Milano, May 6, 2024

Signori Andrea, PhD

Non-tenure track Assistant Professor - RTDa,
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Scopus: 221 citations, h-index 11
Google Scholar: 374 citations, h-index 13, i10-index 16

Research Interests

Mathematical analysis and optimal control of systems of nonlinear partial differential equations based on diffuse interface approach for tumor growth models: well-posedness, regularity, asymptotic analysis, optimal control, phase field models, gradient flows, topology optimisation.

Education and Work Experience

- 05-06-2023/05-06-2034: Italian National Abilitation - Associate Professor
  Abilitazione Scientifica Nazionale: seconda fascia Settore Concorsuale 01/A3: Analisi matematica, Probabilità e Statistica matematica
- 04-07-2022/Now: Non-tenure track Assistant Professor RTDa, at the Department of Mathematics of the Politecnico of Milan (Italy)
- 01-03-2021/04-07-2022: PostDoc position at the Department of Mathematics "F. Casorati", University of Pavia (Italy)
- 11-12-2020: Ph.D. Defense: PhD student in mathematical analysis: Joint PhD Program in Mathematics Pavia–Milano-Bicocca–INdaM, University of Pavia. Title of the Thesis: "*Understanding the Evolution of Tumours, a Phase-field Approach: Analytic Results and Optimal Control*" (supervisor: Prof. Pierluigi Colli)
- 01-10-2017/11-12-2020: PhD student in analysis: Joint PhD Program in Mathematics Pavia–Milano-Bicocca–INdaM
- 19-09-2017: Master degree in mathematics, University of Pavia. Title of the thesis: "*Boundary control problem and optimality conditions for the Cahn–Hilliard equation with dynamic boundary conditions*" (supervisor: Prof. Pierluigi Colli), 110/110 cum Laude
- 21-09-2015: Bachelor's degree in mathematics, University of Pavia. Title of the thesis: "*The Legendre–Fenchel transform*" (supervisor: Prof. Enrico Vitali)

Grants

- 2022, Awarded of the *Humboldt Research Fellowship* for postdoctoral researcher
- Recipient of the *Kovalevskaya Scholarship* for the attendance of the International Congress of Mathematics 2022 in Saint Petersburg
- Member of PRIN 2020: *PRIN Project Mathematics for industry 4.0 (Math4I4)* (PI: Prof. P. Ciarletta)

- Principal investigator of the GNAMPA-INdAM Project 2020 (2925,00€): *Analisi e Controllo di Modelli ad Interfaccia Diffusa in Fisica e in Biologia*
- 2019: LIA-COPDESC Travel Grant
- Member of PRIN 2017: *Mathematics of active materials: From mechanobiology to smart devices* (PI: Prof. L. Preziosi)

Publications

Articles under review

(1) H. Garcke, K.F. Lam, R. Nürnberg and A. Signori, Complex pattern formation governed by a Cahn–Hilliard–Swift–Hohenberg system: Analysis and numerical simulations. Preprint arXiv:2405.01947 [math.AP], (2024), 1-37.

(2) M. Grasselli, L. Scarpa and A. Signori, Cahn–Hilliard equations with source, singular potential, and pure phase initial datum. Preprint arXiv:2404.12113 [math.AP], (2024), 1-32.

(3) P. Colli, G. Gilardi, A. Signori and J. Sprekels, Curvature effects in pattern formation: well-posedness and optimal control of a sixth-order Cahn–Hilliard equation. Preprint arXiv:2401.05189 [math.AP], (2023), 1-45.

(4) P. Colli, P. Knopf, G. Schimperna and A. Signori, Two-phase flows through porous media described by a Cahn–Hilliard–Brinkman model with dynamic boundary conditions. Preprint arXiv:2312.15274 [math.AP], (2023), 1-42.

(5) A. Agosti and A. Signori, Analysis of a multi-species Cahn–Hilliard–Keller–Segel tumor growth model with chemotaxis and angiogenesis. Preprint arXiv:2311.13470 [math.AP], (2023), 1-54.

Published Articles

(6) A. Poiatti and A. Signori, Regularity results and optimal velocity control of the convective nonlocal Cahn–Hilliard equation in 3D. *ESAIM Control Optim. Calc. Var.*, **30** (2024). doi.org/10.1051/cocv/2024007.

(7) P. Colli, G. Gilardi, A. Signori and J. Sprekels, On a Cahn–Hilliard system with source term and thermal memory. *Nonlinear Analysis*, **240**, (2024), 113461.

(8) P. Colli, G. Gilardi, A. Signori and J. Sprekels, Optimal temperature distribution for a nonisothermal Cahn–Hilliard system in two dimensions with source term and double obstacle potential. *Ann. Acad. Rom. Sci.* Ser. Math. Appl., **15**, (2023), 175-204.

(9) P. Colli, G. Gilardi, A. Signori and J. Sprekels, Optimal temperature distribution for a nonisothermal Cahn–Hilliard system with source term. *Appl. Math. Optim.* **88** (2023). https://doi.org/10.1007/s00245-023-10039-9.

(10) G. Gilardi, E. Rocca and A. Signori, Well-posedness and optimal control for a viscous Cahn–Hilliard–Oono system with dynamic boundary conditions. *Discrete Contin. Dyn. Syst. Ser. S*, **16** (2023), 3573-3605.

(11) G. Gilardi, A. Signori and J. Sprekels, Nutrient control for a viscous Cahn–Hilliard–Keller–Segel model with logistic source describing tumor growth. *Discrete Contin. Dyn. Syst. Ser. S*, **16** (2023), 3552-3572.

(12) P. Colli, G. Gilardi, A. Signori and J. Sprekels, Cahn–Hilliard–Brinkman model for tumor growth with possibly singular potentials. *Nonlinearity* **36** (2023), 4470-4500.

(13) H. Garcke, K.F. Lam, R. Nürnberg and A. Signori, Phase field topology optimisation for 4D printing. *ESAIM Control Optim. Calc. Var.* (Forthcoming article, to appear) (2023). https://doi.org/10.1051/cocv/2023012.

(14) H. Garcke, K.F. Lam, R. Nürnberg and A. Signori, Overhang penalization in additive manufacturing via phase field structural topology optimization with anisotropic energies. *Appl. Math. Optim.* **87** (2023). https://doi.org/10.1007/s00245-022-09939-z.

(15) M. Grasselli, L. Scarpa and A. Signori, On a phase field model for RNA-Protein dynamics. *SIAM J. Math. Anal.*, **55**(1) (2023), 405-457.

(16) P. Colli, G. Gilardi, A. Signori and J. Sprekels, Optimal control of a nonconserved phase field model of Caginalp type with thermal memory and double obstacle potential. *Discrete Contin. Dyn. Syst. Ser. S*, **16**(9) (2023), 2305-2325.

(17) E. Rocca, G. Schimperna and A. Signori, On a Cahn–Hilliard–Keller–Segel model with generalized logistic source describing tumor growth. *J. Differential Equations*, **343** (2023), 530-578.

(18) P. Colli, A. Signori and J. Sprekels, Analysis and optimal control theory for a phase field model of Caginalp type with thermal memory. *Commun. Optim. Theory*, **4** (2022). doi.org/10.23952/cot.2022.4.

(19) P. Colli, A. Signori and J. Sprekels, Optimal control problems with sparsity for phase field tumor growth models involving variational inequalities. *J. Optim. Theory Appl.*, (2022). doi.org/10.1007/s10957-022-02000-7.

(20) E. Rocca, L. Scarpa and A. Signori, Parameter identification for nonlocal phase field models for tumor growth via optimal control and asymptotic analysis. *Math. Models Methods Appl. Sci.*, **31**(13) (2021), 2643-2694.

(21) P. Knopf and A. Signori, Existence of weak solutions to multiphase Cahn–Hilliard–Darcy and Cahn–Hilliard–Brinkman models for stratified tumor growth with chemotaxis and general source terms. *Comm. Partial Differential Equations*, **47**(2) (2022), 233-278.

(22) P. Colli, A. Signori and J. Sprekels, Second-order analysis of an optimal control problem in a phase field tumor growth model with singular potentials and chemotaxis. *ESAIM Control Optim. Calc. Var.*, **27** (2021). doi.org/10.1051/cocv/2021072.

(23) L. Scarpa and A. Signori, On a class of non-local phase-field models for tumor growth with possibly singular potentials, chemotaxis, and active transport. *Nonlinearity* **34** (2021), 3199-3250.

(24) H. Garcke, K.F. Lam and A. Signori, Sparse optimal control of a phase field tumour model with mechanical effects. *SIAM J. Control Optim.*, **59**(2) (2021), 1555-1580.

(25) S. Frigeri, K.F. Lam and A. Signori, Strong well-posedness and inverse identification problem of a non-local phase field tumor model with degenerate mobilities. *European J. Appl. Math.*, **33**(2) (2022), 267-308.

(26) P. Knopf and A. Signori, On the nonlocal Cahn–Hilliard equation with nonlocal dynamic boundary condition and boundary penalization. *J. Differential Equations*, **280**(4) (2021), 236-291, https://doi.org/10.1016/j.jde.2021.01.012

(27) H. Garcke, K.F. Lam and A. Signori, On a phase field model of Cahn–Hilliard type for tumour growth with mechanical effects. *Nonlinear Anal. Real World Appl.* **57** (2021), 103192, https://doi.org/10.1016/j.nonrwa.2020.103192.

(28) A. Signori, Penalisation of long treatment time and optimal control of a tumour growth model of Cahn–Hilliard type with singular potential, *Discrete Contin. Dyn. Syst. Ser. A*, (2020), https://doi.org/10.3934/dcds.2020373.

(29) P. Colli, A. Signori and J. Sprekels, Optimal control of a phase field system modelling tumor growth with chemotaxis and singular potentials, *Appl. Math. Optim.* **83** (2021), 2017-2049.

(30) P. Colli and A. Signori, Boundary control problem and optimality conditions for the Cahn–Hilliard equation with dynamic boundary conditions, *Internat. J. Control* (2019), https://doi.org/10.1080/00207179.2019.1680870.

(31) A. Signori, Vanishing parameter for an optimal control problem modeling tumor growth. *Asymptot. Anal.* **117** (2020) 43-66.

(32) A. Signori, Optimal treatment for a phase field system of Cahn–Hilliard type modeling tumor growth by asymptotic scheme, *Math. Control Relat. Fields* **10** (2020) 305-331.

(33) A. Signori, Optimality conditions for an extended tumor growth model with double obstacle potential via deep quench approach, *Evol. Equ. Control Theory* **9** (2020) 193-217.

(34) A. Signori, Optimal distributed control of an extended model of tumor growth with logarithmic potential. *Appl. Math. Optim.* **82** (2020), 517-549.

Teaching Experiences

Politecnico of Milan:

- 2023–2024: "Mathematics", degree course in Biomedical Engineering (MEDTEC Program)
- 2022–2023: "Calculus 2", degree course in civil Engineering
- 2022–2023: Adjunct Professor for "Mathematics with elements of Statistic", **48** hours, degree course in Pharmacy (University of Pavia)
- 2022–2023: Exercise lectures: Mathematical and Numerical Methods in Engineering, Master Degree Program in Biomedical Engineering

University of Pavia:

- 2021–2022: Adjunct Professor for "Mathematics with elements of Statistic", **24** hours, degree course in Pharmacy
- 2020–2021: Exercise lectures "Calculus 2", **4** hours, degree course in Engineering
- 2020–2021: Exercise lectures "Elements of Mathematics and statistic", **12** hours, degree course in Science, technology and environment
- 2020–2021: Seminar lectures "Precorsi", **20** hours, degree course in Engineering
- 2019–2020: Exercise lectures "Advanced Calculus and Statistic", **7** hours, degree course in Engineering
- 2018–2019: Project "Lauree PLS: Il gioco e il Caso", **30** hours
- 2018–2019: Exercise lectures "Calculus 2", **10** hours, degree course in Physics
- 2018–2019: Exercise lectures "Calculus 1", **10** hours, degree course in Engineering
- 2018–2019: Exercise lectures "Elements of Mathematics and statistic", **14** hours, degree course in Science, technology and environment
- 2018–2019: Exercise lectures "Mathematics and statistic", **6** hours, degree course in Biotechnology
- 2017–2018: Exercise lectures "Mathematics", **20** hours, degree course in Biotechnology
- 2017–2018: Exercise lectures "Mathematics", **15** hours, degree course in Biotechnology
- 2016–2017: Exercise lectures "Calculus 2", **28** hours, degree course in Engineering
- 2015–2016: Exercise lectures "Mathematics", **20** hours, degree course in Biotechnology

Conferences and Workshops

- 03-05-2024 GRK 2339 IntComSin Kolloquium (Erlangen, Germany)
- 04-03-2024/06-03-2024 Dynamics of interfaces: From applied math to physics and material science, University of Augsburg (Augsburg, Germany)
- 22-02-2024 BIO-Med Workshop: Cahn–Hilliard and Allen–Cahn Equations in Bio-medicine (Politecnico di Milano, Italy)
- 21-11-2023 Boundary value problems and applications - The legacy of Enrico Magenes (Pavia, Italy)
- 26-10-2023 XI Giornata di Studio Università di Pavia - Politecnico di Milano: Equazioni Differenziali e Calcolo delle Variazioni (Milano)
- 09-10-2023/13-10-2023 Biological condensates: cellular mechanisms governed by phase transitions (SPLW03), Isaac Newton Institute for Mathematical Sciences (Cambridge, England)

- 04-09-2023/09-09-2023 XXII Congresso dell'Unione Matematica Italiana, Pisa, Italy (Pisa, Italy)
- 31-05-2023/04-06-2023 The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, University of Wilmington (Wilmington, NC, USA)
- 11-10-2022/13-10-2022 MOCETIBI kick-off workshop, Laboratory Jacques-Louis Lions, Sorbonne Université (Paris, France)
- 29-08-2022/02-09-2022 Mathematical Biology on the Mediterranean Conference, 3rd edition, FORTH Foundation for Research and Technology Hellas (Heraklion, Greece)
- 20-06-2022/24-06-2022 Lake Como School of Advanced Studies: Mathematical models for bio-medical sciences (Como, Italy)
- 23-05-2022/27-05-2022 INdAM Workshop PHAME2022 - PHAse field MEthods in applied sciences (Rome, Italy)
- 28-03-2022/01-04-2022 Mathematical Modeling of Organization in Living Matter, CIRM-IHP PROGRAM (Marseille, France)
- 01-10-2021 One day in PDEs in honor of Sandro Salsa, Politecnico di Milano
- 27-09-2021/01-10-2021 DMV-ÖMG Annual Conference 2021, Joint Annual Conference of the German Mathematical Society DMV and the Austrian Mathematical Society ÖMG, Passau (online)
- 13-09-2021/17-09-2021 15th International Conference on Free Boundary Problems: Theory and Applications 2021, Berlin (online)
- 23-08-2021/27-08-2021 Summer school: Fluids under Control (Prague, Czech Republic)
- 12-04-2021/16-04-2021 CISM Advanced Course: Optimization of Shape and Material Properties: Advanced Mathematical Methods and 3D Printing (online)
- 14-02-2021/20-02-2021 Oberwolfach: Challenges in Optimization with Complex PDE-Systems (online)
- 05-02-2021 Erlangen-Regensburg-Vienna Colloquium on Nonlinear PDEs (online)
- 22-11-2019 Workshop on Numerical Analysis and Scientific Computing (FAU Erlangen, Germany)
- 08-11-2019 GRK 2339 IntComSin Kolloquium (Regensburg, Germany)
- 25-10-2019 GRK 2339 IntComSin Kolloquium (Erlangen, Germany)
- 30-09-2019/02-10-2019 Annual Meeting GRK IntComSin: Interfaces, Complex Structures, and Singular Limits (kloster Weltenburg, Regensburg, Germany)
- 02-09-2019/07-09-2019 XXI Congresso dell'Unione Matematica Italiana (UMI) (Pavia)
- 01-07-2019/05-07-2019 Summer School on PDEs from theory to applications (Milano, Univ. Milano Statale)
- 08-05-2019/10-05-2019 Recent advances in Phase-Field modeling: from Engineering to Biology (Pavia)
- 25-03-2019/28-03-2019 Calculus of Variation and Nonlinear Partial Differential Equations (Regensburg)
- 21-02-2019 Decima Giornata di Studio Università di Pavia - Politecnico di Milano: Equazioni Differenziali e Calcolo delle Variazioni (Milano)
- 19-09-2018/21-09-2018 Optimal Control and Mean Field Games (Pavia)
- 18-06-2018/22-06-2018 Special Materials and Complex Systems (Gargnano)
- 22-05-2017/25-05-2017 Frontiers in Partial Differential Equations Analysis and Solvers (Pavia)

Invited talks at workshops or conferences

- 04-03-2024 Dynamics of interfaces: From applied math to physics and material science: "Exploring RNA-Protein Dynamics through Phase Segregation", University of Augsburg, Augsburg, Germany.
- 05-09-2023 XXII Congresso dell'Unione Matematica Italiana: "Chemotaxis model for tumour growth", Pisa, Italy.
- 02-06-2023 The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications: "Phase Segregation Drives RNA-Protein Dynamics", University of Wilmington, Wilmington, NC, USA.
- 15-12-2022 *Department seminar series*: "Chemotaxis model for tumour growth", Politecnico di Milano.
- 12-10-2022 MOCETIBI kick-off workshop: "Liquid Droplets in Cell Biology: RNA-Protein model", Sorbonne Université, Paris.
- 23-06-2022 Lake Como School of Advanced Studies: Mathematical models for bio-medical sciences: "Phase segregation in Cell Biology: RNA-Protein model", Como.
- 24-05-2022 INdAM Workshop PHAME2022 - PHAse field MEthods in applied sciences: "Cell's organisation: RNA-Protein dynamics, Rome.
- 30-09-2021 DMV-ÖMG Annual Conference 2021, Joint Annual Conference of the German Mathematical Society DMV and the Austrian Mathematical Society ÖMG, Passau (online): "Mechanical model for tumour growth: mathematical analysis and optimal therapies".
- 13-04-2021 *Seminari di Matematica Applicata*: "Mechanical model for tumour growth: mathematical analysis and optimal therapies", University of Pavia.
- 25-11-2020 *Se mi narri di Matematica*: "Mathematical Perspectives on Tumour Growth: From Well-posedness to Optimal Control", University of Pavia.
- 06-02-2020 *Insalate di matematica*: "Mathematical modeling of cancer: challenges and perspectives towards a tailored therapy", University of Milano-Bicocca.
- 28-11-2019 IntComSin Seminar: "On a phase field model of Cahn–Hilliard type for tumor model with elasticity", Regensburg University.
- 19-11-2019 IntComSin Seminar: "Optimal control theory for parabolic equations: introduction and applications", Regensburg University.
- 02-10-2019 Annual Meeting GRK IntComSin: Interfaces, Complex Structures, and Singular Limits (monastery Weltenburg, Kelheim, Germany): "Optimal control problems with applications to tumor growth models".

Organizing experience

- 22-02-2024 BIO-Med Workshop: Cahn–Hilliard and Allen–Cahn Equations in Bio-medicine (Politecnico di Milano, Italy)

Visiting periods

- University of Regensburg: 01-03-2024/31-05-2024* (ongoing)
- University of Regensburg: 06-06-2022/16-06-2022
- University of Regensburg: 15-09-2019/15-12-2019

Languages

- Italian (mothertongue)
- English (fluent)
- Chinese, German, French (basic)

Referee Activities

- Evolution Equations & Control Theory (*Evol. Eq. Control Th.*)
- Mathematical Control & Related Fields (*Math. Control Relat. Fields*)
- Asymptotic Analysis (*Asymptot. Anal.*)
- International Journal of Numerical Analysis and Modeling (*Int. J. Numer. Anal. Model.*)
- Nonlinear Analysis (*Nonlinear Anal.*)
- Discrete & Continuous Dynamical Systems Series S (*Discrete Contin. Dyn. Syst. Ser. S*)
- Applied Mathematics & Optimization (*Appl. Math. Optim.*)
- Discrete & Continuous Dynamical Systems Series B (*Discrete Contin. Dyn. Syst. Ser. B*)
- Mathematical Methods in the Applied Sciences (*Math. Methods Appl. Sci.*)
- Journal of Mathematical Analysis and Applications (*J. Math. Anal. Appl.*)
- ESAIM: Control, Optimisation and Calculus of Variations (*ESAIM Control Optim. Calc. Var.*)
- **Special Editor** for Discrete & Continuous Dynamical Systems Series S: Special issue in honor of Pierluigi Colli's 65th birthday