin film structures.
To develop expertise in homogenisation, she spent two years at the **Laboratoire J.L. Lions of Paris 6**, a leading centre in homogenisation and thin films problems. During her **Marie Curie Individual Fellowship (FP5)**, supervised by Doina Cioranescu, she interacted also with other scientists, such as A. Damlamian, G. Francfort and F. Murat as well as many others visiting scientists the Laboratoire (see Part II- Awards, EU-Fellowship). She had the opportunity to acquire new techniques and skills in H-convergence, two-scale convergence and periodic unfolding methods. The benefit from this training is demonstrated in various papers inspired by this experience, such as [7], [10] (J.F. Babadjian was a PhD student of G. Francfort), [12] (O. Iosifescu was a PhD student of P. Ciarlet) and more recently [15], [16] in collaboration with G. Dal Maso and C.I. Zeppieri. These later papers develop a novel variational approach to H-convergence, in particular the proof of the equivalence between H and Gamma-convergence was an open problem since the introduction of Gamma and H-convergence in the early 1970s.
During her postdoc period at **CNR-IAC**, she worked on blistering and shell-membrane transition [9], [13] and [26], where a rigorous mathematical analysis was carried out to explain phenomena predicted by numerical simulations.
The postdoctoral experience in the **Department of Mathematics of Sapienza** has contributed to develop her skills and expertise in this field further. Papers, also in the most recent years [11], [14], [15], [18], [19], were inspired by interactions with scientists such as Adriana Garroni and Vincenzo Nesi started during her postdoc.
During her postdoctoral period at **EPFL**, she benefited from interactions with B. Dacorogna, a world leader in the Calculus of Variations. In particular, she developed her skills in lower semicontinuous problems. She had the privilege to contribute a chapter to the second edition of the classic book by Dacorogna, which is widely regarded as the standard reference in the field [22].

More recently (2013-2015), she took a Research and Study leave (funded by the EU Programme **FP7-People-2012, IEF for career development**) at the Department of Mathematical Sciences (**University of Bath, UK**). The fellowship was an excellent opportunity to fully focus on the project where she would learn new techniques, diversify her competency and establish interdisciplinary collaborations. The UK has expertise in industrial applied mathematics and outreach activities. In particular, she could develop her expertise in scale-bridging (of static multiscale problems and global minimisation) on variational evolution problems and local minimisation [20], [21], [25]. The benefit from the UK experience is demonstrated also by her application for the ERC-Consolidator Grant 2015 with the project "Variational Evolution and Scale-bridging in Complex Systems" (see Part II- Awards, EU-Fellowship).

Her current research activity mostly focus on the variational approach to the study of (gradient flow) dynamics. Due to the extreme versatility of variational methods it is possible to cover a wide range of applications from Material Sciences to Opinion Formation Model (see Part X- Current research activity [22] and works in progress [A]-[B]-[C]).

She is currently collaborating with R. Alicandro (University of Cassino), A. Braides (University of Rome Tor Vergata), M. Bruna (University of Oxford, UK), J.A. Carrillo de la Plata (Imperial College London, UK), A. Esposito e S. Fagioli (University of L'Aquila), C. Geldhauser (Technical University of Dresden, Germany), M. Mariani (National Research University Higher School of Economics, Moscow, Russia), A. Piatnitski (The Arctic University of Norway, Institute for Information Transmission Problems of RAS, Moscow), A. Schlichting (University of Bonn, Germany), A. Tribuzio (University of Rome Tor Vergata).

Part II – Awards, EU-Fellowship

Year	Title
2015	**ERC**- Consolidator Grant **Finalist**. Invited to attend the interview with the evaluation panel (14 october 2015). The proposal was reviewed in Step 2 with the following final panel score: A (*Fully meets the ERC's excellence criterion and is recommended for funding if sufficient funds are available)*. Project Title: Variational Evolution and Scale-bridging in Complex Systems (Proposal n. 682434, Gamma-Flow).
2013-2015	Marie Curie Actions: *Intra-European Fellowship* (**IEF**) *for career development*. **FP7-People-2012**. Host Institution: Dept of Mathematical Sciences, University of Bath. Project Title: Microstructures in Dynamic and Anisotropic Systems (MIDAS, contract n. 326044). Total score 98,20 (out of 100)
2001-2003	Marie Curie Actions: Individual Fellowship. **FP5**-Improving Human Research Potential-2000 Host Institution: Laboratoire J.L.Lions, Universite' Pierre et Marie Curie (Paris 6). Project title: Homogenisation of Structures with Multiple Scales (HPMFCT-2000-00654)

Part III – Education

Type	Year	Institution	Degree
University graduation	1996	University of Rome 'Tor Vergata'	Laurea in Mathematics, 110 cum laude. Supervisor Prof. Errico Presutti
PhD	2000	SISSA (International School for Advanced Studies), Trieste, Italy	Doctor Philosophiae in Mathematics (Dottore di Ricerca in Matematica), Sector of Functionals Analysis and Applications. Supervisor Prof. Andrea Braides
French Language Degree	2003	Alliance Francaise (Paris, France)	Level 2 (Levels 1-3)

Part IV – Appointments

IVA – Academic Appointments in highly qualified institutions (France, Switzerland, UK)

Start	End	Institution	Position
Feb2001	Jan2003	Laboratoire J.L.Lions, Universite' Pierre et Marie Curie (Paris 6), Paris, France	Postdoc-Individual Marie Curie Fellowship (FP5).
Oct2005	July2006	EPFL (Ecole Polytechnique Federale de Lausanne), Section de Mathematiques, Lausanne, Switzerland	Postdoc (research and teaching activities in French in collaboration with Prof. B. Dacorogna)
Nov2013	Jan2015	Dept of Mathematical Sciences, University of Bath	Marie Curie Actions: Intra-European Fellowship (IEF) for career development (FP7).

IVB – Academic Appointments in highly qualified institutions (in Italy)

Start	End	Institution	Position
June2003 Apr2005 Nov2006 Aug2007	Nov2003 May2005 Jan2007 Nov2007	CNR-IAC-Rome (Ist. per le Applicazioni del Calcolo, Mauro Picone)	Postdoc (co.co.co, collaborazione scientifica esterna, prestazione d'opera). Project Title: 1) Metodi matematici per problemi multiscala nei materiali; 2) Sviluppo di un metodo di Gamma-convergenza per il calcolo di profili nell'ambito di morfologie di blistering di pellicole sottili; 3) Indagine analitica per lo studio matematico del blistering di pellicole sottili; 4) Applicazioni di metodi tipici del calcolo delle variazioni per la caratterizzazione di fenomeni connessi al blistering di pellicole sottili
Oct2003	Sept2005	Dept of Mathematics, University of Rome 'Sapienza'	Postdoc (Assegno di Ricerca, 24 months)
Feb2003 Mar2007	July2003 Oct2007	Dept of Mathematics, University of Rome 'Sapienza'	Postdoc (affidamento d' incarico, co.co.co)
Dec2007	Nov2008	Dept of Mathematics, University of Rome 'Sapienza'	Postdoc (Assegno di Ricerca, 12 months)
Dec2008	———	Dept of Mathematics, University of Rome 'Sapienza'	Permanent position: Researcher in Mathematical Analysis (Ricercatore universitario)

IVC – Shorts visits (more than 2 weeks: UK, USA, France)

Period	Institution	Position
July 2011	Carnegie Mellon University, Center for Nonlinear Analysis, Dept of Mathematical Sciences, Pittsburgh (USA)	Visiting professor
October 2005	University of Bath, Dept of Mathematical Sciences (UK)	Visiting professor
July 2004	Laboratoire J.L.Lions, Universite' Pierre et Marie Curie (Paris 6), Paris (France)	Visiting professor (funded by European Network HMS2000)

Part V - Funding Information [grants as PI-principal investigator or I-investigator]

V A – **European Grants as PI-principal investigator**

Year	Title	Program	Grant value
2001 24 months	Marie Curie Actions: Individual Fellowship. Host Institution: Laboratoire J.L.Lions, Universite' Pierre et marie Curie (Paris 6). Project title: Homogenisation of Structures with Multiple Scales (HPMFCT-2000-00654)	FP5-Improving Human Research Potential-2000	~ €180,000 (PI)

2013 18 months	Marie Curie Actions: Intra-European Fellowship (IEF) for career development. Host Institution: Dept of Mathematical Sciences, University of Bath. Project Title: Microstructures in Dynamic and Anisotropic Systems (MIDAS, contract n. 326044).	FP7-People-2012	€ 231,926.40 (PI)

V B – **National Grants as PI-principal investigator**

Year	Title	Program	Grant value
2009 12 months	Progetto di Ricerca Ateneo Federato dello spazio e della Societa' A.DE.S.SO (codice C26F09P4AL). Project Title: Problemi variazionali di tipo integrale e supremale con vincoli differenziali	Progetti di Ricerca di Ateneo Federato	€ 3,720.88 (PI and unique member)
2016 12 months	Progetto MEDIO di Ricerca di Ateneo e Assegno di Ricerca Project Title: Metodi Variazionali e Probabilistici per lo studio di Sistemi Complessi	Progetti di Ricerca di Ateneo	€ 12.500 + **Assegno di Ricerca** € 23.600 Other members: Bertini L., Dipasquale F., Faggionato A., Garroni A., Pisante A., Ponsiglione M.
2017 12 months	Progetto MEDIO di Ricerca di Ateneo Project Title: Studio del comportamento statico e dinamico di sistemi complessi con metodi probabilistici e variazionali	Progetti di Ricerca di Ateneo	€ 14.000 Other members: Dipasquale F., Faggionato A., Franzina G., Garroni A., Pisante A., Ponsiglione M.
2018		FFABR, Finanziamento delle Attività' Base di Ricerca	€ 3.000
2018: Postdoctoral Position, Dr. Riccardo Scala, Starting date 1st September 2018, Scientific coordinator: Nadia Ansini		Assegno di ricerca funded by Progetto MEDIO di Ricerca di Ateneo 2016.	€ 23.786,82

V C – **National Grants as I- investigator**

Year	Title	Program
2009 2010 2011 2012 2013 2014 2015 2018 2019 12 months	Sapienza (codice C26A09YJK8) Sapienza (codice C26A10F5K9) Sapienza (codice C26A11C79C) Sapienza (codice C26A12NKXN) Sapienza (codice C26A13PW79) Sapienza (codice C26A14M9KE) Sapienza (codice C26A15M5M7) Sapienza (codice RM118164337FF0B7) Sapienza (codice RM11916B74508124)	Progetto di Ricerca di Ateneo Pending

2006 2012	Project Title: Problemi di evoluzione non lineari suggeriti dalla fisica e dalla biologia. Project Title: Modelli variazionali con interazione continuo-discreta.	GNAMPA
Since 1997	Coordinators: L. Ambrosio, G. Dal Maso	PRIN (SISSA, Rome2, Rome1)

Part VI – Teaching experience

Year	Institution	Lecture/Course
2002-03 2003-04 2004-05	Sapienza, Dept of Mathematics	Mathematical Analysis I (Exercises)
2005-06	EPFL (Lausanne, Switzerland)	Mathematical Analysis III, IV (Exercises) in French
2006-07 2007-08 2008-09	University of Cassino, Faculty of Engineering (Environment and Territory/ Industrial Production)	Mathematical Analysis I, II
Sept2008	Sapienza (Latina), Agricultural and Industrial Biotechnology	Preparatory course in Mathematics
2008- 2019	Sapienza, Faculty of Architecture	Mathematical Analysis I , II
2017-18 2018-19	Sapienza, Dept of Mathematics	Course SSAS-Sapienza (Sapienza School for Advanced Studies) 'Calcolo delle Variazioni ed Eq. Differenziali'
2018-19 2019-20	Sapienza, Dept of Mathematics	Analisi Superiore
2019-20	Sapienza, Computer Science	Calcolo Differenziale (with M. Ponsiglione)

Part VII – Organisation of conference, events and services to the scientific community

2009	Sapienza, Faculty of Architecture	Admission Tests. Member of the Admission panel
2014	University of Bath, Dept of Mathematical Sciences	Postdoctoral position Leverhulme Fellowship. Member of the panel
2014	University of Bath, Dept of Mathematical Sciences	Organizer and speaker for a series of lectures on 'Local minimisation and variational evolution'
since 2015	Sapienza, Department of Mathematics	Co-organiser of the Weekly Seminar series of Mathematical Analysis at the Department of Mathematics, http://www1.mat.uniroma1.it/ricerca/seminari/analisi-matematica/
2017	Sapienza, Department of Mathematics	Co-organiser of the Ninth Summer School in Analysis and Applied Mathematics (June 5-9 2017) http://www1.mat.uniroma1.it/people/garroni/SummerSchool2017.html
2017	Sapienza, Department of Mathematics	Co-organiser of the conference A.MA.CA (Mathematical Analysis at Castelnuovo) (8-9 may 2017)

2018	Sapienza, Department of Mathematics	Co-organiser of the conference A.MA.CA (Mathematical Analysis at Castelnuovo) (7 may 2018)
2018	Sapienza, Department of Mathematics	Postdoctoral position "ASSEGNO DI RICERCA: Matematica e sue applicazioni". Member of the panel

Referee for several international journals	
2017- Reviewer for Research Proposal NWO Grant.	Netherlands Organisation for Scientific Research (NWO). Vidi grant within the Innovational Research Incentives Scheme of the Domain Science.
17 September 2019 - Master's Degree student in Mathematics	Jessica d'Ambrino, Title of the thesis: Kinetic Models for Opinion Formation
Ph.D. defence 2019. Member of the panel.	4 March 2019- University of L' Aquila. Candidate: Antonio Esposito (Supervisor: Marco Di Francesco). 27 June 2019- University of Bath (UK). Candidate : Xavier Pellet (Supervisor: Lucia Scardia)

Part VIII – Selected seminars (invited speaker)

- Workshop on Calculus of variations: *Geometric Measure Theory, Relaxation and Gamma -Convergence*, Levico Terme (Trento), Italy, April 1998.
- *Department of Mathematics Politecnico di Torino*, Turin, Italy, March 2000.
- *Le Séminaire du Groupe de travail Homogénéisation et Echelles Multiples*, Laboratoire Jacques-Louis Lions (Paris 6), France, March 2001.
- *Le Séminaire du Laboratoire ACSIOM*, Université Montpellier II, Montpellier, France, November 2001.
- *Séminaire du Laboratoire Jacques-Louis Lions* (Paris 6), France, May 2002.
- *Young Researchers Workshop a Skodsborg* (Copenhagen), Danemark, May 2002.
- *Le Séminaire du Groupe de travail Homogénéisation et Echelles multiples*, Laboratoire Jacques-Louis Lions (Paris 6), France, January 2003.
- Conference *Amam 2003*, Nice, France, February 2003.
- Conference on *Multiscale Problems and Asymptotic Analysis*, Narvik, Norway, June 2004.
- *Le Séminaire du Groupe de travail Homogénéisation et Echelles multiples*, Laboratoire Jacques-Louis Lions (Paris 6), France, June 2004.
- *Le Séminaire d'Analyse, Section de Mathématiques, EPFL*, Lausanne, Switzerland, November 2005.
- *CBPF, Rio de Janeiro*, Brasil, February 2006.
- *Seminars Mathematical Analysis,* Department of Mathematics of Sapienza University of Rome, September 2009.
- *Seminars Mathematical Analysis,* Carnegie Mellon University, Center for Nonlinear Analysis, Dept of Mathematical Sciences, Pittsburgh (USA), July 2011.
- *Le Séminaire du Groupe de travail Homogénéisation et Echelles multiples*, Laboratoire Jacques-Louis Lions (Paris 6), France, December 2012.
- *Seminars Mathematical Analysis,* Department of Mathematical Sciences*,* University of Bath (UK), October 2013.
- *Seminars Mathematical Analysis,* Department of Mathematical Sciences, University of Swansea (UK), February 2014.
- *Seminars Mathematical Analysis,* Department of Mathematics, Heriot-Watt University, Edinburgh (UK), November 2014.
- *Seminars Mathematical Analysis,* Department of Mathematics, University of Sussex (UK), December 2014.
- *GW4 Meeting*, Department of Mathematical Sciences, University of Bath (UK), December 2014.
- *Working seminar on Calculus of Variations and Gamma-convergence*. Dipartimento di Matematica, Sapienza Universita' di Roma, November 2015.
- Conference *Women and Research in Mathematics: the contribution of SISSA*, Trieste, September 2016.
- *Seminars Mathematical Analysis,* Department of Mathematics, Tokyo Institute of Technology, Tokyo (Japan), October 2016.
- Conference *CoMFoS16: Mathematical Analysis of Continuum Mechanics and Industrial Applications II*, Fukuoka (Japan) October 2016.
- *Seminars Mathematical Analysis,* Department of Mathematics, Kyoto University (Japan), October 2016.
- Conference *NPDEs and Gradient Flows*, TU Wien (Austria), November 2016.
- Conference *Contemporary research in elliptic PDEs and related topics*, University of Bari, May 2017.
- Conference *Operators, Operator Families and Asymptotics II*, Department of Mathematical Sciences, University of Bath (UK), January 2019.

Part IX– Summary of Scientific Achievements (IF 2018 database Web of Science, citations are the maximum between Scopus and Web of Science).

Papers Published on Journals

[1] N. Ansini, A. Braides and V. Chiado Piat. Homogenization of Periodic Multi-dimensional Structures. In: *Boll. Un. Mat. Ital.* 8 (1999), 735-758. *Citations 6.*

[2] N. Ansini, A. Braides. Homogenization of Oscillating Boundaries and Applications to Thin Films. In : *J. d'Analyse Mathematique* 83 (2001), 151-182. *IF 0.718, citations 27.*

[3] N. Ansini, F. Bille Ebobisse. Homogenization of Periodic Multi-dimensional Structures: the linearly elastic /perfectly plastic case. In: *Adv. Math. Sci. Appl.* 11 (2001), 203-225.

[4] N. Ansini, A. Braides. Separation of Scales and Almost-Periodic Effects in the Asymptotic Behaviour of Perforated Periodic Media. In: *Acta Appl. Math.* 65 (2001), 59-81. *IF 1.035, citations 7.*

[5] N. Ansini, A. Braides. Asymptotic Analysis of Periodically Perforated Nonlinear Media. In: *J. Math. Pures Appl.* 81 (2002), 439-451. *IF 1.961, citations 31.*

[6] N. Ansini, A. Braides and V. Chiado Piat. Gradient Theory of Phase Transitions in Composite Media. In: *Proc. Roy. Soc. Edinb. A* 133 (2003), 265-296. *IF 1.045, citations 12.*

[7] N. Ansini. The Nonlinear Sieve Problem and Applications to Thin Films. In: *Asymptotic Analysis* 39 (2) (2004), 113-145. *IF 0.808, citations 15.*

[8] N. Ansini, A. Braides. Erratum to "Asymptotic analysis of periodically-perforated nonlinear media". In: *J.Math.Pures Appl.* 84 (2005), 147-148. *IF 1.961, citations 10.*

[9] N. Ansini, A. Braides and V. Valente. Multi-scale Analysis by Gamma-convergence of a One-dimensional Non-local Functional Related to a Shell-membrane Transition. In: *SIAM Journal on Mathematical Analysis* 38 (2006), 944-976. *IF 1.334, citations 5.*

[10] N. Ansini, J.F. Babadjian and C.I. Zeppieri. The Neumann Sieve Problem and Dimensional Reduction: a Multiscale Approach. In: *Mathematical Models and Methods in Applied Sciences (M3AS)* 17 (2007), 681-735. *IF 3.127, citations 7.*

[11] N. Ansini, A. Garroni. Gamma-convergence of Functionals on Divergence Free Fields. In: *ESAIM: Control, Optimisation and Calculus of Variations* 13 (2007), 809-828. *IF 1.295, citations 13.*

[12] N. Ansini, O. Iosifescu. Approximation of Anisotropic Perimeter Functionals by Homogenisation. In: *Boll. Un. Mat. Ital.* 3 (2010), 149-168. *Citations 4.*

[13] N. Ansini, V. Valente. On a nonlocal functional arising in the study of thin-film blistering, In: *Analysis and Applications* 8 (2010), 109-123. *IF 1.231*

[14] N. Ansini, C.I. Zeppieri. Asymptotic analysis of non-symmetric linear operators via Gamma-convergence. In: *SIAM Journal on Mathematical Analysis* 44 (2012), 1617-1635. *IF 1.334, citations 4.*

[15] N. Ansini, G. Dal Maso and C.I. Zeppieri. Gamma-convergence and H-convergence of linear elliptic operators. In: *J.Math.Pures Appl.* 99 (2013), 321-329. *IF 1.961, citations 4.*

[16] N. Ansini, G. Dal Maso and C.I. Zeppieri. New results on Gamma-limits of integral functionals. In: *Ann. Ist. H. Poincaré Anal. Non Linéaire* 31(2014), 185-202. *IF 2.201,citations 3.*

[17] R. Alicandro, N. Ansini. A variational model of interactions between continuum and discrete. In: *Mathematical Models and Methods in Applied Sciences (M3AS)* 24 (2014), 1957-2008. *IF 3.127*

[18] N. Ansini, F. Prinari. Power-law approximation under differential constraints. In: *SIAM Journal on Mathematical Analysis* 46 (2014)*,* 1085-1115. *IF 1.334, citations 2.*

[19] N. Ansini, F. Prinari. On the lower semicontinuity of supremal functional under differential constraints. In: *ESAIM: Control, Optimisation and Calculus of Variations* 21 (2015), 1053-1075. *IF 1.295, citations 2.*

[20] N. Ansini, A. Braides and J. Zimmer. Minimising movements for oscillating energies: the critical regime. *Proc. Roy. Soc. Edinb.*149 (2019)*,* 719-737. *IF 1.045.*

[21] N. Ansini, S. Fagioli. Nonlinear diffusion equations with degenerate fast-decay mobility by coordinate transformation. arXiv:1902.02764v1, appear to *Comm. Math. Sci. IF (1.303)*.

Preprint

[22] R. Alicandro, N. Ansini, A. Braides, A. Piatnitski and A. Tribuzio. A Variational Theory of Convolution-type Functionals. In preparation 2019.

Contribution to Scientific Book

[23] N. Ansini, B. Dacorogna. Some remarks on Weak Lower Semicontinuity for Quasiconvex Integrands. In: B. Dacorogna.'Direct Methods in the Calculus of Variations' Second Ed. Vol. 78. Applied Mathematical Sciences. Berlin: Springer, 2008. Chapter: Lower Semicontinuity for General Quasiconvex Functions for 1<= p< infinity, pp. 381-391.

Conference Proceedings with referee

[24] N. Ansini, A. Braides and V. Chiad`o Piat. Interactions between Homogenization and Phase-Transition Processes. In: *Proceedings of the International Conference, Suzdal (Vladimir, Russia)*, 21-26/8/2000. Proceedings of the Steklov Institute of Mathematics 236 (2002), 373–385. *IF 0.70*

[25] N. Ansini. Gradient flows with wiggly potential: a variational approach to the dynamics. In: van Meurs P., Kimura M., Notsu H. (eds) *Mathematical Analysis of Continuum Mechanics and Industrial Applications II*. CoMFoS 2016. Mathematics for Industry, vol 30. Springer, (2018), 139-151.

Monographs

[26] Ph.D. Thesis. N. Ansini. Homogenization Problems for Multi-dimensional and Multi-scale Structures. SISSA Ph.D. Thesis 2000.

[27] N. Ansini. Indagine Analitica su Metodi Variazionali per lo Studio Matematico del Blistering di Pellicole Sottili. Opus n. 124 (4/2007) CNR Roma IAC, 2007.

Works in progress (see Part X) Institutions of collaborators: University of L' Aquila; Institute for Applied Mathematics, University of Bonn; University of Oxford; Imperial College of London; Technical University of Dresden, Germany; National Research University Higher School of Economics, Moscow.

[A] N. Ansini, A. Esposito, S. Fagioli and A. Schlichting; [B] N. Ansini, M. Bruna, and J.A. Carrillo de la Plata; [C] N. Ansini, C. Geldhauser, M. Mariani.

Product type	Number
Papers	21
Contribution to Scientific Book	1
Conference Proceedings with referee	2
Monographs	2
Preprint	1

Total Impact factor 2018	28,815

	Scopus (by 19 documents)	Web of Science (by 19 documents)	RG (Research Gate) (by 25 documents)	Google Scholar (by 22 documents)
Total Citations	145	135	174	231
Hirsch (H) index	6	7		8

Part X – Research Activities

Keywords: *Periodically perforated domains* [4],[5], [8], [17]

Brief Description: In [5] we introduce a new method to study via Gamma-convergence the asymptotic behaviour of Dirichlet problems in perforated domains which gives rise to the appearance of an additional term in the limit problem as the period of the perforations tends to zero (see also [8]). This method can be easily applied to more general families of integral functionals and domains. For example, in [4], we examine the case of oscillating functionals in perforated domains. More recently, in [17] we consider a variational model for complex systems where the perforations are replaced by small interacting particles immersed in a continuous medium. The energy associated with the system consists of two terms: the energy of the continuous medium and the spatially discrete energy of the interacting particles. Its macroscopic limit (via Gamma-convergence) highlights different regimes. The validity (or failure) of the so-called `Cauchy-Born' rule is also addressed.

Keywords: *Thin films* [2], [7], [10], [13], [27]

Brief Description: In [2] we study the homogenisation and dimension reduction phenomena for sets with fast-oscillating profile. A ‘loss of coerciveness’ is observed as the period of the oscillations tends to zero. In [7] we consider bilateral thin films (thickness delta) connected by epsilon-periodically distributed `contact zones’. The macroscopic limit (as the parameters delta and epsilon tends to zero, delta>>~ epsilon) show the appearance of an interface energy. In [10] we complete the multiscale analysis (as delta<<epsilon). The appearance of an extra `interfacial energy' term is still observed but with three different limit behaviours (or regimes), depending on the mutual vanishing rate. In [13] we propose and study a perturbed variational problem which arises in the study of thin-film blistering via energy methods for the Von Karman model. See also [26].

Keywords: *Phase transitions* [6], [9], [24] *and Perimeter functionals* [12]

Brief Description: In [6] we study the behaviour of non-convex functionals which are singularly perturbed by a possibly oscillating inhomogeneous gradient term, in the spirit of the gradient theory of phase transitions (we consider a generalisation of Modica-Mortola functional). We show that as the perturbation vanishes, a limit problem giving a sharp interface always exists (perimeter functional), but may be inhomogeneous or anisotropic. Three different types of regimes, can be observed in the limit problem depending on the speed of the oscillations. See also [23]. In [12] we show that all anisotropic perimeter functionals can be approximated in the sense of Gamma-convergence by isotropic but inhomogeneous perimeter functionals. The anisotropic perimeter functionals are often studied in connection with crystalline motion by curvature. Our approximation suggests an indirect way to deal with crystalline problems where

anisotropy is replaced by inhomogeneity and a passage to the limit.
A possible application of [12] is the approximation of perimeter functionals by elliptic energies as in Modica-Mortola using a double-scale procedure as in [6].
In [9] we examine the asymptotic behaviour of energy of a thin nonlinear elastic spherical shell in the limit of vanishing thickness, under the assumption of radial deformations. The functionals are characterised by the presence of a nonlocal potential term and defined on suitable weighted functional spaces. The transition shell-membrane is studied at three relevant different scales. The optimal transitions exhibit a kind of `Gibbs' phenomenon'.

Keywords: *Variational approach to non-symmetric linear operators* [14], [15], [16]

Brief Description: In [14] we study the asymptotic behaviour of a sequence of Dirichlet problems for second order linear operators in divergence form where the matrices are uniformly elliptic and non symmetric. We prove that is possible to associate to the sequence of matrices suitable quadratic forms in such a way that the H-convergence of the sequence of matrices is equivalent to the Gamma-convergence of the associated quadratic forms. In [15] we fully characterise from the variational point of view, the H-convergence of the linear operators as above by applying the general Gamma-convergence results proved in [16] (see below). The equivalence between H and Gamma convergence was an open problem since the 1970s.

Keywords: *Integral and supremal functional under differential constraint (constant rank operators)* [18], [16], [11]; *Lower semicontinuity* [19],[23]

Brief Description: In the setting of continuum mechanics and electromagnetism it is
interesting to consider variational models involving integral functionals depending on fields which satisfy a differential constraint. In [11] we study the stability of a sequence of integral functionals on divergence-free matrix valued fields. We prove that the Gamma-limit is an integral functional on divergence-free matrix valued fields. We also show that the Gamma-limit is stable under volume constraint and various type of boundary conditions. In [16] we consider functionals on (w,v) matrix valued fields where w is curl-free and v satisfies a fixed divergence constraint (div v=g). We prove a general Gamma-compactness result, in particular we prove that the integrand of the Gamma-limit does not depend on g. Similar problems have been studied in the framework of A-quasiconvexity, however it does not seem that the techniques used in these papers can lead directly to the independence on g. We finally remark that results contained in [16] are used in [15] to provide a Gamma-convergence approach to the the study of H-convergence of non-symmetric linear elliptic operators.
In [18] we deal with the approximation, by way of Gamma-convergence, of supremal functionals under differential constraint by a suitable family of integral functionals (the so-called power-law functionals). These results can be apply to characterise the strength set in the context of electrical resistivity.
In [19] we provide necessary and sufficient conditions for the weak lower semicontinuity of supremal functionals under differential constraint. The lower semicontinuity is a fundamental property in calculus of variations, moreover the Gamma-limit is always lower semicontinuous for this reason we are interested in finding conditions that guarantee such property.
In [23] we review the proof of the weak lower semicontinuity of integral functionals with quasiconvex integrand (depending on vector-valued functions) at the aim to make it as much as possible self-contained. We simplify the approach by Acerbi ad Fusco by using the equi-integrability Lemma by Fonseca, Muller and Pedregal. We also propose an alternative proof of such lemma that does not involve Young measures. The proof in [23] has been published in the book by B. Dacorogna `Direct Method in the Calculus of Variations', second edition.

Keywords: *Homogenisation of periodic multi-dimensional structures* [1], [3]

Brief Description: In [1] we study the asymptotic behaviour of integral functionals which may model energies concentrated on multidimensional structures. The model ex- ample we have in mind is that of composite elastic bodies composed of n-dimensional elastic grains interacting through contact forces depending on the relative displacements of their common boundaries. The energy functionals depend on the deformation gradient and on a family of measures describing the multidimensional structures. In [3] we consider also the linearly elastic/perfectly plastic case where the deformation gradient is replaced by a more appropriate linearised strain tensor.

Keywords: *(Current research activity) Local minimisation and variational evolution* [20], [21], [25], [A], [B], [C]. *Variational theory of convolution-type functionals* [22]

Brief Description: Free energies with many small wiggles, arising from small scale micro-structural changes, appear often in phase transformations, protein folding and friction problems. In [20] we investigate gradient flows with energies, depending on a small parameter, given by the superposition of a convex functional and fast small oscillations. We apply the time-discrete minimising movement scheme to capture the effect of the local minimisers of the energy in the limit equation as the parameter tends to zero. We discuss the pinning threshold and we derive the limit equation describing the motion (see also [25]). In [21] we investigate nonlinear convection-diffusion equation with degenerate fast-decay mobility. We are interested in nonnegative solutions with finite mass. Since the mobility degenerate, the problem of posing suitable zero-flux boundary conditions arises in order to have a (unique) solution with constant mass. Intuitively, thinking to the equation as the continuum limit of a many particle system, if the mobility vanishes very fast at the extremes of a bounded interval, particles slow down so fast at the boundary that one does not need to prescribe any boundary condition in order to preserve the total mass of the solution. On the other hand, if the mobility goes to zero very slowly, a zero-flux boundary condition may be needed in order to avoid loss of mass. In this paper we focus on the fast-decay case. In a forthcoming paper (see [A]) we consider the slow-decay case.
In [22] we study perturbations of families of convolution-type energies modelled by functionals that can be seen as a generalisation of an Lp-norm of the gradient of a function u. If p=2 energies of this type derive from models in population dynamics where macroscopic properties can be reduced to studying evolution of the first-correlation functions describing the population density u in the system. With that interpretation in mind, in the simplest formulation one can consider perturbations of energies that may take into account inhomogeneities of the environment. Our aim is to consider a wide class of convolution-type energies and study the limit (via Gamma-convergence) as the small parameter tends to zero. Since the limit energy may be nonlocal, suitable assumptions on the decay must be required to ensure that the limit be a local integral energy.

Works in progress:
A] We continue the study of existence, uniqueness and asymptotic behaviour of non-negative solution to nonlinear convection-diffusion equation with degenerate mobility. We want to analyse now the effect of a slow decay mobility on the existence of a unique solution under suitable boundary conditions. The case of unbounded mobilities is also very interesting since the usual Wasserstein distance has to be replaced by a distance constructed in the spirit of Benamou-Brenier with and additional weight due to the presence of the unbounded mobilities (forthcoming paper in collaboration with A. Esposito, S. Fagioli and A. Schlichting).

B] Fokker-Planck equation for the join probability density of N particles interacting with each other and the domain walls with a repulsive hard-core potential (hard-spheres), and in the presence of an external potential. We reduce the equation to a gradient flow with respect to the Wasserstein distance. We want to study stability of the gradient flow equations and Gamma-convergence of the associated energy entropy (in collaboration with M. Bruna, J. A. Carrillo de la Plata).

C] Fluctuations of a discrete scheme for the Cahn-Hilliard Dynamics (in collaboration with C. Geldhauser, M. Mariani). We study a stochastic perturbation of a so-called discrete ill-posed nonlinear evolution equation. Such discrete in space evolution equations arise for example in the study of formations of shear bands in granular flows, in population dynamics or as a class of models of reinforced random walks on a lattice modeling the chemotactic movement of bacteria. Moreover, they appear in computer vision as models of image denoising and segmentation.

Part XI– Selected Publications List of the publications selected for the evaluation. For each publication has been reported title, authors, reference data, journal IF corresponding to the year of publication of the paper (if applicable, database Web of Science), citations are calculated as the maximum between Scopus and Web of Science.

[1] N. Ansini, G. Dal Maso and C.I. Zeppieri. New results on Gamma-limits of integral functionals. In: *Ann. Ist. H. Poincaré Anal. Non Linéaire* 31 (2014), 185-202. IF2014 (1.341), *citations 3*

[2] R. Alicandro, N. Ansini. A variational model of interactions between continuum and discrete. In: *Mathematical Models and Methods in Applied Sciences (M3AS)* 24 (2014), 1957-2008. IF2014 (3.094)

[3] N. Ansini, F. Prinari. Power-law approximation under differential constraints. In: *SIAM*

Journal on Mathematical Analysis 46 (2014)*,* 1085-1115. IF2014 (1.265)*, citations 2*

[4] N. Ansini, F. Prinari. On the lower semicontinuity of supremal functional under differential constraints. In: *ESAIM: Control, Optimisation and Calculus of Variations* 21 (2015), 1053-1075. IF2015 (1.112), *citations 2*

[5] N. Ansini. Gradient flows with wiggly potential: a variational approach to the dynamics. In: van Meurs P., Kimura M., Notsu H. (eds) *Mathematical Analysis of Continuum Mechanics and Industrial Applications II*. CoMFoS 2016. Mathematics for Industry, vol 30. Springer, (2018), 139-151.

[6] N. Ansini, A. Bradies and J. Zimmer. Minimising movements for oscillating energies: the critical regime. *Proc. Roy. Soc. Edinb. A* 149 (2019)*,* 719-737. IF2018 (1.045).

[7] N. Ansini, S. Fagioli. Nonlinear diffusion equations with degenerate fast-decay mobility by coordinate transformation. arXiv:1902.02764v1, appear to *Comm. Math. Sci.* IF2018 (1.303).