

Curriculum Vitae

Personal Information

Family Name: *Velichkov* First Name: *Bozhidar* Web Page: www.velichkov.it
Date of birth: *03/02/1985* Mail: bozhidar.velichkov@unipi.it

Current Position

Since **1 June 2020**, I am *Full Professor (Professore Ordinario)* at
Università di Pisa (Pisa, Italy), where I work on
free boundary problems arising in calculus of variations and shape optimization.

Career and cursus

- 04/2019 - 05/2020.** I was *Associate Professor (Professore Associato)* at
Università degli Studi di Napoli Federico II (Naples, Italy).
- 09/2014 - 03/2019.** I was *Assistant Professor (Maître de Conférences)* at
Laboratoire Jean Kuntzmann - Université Grenoble Alpes (Grenoble, France).
- 02/2014 - 08/2014.** I spent six months as *Post-doc* in Shape Optimization at *Università di Pisa*.
- 10/2010 - 11/2013.** I was PhD student at *Scuola Normale Superiore SNS*,
and (since 2012) also at *Laboratoire de Mathématiques LAMA - Université de Savoie*. My advisors
are Giuseppe Buttazzo (*Università di Pisa*) and Dorin Bucur (*Université de Savoie*).
- 10/2005 - 10/2010.** I was *Student in Mathematics* at SNS and I graduated with honors: 70/70 cum
Laude, Diploma 1235. As every SNS student, I was also a student at the University of Pisa:
- 2008 - 2010. Master in Mathematics - *Università di Pisa* (110/110 cum Laude, Diploma 254324)
 - 2005 - 2008. Bachelor in Mathematics - *Università di Pisa* (110/110 cum Laude)

Honors and awards

- 2020.** *Book Prize UMI* for the lecture notes *Regularity of the one-phase free boundaries*.
- 2019.** P.I. of the project *ERC Starting Grant VAREG*
- 2015.** PEDR - *Prime d'Encadrement Doctoral et de Recherche*
- 2015.** P.I. of the project *VariForm* financed by *Université Grenoble Alpes*.
- 2013.** My PhD Thesis was selected for publication in *Edizioni della Normale*.

PhD Thesis

Discussed on 8 Nov 2013 in SNS (Pisa, Italy); mention: 70/70 cum Laude.
Title: *Existence and Regularity Result for Some Shape Optimization Problems*
Published in: *Edizioni della Normale, Tesi 19, Springer 2015, ISBN 978-88-7642-526-4*

Links

My personal web page: www.velichkov.it
My page on the preprint server CVGMT: <http://cvgmt.sns.it/person/336/>
My ArXiv page: https://arxiv.org/a/velichkov_b_1.html
My page at Scopus: [Author ID: 55382990900](https://scopus.com/authid/detail.url?authorID=55382990900)
ORCID ID: <https://orcid.org/0000-0003-4968-3087>

CONTENTS

PhD students	2
Commissions of trust	3
Organization of workshops, conferences and seminars	5
Conferences and seminars	6
Research periods and invitations	10
List of publications	11
Projects - Funding ID	13

PHD STUDENTS

Baptiste Trey (09/2016 - 06/2020). Baptiste is a PhD student financed by the collaborative project GeoSpec (2016-2020) between LJK* and IF**. He is co-advised by myself (LJK, 50%) and Emmanuel Russ (IF, 50%). Baptiste is working on the existence and the regularity techniques in shape optimization. Recently, using different techniques from the regularity of the free boundaries, we proved new regularity results for several different classes of shape optimization problems. In

E. Russ, B. Trey, B. Velichkov : *Existence and regularity of optimal shapes for elliptic operators with drift*. Calc. Var. PDE, 2019

we studied the optimal sets for the first eigenvalue of an operator with drift, while in

L. Spolaor, B. Trey, B. Velichkov : *Free boundary regularity for a multiphase shape optimization problem*. Comm. PDE, 2019

we used an epiperimetric inequality approach to conclude the proof of the regularity of the solutions of the multiphase optimization problem studied in

B. Bogosel, B. Velichkov. *Multiphase Optimization Problems for Eigenvalues: Qualitative Properties and Numerical Results*. SIAM J. Numer. Anal. 54 (1) (2015), 210–241.

*LJK = Laboratoire Jean Kuntzmann - Applied Mathematics Dept, Université Grenoble Alpes.

**IF = Institut Fourier - Mathematics Department, Université Grenoble Alpes.

François Générau (09/2017 - 06/2020). François is a PhD student in my department Laboratoire Jean Kuntzmann, but his thesis is financed by École Normale Supérieure (Paris). He is co-advised by myself (50%) and Édouard Oudet (LJK), who is a specialist in numerical methods for shape optimization problems. During his PhD thesis François worked on obstacle-type problems and discovered a new variational approach for the computation of the cut locus and the λ -cut locus of the distance function to a point on a compact Riemannian manifold. The method is based on the approximation with solutions of the elastic-plastic torsion problem on a manifold and is inspired by

G. Buttazzo, E. Oudet, B. Velichkov. *A free boundary problem arising in PDE optimization*. Calc. Var. PDE 54 (4) (2015), 3829–3856.

The Hausdorff convergence of the approximating λ -contact sets is a delicate question whose solution requires the uniform semiconcavity of the approximating solutions.

F. Générau, E. Oudet, B. Velichkov. *Cut locus on compact manifolds and uniform semiconcavity estimates for a variational inequality*. Preprint, 2020.

COMMISSIONS OF TRUST

I am **referee** for numerous journals, among which the following:

- Acta Mathematica;
- ARMA - Archive for Rational Mechanics and Analysis;
- JFA - Journal of Functional Analysis;
- CalcVar - Calculus of Variations and Partial Differential Equations;
- Analysis & PDE;
- ESAIM COCV - Control, Optimisation and Calculus of Variations;
- JMAA - Journal of Mathematical Analysis and Applications;
- JMPA - Journal de Mathématiques Pures et Appliquées;
- SIMA - SIAM Journal on Mathematical Analysis;
- JEMS - Journal of the European Mathematical Society.

2021. I was IMO Commissioner of the Italian team (team leader: Massimo Gobbino) for IMO2021.

2020. Referee (controrelatore) of the Master Thesis of Davide Carazzato (Università di Pisa).

2020. I was IMO Commissioner of the Italian team (team leader: Massimo Gobbino) for IMO2020.

2020. I was member of the evaluation committee for the entrance exam at SNS - Scuola Normale Superiore for the a.y. 2020/2021. Chair: Franco Flandoli.

2018. I was referee and member of the evaluation committee of the PhD thesis

*Shape Optimization Problems for Integral Functionals
and Regularity Properties of Optimal Domain.*

Candidate: Harish Shrivastava (Università di Pisa).

Advisor: Giuseppe Buttazzo (Università di Pisa).

Head of the PhD School: Giovanni Alberti (Università di Pisa). *Date of the discussion:* 3/12/2018.

2018. I was referee of a project for the call for the award of research grants for young researchers *Progetti Giovani Ricercatori 2018* of *INdAM - Istituto Nazionale di Alta Matematica "F. Severi"*.

2017. I was member of the evaluation committee for the position ATER - *Attaché temporaire d'enseignement et de recherche* (one-year lecturer position) at Laboratoire Jean Kuntzmann (Université Grenoble Alpes) for the academic year 2017-2018. Chair: Eric Blayo.

2016. I was member of the evaluation committee for the position ATER - *Attaché temporaire d'enseignement et de recherche* (one-year lecturer position) at Laboratoire Jean Kuntzmann (Université Grenoble Alpes) for the academic year 2016-2017. Chair: Eric Blayo.

2016. I was member of the evaluation committee (composed by myself, Édouard Oudet and Emmanuel Russ) for the PhD position on the project *GeoSpec - Geometry and Spectral Optimization*.

2015. I was member of the evaluation committee for the position ATER - *Attaché temporaire d'enseignement et de recherche* (one-year lecturer position) at Laboratoire Jean Kuntzmann (Université Grenoble Alpes) for the academic year 2015-2016. Chair: Laurant Desbat.

2013. I was member of the grading committee of the (written) entrance exam at Scuola Normale Superiore. Chair: Stefano Marmi.

ORGANIZATION OF WORKSHOPS, CONFERENCES AND SEMINARS

2021. I organized the ERC VAREG workshop

Regularity Theory for Free Boundary and Geometric Variational Problems

held in Levico Terme, 5-10 September 2021, jointly organized with Luca Spolaor.

2019. I organized the workshop

Calculus of Variations and free Boundary Problems III

which took place in Naples on 21-22 December 2019 and was co-organized with Nicola Fusco.

2018. I organized the workshop

Journées ANR SHAPO Shape Optimization

This workshop was also the opening meeting of the project ANR SHAPO; it took place in Grenoble in December 2018 and was co-organized with Charles Dapogny.

2017. I organized a cycle of workshops dedicated on Calculus of Variations and free Boundary Problems. The first workshop took place in 2017

Calculus of Variations and free Boundary Problems

and was co-organized with Emmanuel Russ and was financed by the project GeoSpec.

2018. The second workshop

Calculus of Variations and free Boundary Problems II

took place in 2018 and was co-organized with Dorin Bucur and was financed by the projects GeoSpec, ANR CoMeDiC and the IUF grant of Dorin Bucur.

2016. I was member of the local organizing committee of the international conference

PICOF - Problèmes Inverses, Contrôle et Optimisation de Formes

that took place in Autrans (Grenoble) in 2016. The other members of the local organizing committee were Charles Dapogny, Eric Bonnetier and Edouard Oudet.

2015. I took part in the organization of the workshop

Calculus of Variations and PDEs

co-organized with Dorin Bucur and Marguerite Gisclon.

2014-2019. While I was Assistant Professor in Grenoble, I was organizing the seminars

Calcul des Variations, Géométrie Images

of the research groups CVGI and EDP at Laboratoire Jean Kuntzmann (LJK). The seminars take place each Thursday at LJK, and are co-organized with Charles Dapogny (CVGI), Clément Jourdana (EDP) and Ludovic Métivier (EDP).

2014. During my pos-doc at Università di Pisa, I was organizing the seminars

Calculus of Variations and Geometric Measure Theory

together with Agnese Di Castro.

CONFERENCES AND SEMINARS

Talks at conferences and workshops

An epsilon-regularity theorem for a free boundary system.
Workshop Partial Differential Equations (Oberwolfach, 2021). [Link](#).

Regularity of the two-phase free boundaries.
Workshop Calculus of Variations (Oberwolfach, 2020). [Link](#).

Regularity of the two-phase free boundaries.
XXX Convegno Nazionale di Calcolo delle Variazioni (Levico Terme, 2020). [Link](#).

Regularity of the two-phase free boundaries.
Workshop Geometric Measure Theory in Padova (Padova, 2020). [Link](#).

Regularity of the two-phase free boundaries.
Shape optimization, Isoperimetric and Functional Inequalities (Levico Terme, 2019) [Link](#).

On the logarithmic epiperimetric inequality.
Partial Differential Equations (Oberwolfach, 2019) [Link](#).

On the logarithmic epiperimetric inequality.
Brescia - Trento Nonlinear Day III (Trento, 2019). [Link](#).

On the logarithmic epiperimetric inequality.
Analytic and Geometric Aspects of PDEs (Milano, 2019). [Link](#).

Regularity of the one-phase free boundaries. (6 hours mini-cours - [Link](#).)
Indam Intensive Period: Shape optimization, control and inverse problems for PDEs (Napoli, 2019).

On the logarithmic epiperimetric inequality.
XXIX Convegno Nazionale di Calcolo delle Variazioni (Levico Terme, 2019). [Link](#).

Recent results on the regularity of the free boundary of the obstacle problem.
Calculus of Variations at Paris-Diderot (Paris, 2018). [Link](#).

Shape optimization problems for elliptic operators with drift.
Journées Optimisation de Formes et Applications 2 (Pau, 2018). [Link](#).

On the honeycomb conjecture for a class of minimal convex partitions.
Transport problems in Zürich (Zürich, 2017). [Link](#).

An epiperimetric inequality approach to the regularity of the free boundaries.
GMT Shape Optimization and Free Boundaries (SISSA, Trieste, 2016). [Link](#).

Lipschitz regularity for quasi-minimizers and applications to some shape optimization problems.
Calculus of Variations, Geometric Measure Theory, Optimal Transportation: from Theory to Applications (Lyon, 2016). [Link](#).

Regularity of optimal sets for spectral functionals.
Advances in Nonlinear Problems from Material Science and Shape Optimization (Pisa, 2016). [Link](#).

Regularity of optimal sets for spectral functionals.
Bru-To: Bruxelles-Torino PDE's Conference (Torino, 2016). [Link](#).

Reinforcement of an elastic membrane, infinity laplacian and obstacle problems.
Spectral Theory and Shape Optimization Problems for Elliptic PDEs (Milano, 2015). [Link](#).

Tre problemi di ottimizzazione legati al problema dell'ostacolo
Proprietà Analitico-Geometriche di Soluzioni di EDP (Napoli, 2016). [Link](#).

Lipschitz continuity of the eigenfunctions on optimal sets.
Journées EDP Rhone-Alpes-Auvergne 2014 (Ecully, 2014). [Link](#).

Short talks (20-30 min) at conferences and workshops

On the logarithmic isoperimetric inequality.
Conference DEA - Dynamics, Equations and Applications, (Krakow, 2019). [Link](#).

On the logarithmic isoperimetric inequality.
12th ISAAC Congress, (Aveiro, 2019). [Link](#).

Variational approach to the regularity of optimal sets
VII PDE, Optimal Design and Numerics (Benasque, 2017). [Link](#).

An isoperimetric inequality approach to the regularity of the free boundaries.
Shape Optimization and Isoperimetric and Functional Inequalities (CIRM Luminy, 2016). [Link](#).

Regularity of the optimal sets for spectral functionals.
XIII Colloque Franco-Roumain de Mathématiques Appliquées (Iași, 2016). [Link](#).

A free boundary problem arising in PDE optimization.
XXVI Convegno Nazionale di Calcolo delle Variazioni (Levico Terme, 2016). [Link](#).

A free boundary problem arising in PDE optimization.
Shape Optimization and Spectral Geometry (ICMS Edinburgh, 2015). [Link](#).

Lipschitz continuity of the eigenfunctions on optimal sets.
Workshop Shape and topological optimization (RICAM, Linz, 2014). [Link](#).

Shape optimization problems for spectral functionals with perimeter and volume terms.
XXVI Convegno Nazionale di Calcolo delle Variazioni (Levico Terme, 2014). [Link](#).

Multiphase shape optimization problems.
New Trends in Shape Optimization (Erlangen, 2013). [Link](#).

The spectral drop problem.
Partial Differential Equations, Optimal Design and Numerics (Benasque, 2013). [Link](#).

Shape optimization problems with internal constraint.
Shape Optimization Problems and Spectral Theory (CIRM Luminy, 2012). [Link](#).

Shape optimization problems with internal constraint.
XXVI Convegno Nazionale di Calcolo delle Variazioni (Levico Terme, 2012). [Link](#).

Shape Optimization Problems on Metric Measure Spaces.
Geometric Analysis of Sub-Riemannian and Metric Spaces (Pisa, 2011). [Link](#).

Seminars

Regularity of the two-phase free boundaries.
Sapienza Università di Roma, 28/11/2019.

Regularity of the two-phase free boundaries.
Università di Pisa, 06/11/2019.

Regularity of the free boundaries around isolated singularities.
Università degli studi di Napoli Federico II, 26/03/2018.

Variational approach to the regularity of the singular free boundaries.
ETH Zürich, 13/03/2018.

Regularity of the free boundaries around isolated singularities.
Calcolo delle Variazioni ed Analisi Geometrica, Università di Pisa, 07/02/2018.

Regularity of the free boundaries around isolated singularities.
Université Paris Diderot, 05/02/2018.

Regularity of the free boundaries around isolated singularities.
Université Paris Sud, 26/01/2018.

Variational approach to the regularity of the free boundaries.
Université Aix-Marseille, 26/10/2017.

Regularity of the optimal sets for spectral functionals.
Max Planck Institut Leipzig, 13/05/2016.

Regularity of the optimal sets for spectral functionals.
Universität Zürich, 13/04/2016.

Regularity of the optimal sets for spectral functionals.
Politecnico di Milano, 20/04/2016.

Lipschitz continuity of the eigenfunctions on optimal sets.
Università degli Studi di Torino, 29/10/2014.

Régularité Lipschitz pour les fonctions propres sur ensembles optimaux.
Séminaire Parisien d'Optimisation, 6/10/2014.

Optimal domains for spectral functionals with perimeter and volume penalizations.
Séminaires Analyse Appliquée LATP Marseille, 08/04/2014.

Optimal domains for spectral functionals with perimeter and volume penalizations.
Séminaires LJK - Géométrie - Images - Calcul des Variations, Université de Grenoble, 02/04/2014.

Existence and regularity for some spectral optimization problems with perimeter constraint.
Université de Savoie, 09/11/2012.

Subsolutions of the Dirichlet energy functional. Density estimates and applications.
Università di Pavia, 08/05/2012.

Concentration-compactness principle and shape optimization problems.
Calcolo delle Variazioni ed Analisi Geometrica, Università di Pisa, 25/05/2011.

RESEARCH PERIODS AND INVITATIONS

- 10/03/2019 - 17/03/2019. SISSA Trieste. Invited by Guido De Philippis.
- 21/10/2018 - 02/11/2018. SISSA Trieste. Invited by Guido De Philippis.
- 27-31/03/2018. SISSA Trieste. Invited by Guido De Philippis.
- 05-17/03/2018. ETH Zürich. Invited by Maria Colombo.
- 20/02/2018-03/03/2018. Politecnico di Milano. Invited by Ilaria Fragalà.
- 05-11/02/2018. Università di Pisa. Invited by Giuseppe Butazzo.
- 20-24/03/2017. Politecnico di Milano. Invited by Ilaria Fragalà.
- 08-31/01/2017. Università di Pisa. Invited by Giuseppe Butazzo.
- 06-10/06/2016. SISSA Trieste. Invited by Giovanni Franzina.
- 09-13/05/2016. Max Planck Institut Leipzig. Invited by Luca Spolaor.
- 18-22/03/2016. Politecnico di Milano. Invited by Ilaria Fragalà.
- 11-15/04/2016. Universität Zürich. Invited by Annalisa Massaccesi.
- 04-08/04/2016. Università degli Studi di Torino. Invited by Susanna Terracini.
- 03-31/01/2016. Università di Pisa. Invited by Giuseppe Buttazzo.
- 13-17/07/2015. Università degli Studi di Torino. Invited by Susanna Terracini.
- 02-06/03/2015. Università di Pisa. Invited by Giuseppe Buttazzo.
- 26-30/10/2014. Università degli Studi di Torino. Invited by Susanna Terracini.
- 09-18/04/2014. Isaac Newton Institute, Cambridge. Visit during the research period *Free boundary problems and related topics*.
- 19-21/03/2014. Université Paris Dauphine. Invited by Jimmy Lamboley.
- 07-11/04/2013. Friedrich Alexander Universität Erlangen - Nürnberg. Invited by Aldo Pratelli.
- 06-08/05/2012. Università di Pavia. Invited by Aldo Pratelli.

LIST OF PUBLICATIONS

Preprints (for the complete list check my ArXiv page)

- [P2] F. Générault, E. Oudet, B. Velichkov. *Cut locus on compact manifolds and uniform semiconcavity estimates for a variational inequality*. **arXiv:2006.07222**.
- [P1] B. Velichkov : *Regularity of the one-phase free boundaries*. Lecture notes.
Preprint CVGMT <http://cvgmt.sns.it/paper/4367/>

Journal articles

- [A37] D. Mazzoleni, B. Trey, B. Velichkov : *Regularity of the optimal sets for the second Dirichlet eigenvalue*. **Ann. Inst. H. Poincaré Anal. Non Linéaire** (to appear in 2022); **arXiv:2010.00441**.
- [A36] G. De Philippis, L. Spolaor, B. Velichkov : *Regularity of the free boundary for the two-phase Bernoulli problem*. **Invent. Math.** 225 (2021), 347–394; **arXiv:1911.02165**.
- [A35] M. Colombo, L. Spolaor, B. Velichkov : *Almost everywhere uniqueness of blow-up limits for the lower dimensional obstacle problem*. **Interfaces and Free Bound.** 23 (2) (2021), 159–167
arXiv:1908.01413.
- [A34] S. Guarino Lo Bianco, D. A. La Manna, B. Velichkov : *A two-phase problem with Robin conditions on the free boundary*. **Journal de l'École Polytechnique** 8 (2021), 1–25; **arXiv:2003.14139**.
- [A33] L. Spolaor, B. Velichkov : *On the logarithmic epiperimetric inequality for the obstacle problem*. **Math. in Engineering** - a special issue dedicated to the 70th birthday of Sandro Salsa (2020).
- [A32] M. Engelstein, L. Spolaor, B. Velichkov : *Uniqueness of the blow-up at isolated singularities for the Alt-Caffarelli functional*. **Duke Math. J.** 169 (8) (2020), 1541–1601; **arXiv:1801.09276**
- [A31] E. Russ, B. Trey, B. Velichkov : *Existence and regularity of optimal shapes for elliptic operators with drift*. **Calc. Var. PDE** 58 (2019); **arXiv:1810.07943**.
- [A30] M. Colombo, L. Spolaor, B. Velichkov : *On the asymptotic behavior of the solutions to parabolic variational inequalities*. **J. reine angew. Math.** 768 (2020), 149–182; **arXiv:1809.06075**.
- [A29] L. Spolaor, B. Trey, B. Velichkov : *Free boundary regularity for a multiphase shape optimization problem*. **Comm. PDE** 45 (2) (2020), 77–108; **arXiv:1810.06963**.
- [A28] D. Mazzoleni, S. Terracini, B. Velichkov : *Regularity of the free boundary for the vectorial Bernoulli problem*. **Anal. PDE** 13 (3) (2020), 741–764; **arXiv:1804.09243**.
- [A27] M. Colombo, L. Spolaor, B. Velichkov : *Direct epiperimetric inequalities for the thin obstacle problem and applications*. **Comm. Pure. Appl. Math.** 73 (2) (2020), 384–420; **arXiv:1709.03120**.
- [A26] M. Engelstein, L. Spolaor, B. Velichkov : *(Log-)epiperimetric inequality and regularity over smooth cones for almost area-minimizing currents*. **Geometry & Topology** 23 (2019), 513–540; **arXiv:1802.00418**.
- [A25] I. Fragalà, B. Velichkov : *Serrin-type theorems for triangles*. **Proc. Amer. Math. Soc.** 147 (2019), 1615–1626.
- [A24] G. Buttazzo, F. Maestre, B. Velichkov : *Optimal potentials for problems with changing sign data*. **J. Optim. Theory Appl.** 178 (3) (2018), 742–762.
- [A23] M. Colombo, L. Spolaor, B. Velichkov : *A logarithmic epiperimetric inequality for the obstacle problem*. **Geom. Funct. Anal.** 28 (4) (2018), 1029–1061.
- [A22] G. Buttazzo, B. Velichkov : *A shape optimal control problem with changing sign data*. **SIAM J. Math. Anal.** 50 (3) (2018), 2608–2627.
- [A21] L. Spolaor, B. Velichkov : *An epiperimetric inequality for the regularity of some free boundary problems: the 2-dimensional case*. **Comm. Pure. Appl. Math.** 72 (2) (2018), 375–421.
- [A20] G. De Philippis, J. Lamboley, M. Pierre, B. Velichkov : *Regularity of minimizers of shape optimization problems involving perimeter*. **J. Math. Pure. Appl.** 109 (2018), 147–181.
- [A19] D. Bucur, I. Fragalà, B. Velichkov, G. Verzini : *On the honeycomb conjecture for a class of minimal convex partitions*. **Trans. Amer. Math. Soc.** 370 (10) (2018), 7149–7179.

- [A18] D. Mazzoleni, S. Terracini, B. Velichkov : *Regularity of the optimal sets for some spectral functionals*. **Geom. Funct. Anal.** 27 (2017), 373–426.
- [A17] A. Massaccesi, E. Oudet, B. Velichkov : *Numerical Calibration of Steiner trees*. **Appl. Math. Optim.** (2017). <https://doi.org/10.1007/s00245-017-9421-5>
- [A16] J.C. Bellido, G. Buttazzo, B. Velichkov : *Worst-case shape optimization for the Dirichlet energy*. **Nonlinear Analysis** 153 (2017), 117–129.
- [A15] G. De Philippis, A. Meszaros, F. Santambrogio, B. Velichkov : *BV Estimates in Optimal Transportation and Applications*. **Arch. Rat. Mech. Anal.** 219 (2) (2016), 829–860.
- [A14] D. Bucur, D. Mazzoleni, A. Pratelli, B. Velichkov : *Lipschitz Regularity of the Eigenfunctions on Optimal Domains*. **Arch. Rat. Mech. Anal.** 216 (2015), 117–151.
- [A13] L. Brasco, G. De Philippis, B. Velichkov : *Faber-Krahn inequalities in sharp quantitative form*. **Duke Math. J.** 164 (9) (2015), 1777–1831.
- [A12] G. Buttazzo, E. Oudet, B. Velichkov : *A free boundary problem arising in PDE optimization*. **Calc. Var. PDE** 54 (4) (2015), 3829–3856.
- [A11] B. Bogosel, B. Velichkov : *Multiphase Optimization Problems for Eigenvalues: Qualitative Properties and Numerical Results*. **SIAM J. Numer. Anal.** 54 (1) (2015), 210–241.
- [A10] D. Bucur, B. Velichkov : *A free boundary approach to shape optimisation problems*. **Phil. Trans. R. Soc. A** 373 (2015).
- [A9] G. De Philippis, B. Velichkov : *Existence and regularity of minimizers for some spectral optimization problems with perimeter constraint*. **Appl. Math. Optim.** 69 (2) (2014), 199–231.
- [A8] G. Buttazzo, B. Ruffini, B. Velichkov : *Spectral optimization problems for metric graphs*. **ESAIM: COCV** 20 (1) (2014) 1–22.
- [A7] B. Velichkov : *A Note on the Monotonicity Formula of Caffarelli-Jerison-Kenig*. **Rend. Lincei Mat. Appl.** 25 (2014), 165–189.
- [A6] G. Buttazzo, A. Gerolin, B. Ruffini, B. Velichkov : *Optimal potentials for Schrödinger operators*. **Journal de l'École Polytechnique** 1 (2014), 71–100.
- [A5] D. Bucur, G. Buttazzo, B. Velichkov : *Spectral Optimization Problems for Potentials and Measures*. **SIAM J. Math. Anal.** 46 (4) (2014), 2956–2986.
- [A4] D. Bucur, B. Velichkov : *Multiphase shape optimization problems*. **SIAM J. Control Optim.** 52 (6) (2014), 3556–3591.
- [A3] G. Buttazzo, B. Velichkov : *Some new problems in spectral optimization*. **Banach Center Publications** 101 (2014), 19–35.
- [A2] D. Bucur, G. Buttazzo, B. Velichkov : *Spectral optimization problems with internal constraint*. **Ann. Inst. H. Poincaré Anal. Non Linéaire** 30 (3) (2013), 477–495.
- [A1] G. Buttazzo, B. Velichkov : *Shape optimization problems on metric measure spaces*. **J. Funct. Anal.** 264 (1) (2013), 1–33.

Book chapters

- [B4] G. Buttazzo, B. Velichkov : *Spectral optimization problems for Schrödinger operators*. *Shape Optimization and Spectral Theory*, De Gruyter (2017), 325–352.
- [B3] G. Buttazzo, B. Velichkov : *The spectral drop problem*. *Contemporary Mathematics* **666** (2016), 111–135.
- [B2] G. Buttazzo, M. Van Den Berg, B. Velichkov : *Optimization problems involving the first Dirichlet eigenvalue and the torsional rigidity*. *New Trends in Shape Optimization*, Springer (2015), 19–41.
- [B1] V. Georgiev, B. Velichkov : *Decay estimates for the supercritical 3-D Schrödinger equation with rapidly decreasing potential*. *Progr. in Math.* **301** (2012), 145–162.

Monographs

- [M1] B. Velichkov : *Existence and regularity results for some shape optimization problems*. Edizioni della Normale, Tesi 19, Springer 2015, ISBN 978-88-7642-526-4.

PROJECTS - FUNDING ID

Project Title	Funding source	Amount	Period (mm/yyyy)	My role
Variational approach to the regularity of the free boundaries - VAREG	ERC	1.333kE	1/6/2020 - 31/5/2024	P.I.
Shape Optimization - ShapO	ANR	300kE	10/2018 - 10/2022	local coordinator
Convergent Metrics for Digital Calculus - CoMeDiC	ANR	400kE	10/2015 - 09/2020	member
Geometry and Spectral Optimization - GeoSpec	ANR	250kE	09/2016 - 02/2020	member
Méthodes Variationnelles en Optimisation de Formes - VariForm	UGA	15kE	4/2015 - 12/2016	P.I.

ANR = Agence Nationale de la Recherche UGA = Université Grenoble Alpes
 ERC = European Research Council

I am the **Principal Inverstigator** of the *ERC Starting Grant* project
VAREG - "Variational approach to the regularity of the free boundaries"
 financed by the program Horizon 2020.
Duration: 60 months, 1/6/2020 - 30/5/2024. **Volume:** 1,333kE.
Summary: This project is dedicated to the study of the regularity of the free boundaries via variational techniques as the epi-perimetric and the logarithmic epi-perimetric inequality.
 Detailed description of the project, the team, and the results can be found on the web page
<http://www.velichkov.it/vareg.html>

I was the **Principal Inverstigator** of the project
VariForm - "Méthodes Variationnelles en Optimisation de Formes"
 financed by the program "Alpes Grenoble Innovation Recherche" of Université Grenoble Alpes.
Duration: 2 years, 2015-2016. **Volume:** 15kE.
Summary: This project was dedicated to the study of monotonicity formulas and their applications to the regularity of the free boundaries arising in variational free boundary and shape optimization problems. My main contributions, developed in the context of this project are the following:
 [MTV] D. Mazzoleni, S. Terracini, B. Velichkov. *Regularity of the optimal sets for some spectral functionals*. **Geom. Funct. Anal.** 27 (2017), 373–426.
 [SV] L. Spolaor, B. Velichkov. *An epi-perimetric inequality for the regularity of some free boundary problems: the 2-dimensional case*. **Comm. Pure. Appl. Math.** (2018).
<https://doi.org/10.1002/cpa.21785>
 The papers [MTV] and [SV] were fundamental for my subsequent research on the regularity of the free boundaries. The methods pioneered in [SV] later led to the introduction of the *logarithmic epi-perimetric inequality*.