



Alfio Borzi

Professor of Mathematics

Experience

- 2011 - Now **Full Professor (Chair Mathematik IX)** [University of Würzburg, Germany](#)
Starting March 1st, 2011, till now, Full Professor (W3) and Chair of Mathematik IX 'Scientific Computing' at the Institute for Mathematics, University of Würzburg. I built up this new chair to its present status with a W2 and W1 professorships. In few years, I could make this chair internationally visible.
In 2011, I also got a call for the full professorship 'Algorithmic Optimization' at the Humboldt Universität zu Berlin, but I declined this offer.
- 2008 - 2011 **Associate Professor** [Università degli Studi del Sannio, Italy](#)
In the period 2008-2010, I was Associate Professor at the Università degli Studi del Sannio, in the Engineering Faculty. During this period, I contributed to the LIGO project and collaborated on the development of algorithms for image restoration applied to SAR interferograms.
- 2003 - 2007 **Associate Professor** [University of Graz, Austria](#)
In the period 2003-2007, I was Associate Professor at Institute for Mathematics and Scientific Computing, Karl-Franzens-University Graz. During this period I was leading a FWF project on quantum control problems and a SFB sub-project on non-linear reaction-diffusion (monodomain) models for medical application.
- 1998 - 2003 **Assistant Professor** [University of Graz, Austria](#)
In 1998 - 2003, I was Assistant Professor at Institute for Mathematics and Scientific Computing Karl-Franzens-University Graz. My research focused on multigrid methods and optimal control problems.
- 1996 - 1997 **Research Engineer** [AVL List GmbH, Graz, Austria.](#)
During the period 1996 - 1997, I was Research Engineer in the internationally renowned company AVL List GmbH, Graz, Austria. I worked on gas dynamics problems and on multigrid solvers and finite-volume schemes for CFD problems.
- 1993 - 1995 **Research Officer** [University of Oxford, UK](#)
In 1993 - 1995, I was Research Officer at the Oxford University Computing Laboratory (OUCL), Oxford, UK, in the group of Professor Bill Morton. I worked on special finite-volume schemes and their solution by multigrid methods.
- 1991 - 1992 **Lieutenant** [CNMCA, Roma, Italy](#)
During the period 1991 - 1992, I was an Italian Air Force Officer (Lieutenant) serving at the Centro Nazionale di Meteorologia e Climatologia, CNMCA, Roma, Italy. I worked on data analysis and numerical weather prediction.

Address

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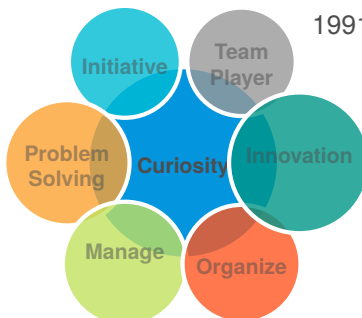
Web

www.mathematik.uni-
wuerzburg.de/ borzi/
www9.mathematik.uni-
wuerzburg.de

Personal Data

Birth: 01.03.1965,
Catania, Italy
Citizenship: Italian

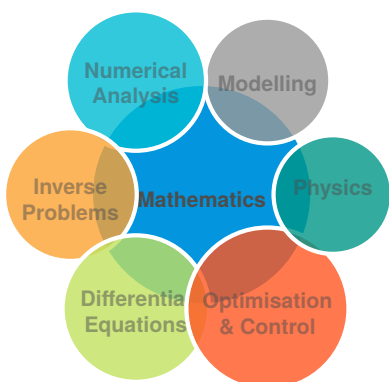
Personal Skills



Languages

Italian ★★★★★
English ★★★★★
German ★★★★★

Scientific Knowledge



Professional metrics

Scopus h-index : 18;
Google h-index : 27;
i10-index 61;
Total citations : Scopus
1164; Google 2599.

OS & Coding

GNU/Linux ★★★★★
MacOS ★★★★★
Fortran ★★★★★
MATLAB ★★★★★
C++ ★★★★★

Places Lived

Benevento
Cambridge
Catania
Firenze
Graz
Oxford
Roma
Salzburg
Würzburg

Education

- 1998 - 2003 **Habilitation** [Karl-Franzens-University Graz](#)
Habilitation at Karl-Franzens-University Graz, Austria.
- 1991 - 1993 **Dottore di ricerca in Matematica** [SISSA/ISAS, Italy](#)
Doctor Philosophy (Ph.D.) in Mathematical Physics, SISSA/ISAS-
International School for Advanced Studies, Trieste, Italy.
- 1988 - 1990 **Magister Philosophiae (M.Ph.) in Mathematical Physics** [SISSA/ISAS, Italy](#)
1988 - 1990 Master Philosophy (M.Ph.) in Mathematics, SISSA/ISAS-
International School for Advanced Studies, Trieste, Italy.
- 1983 - 1988 **Laurea in Fisica** [Università degli Studi di Catania, Italy](#)
1983 - 1988 Laurea in Physics (MSc), University of Catania, Italy.

Additional education

- 1997 **Unternehmer Pruefung** [WIFI Graz, Austria](#)
Academy of Management, WIFI Graz (A).
- 1996 **Unix and Database Administrator** [HP and Informix, Austria and Germany](#)
Administration of UNIX systems, Hewlett-Packard, Boeblingen (D), Vienna
(A). Development and administration of databases, Informix, Ismaning (D).
- 1991 **Lieutenant** [Italian Air Force, Italy](#)
Military law, management of personnel and logistic, Italian Air Force 'Scuola
di Guerra Aerea', Firenze (I).
- 1991 **Lieutenant** [Italian Air Force, Italy](#)
Meteorology and numerical weather prediction, National Center of
Meteorology and Climatology (CNMCA), Roma (I).

Main research and teaching topics

1) Numerical solution of PDE optimization problems. 2) Development and analysis of multigrid methods. 3) Analysis of discretization schemes for partial differential equations. 4) Simulation and optimization with uncertainty. 5) Simulation and control of quantum systems. 6) Modeling and numerical solution of gas dynamics problems. 7) Modeling and simulation of bio-chemical processes. 8) Imaging analysis and inverse problems. 9) Multi-agent differential systems. 10) Stochastic models and control. 11) Fokker-Planck and continuity equations.

Research Work - Main Contributions

Trained in Mathematics and Physics, my main field of expertise consists in developing and connecting analytical and numerical methods in view of solving fundamental application problems that are often related to optimal control. I was among the early initiators, alone or in cooperation, of the following research fields

Reviewer

For Agencies:

DFG, ANVUR, The Royal Society of London, The Russian Science Foundation

For Journals:

SISC, SICON, SINUM, SIOPT, MMS, COAP, JCAM, JCOMP, JDCS, OMS, IJVC, NM:TMA, etc.

Scopus & ORCID

Scopus Author ID:
6603632708

ORCID ID:
0000-0002-8050-1336

Hobby

Oil painting
gourmet cooking
poetry

1. Multigrid methods for solving PDE optimality systems
2. Fast methods for solving quantum control problems
3. Fokker-Planck approach to stochastic control problems

Among my achievements, I also would like to mention the theoretical investigation of non-smooth PDE control problems, the development of proximal and Pontryagin's MP schemes for PDE control problems, the modelling of leadership-based control of multi-agent systems, the development of optimisation schemes to solve imaging problems, and various numerical analysis results with linear and nonlinear PDE models.

Teaching

Analysis I and II, Linear Algebra I and II, Optimization I and II, Operations Research, Complex Analysis, Functional Analysis, Applied Analysis, Nonlinear Analysis, Ordinary Differential Equations, Programming in C++, Numerical Analysis I and II, Theory of Partial Differential Equations, Optimal Control Theory, Multigrid Methods, Multilevel Methods in Optimization with PDE models, Numerical Solution of Partial Differential Equations, Modeling and Scientific Computing, Simulation and Optimal Control of Quantum and Stochastic Systems, Implementation of Deep Learning Algorithms, Numerical Analysis of Optimal Control Problems with Differential Models.

Memberships and fellowships

- Past member of EMS and SIAM.
- Tinsley Oden Fellow, Institute for Computational Engineering and Sciences, University of Texas at Austin, USA.

Professional responsibilities

- Member of the Research Council of the Hugo Steinhaus Center, Wrocław (Breslau). http://prac.im.pwr.wroc.pl/~hugo/HSC/hsc_ang.html
- Member of the Internationalisation Committee, Universität Würzburg. Member of the Commission for Research and Technology Transfer of the University of Würzburg. Past member of the Research in Sciences Committee, Universität Würzburg.
- Profesor Invitado of the PHD Program in Applied Mathematics at Escuela Politécnica Nacional de Ecuador. <http://www.math.epn.edu.ec/doctorado/index.php/profesores>

Editor Duty

Associate Editor:

SIAM Journal on Scientific Computing (SISC).

SIAM Review, Books section

Numerical Mathematics: Theory, Methods and Applications (NM-TMA).

Guest Editor of CVS, NLAA and NM:TMA.

Supervision of PhD Thesis

- **D. Kioi Gathungu**, *On multigrid and H-matrix methods for partial integro-differential equations*. PhD Math. Thesis, Univ. Würzburg, 2017.

- **M. Sprengel**, *A theoretical and numerical analysis of a Kohn-Sham equation and related control problems*, PhD Math. Thesis, Univ. Würzburg, 2017.
- **B. Gaviraghi**, *Theoretical and numerical analysis of Fokker-Planck optimal control problems for jump-diffusion processes*. PhD Math. Thesis, Univ. Würzburg, 2017.
- **A. Schindele**, *Proximal methods in medical image reconstruction and in nonsmooth optimal control of partial differential equations*. PhD Math. Thesis, Univ. Würzburg, 2016.
- **J. Merger**, *Optimal control and function identification in biological processes*. PhD Math. Thesis, Univ. Würzburg, 2016.
- **S. Wongkaew**, *On the control through leadership of multi-agent systems*. PhD Math. Thesis, Univ. Würzburg, 2015.
- **G. Ciaramella**, *Optimal control of quantum spin systems*. PhD Math. Thesis, Univ. Würzburg, 2015.
- **M. Mohammadi**, *Discretization of the Fokker-Planck equation and related control systems*. PhD Math. Thesis, Univ. Würzburg, 2015.
- **M. Munir Butt**, *Formulation and multigrid solution of Cauchy-Riemann optimal control problems*, PhD Math. Thesis, Univ. Graz, 2011.
- **M. Vallejos**, *Multigrid optimization methods for elliptic optimal control problems*. PhD Math. Thesis, Univ. Graz, 2008.

Ongoing:

- **T. Breitenbach**, *Efficient solution of PDE optimal control problems with the Pontryagin's maximum principle*, PhD Math. Thesis, ongoing.
- **F. Calà Campana**, *FP differential games*, PhD Math. Thesis, ongoing.
- **J. Bartsch**, *Boltzmann models*, PhD Math. Thesis, ongoing.

Supervision of Master Thesis (selection out of 17)

The supervision of Master thesis has given me always great satisfaction: it is the unique opportunity for very young students to taste the pleasure of achieving new results. The following Students were able to do great original research work :

- **Melina-Loren Kienle Garrido**, *On the optimal control of a new cancer therapy model*, MSc Math. Thesis, Univ. Würzburg, 2017. (with publication in Journal)
- **Lisa Schäfer**, *A mathematical investigation of a new Lorentz-covariant heat conduction model*, MSc Math. Thesis, Univ. Würzburg, 2017.
- **Andrea Thomann**, *Stability and accuracy of a pseudospectral scheme for the Wigner function equation*, MSc Math. Thesis, Univ. Würzburg, 2015. (with publication in Journal)
- **Veronika Thalhofer**, *Formulation and investigation of a new stochastic hybrid system for subtilin production and the corresponding Fokker-Planck equation*, MSc Math. Thesis, Univ. Würzburg, 2015. (with publication in Journal)
- **Julia Kwasny**, *Investigation of a robust single particle tracking algorithm*. MSc Math. Thesis, Univ. Würzburg, 2013.
- **Roberta Mancini**, *An adjoint-based optimization scheme for solving time-domain electromagnetic inverse scattering problems*, MSc Math. Thesis, Univ. Sannio, 2009.
- **Elisabeth Decker**, *Spectral methods for the Schrödinger equation*. MSc Math. Thesis, Univ. Graz, 2005. (with publication in Journal)

I have also supervised 10 Bachelor thesis.

Main Research Grants

- BFHZ Project **Multi-agent Fokker-Planck Nash games** (Project Leader, 1 year; start 2018). Supported by BFHZ, Germany.
- BMBF-Verbundprojekt **ROENOBIO - Robust energy optimization of fermentation processes for the production of biogas and wine** (Project Leader, 4 years; start 2013), supported by BMBF, Germany.
- EU Marie-Curie **Multi-ITN STRIKE - Novel Methods in Computational Finance** (Project Leader, 3 years; start 2013). Supported by EU.
- IZKF-Project **Parallel Multigrid Imaging and Compressed Sensing for Dynamic 3D Magnetic Resonance Imaging** (Project Leader, 3 years; start 2013). Supported by IZKF Universität Würzburg, Germany.
- DFG Project **COCIQ, Controllability and Optimal Control of Interacting Quantum Dynamical Systems** (Project Leader, 3 years; start 2012). Supported by DFG, Germany.
- FWF-Project, MGINV-MOBIS, SFB Mathematical Optimization with Applications to Biomedical Sciences, **Fast Multigrid Methods for Inverse Problems** (Project Leader, 3 years; start 2008). Supported by FWF, Austria.
- FWF-Project, **Quantum optimal control of semiconductor nanostructures** (Project Leader, 3.5 years; start 2005). Supported by FWF, Austria.

Industrial Projects

- CFD Optimal shape design (with AVL List GmbH).
- PARALLEL AMG: Investigation and Development (with AVL List GmbH).
- Boundary Conditions Calculation in gas-dynamics package BOOST (with AVL List GmbH).
- The Simulation of the Gas Dynamics with Perforated Pipes in Plenum or in Pipes with BOOST (with AVL List GmbH).
- Comparison of Multigrid and SOR for the Solution of the Reynolds Equation in EXCITE (with AVL List GmbH).

Organization of Workshops/Conferences

- Organizer and Chair of the European Multigrid Conference EMG2010, Isola d'Ischia, Italy, 2010.
- European Science Foundation OPTPDE Workshop Fast solvers for simulation, inversion, and control of wave propagation problems, 26 - 28 September 2011, University of Würzburg, Germany. (ESF Grant 22.000 Eur)
- Weizmann Workshop 2013 on Multilevel Computational Methods and Optimization, The Weizmann Institute of Science, April 30 - May 02, 2013, Rehovot, Israel.
- European Science Foundation OPTPDE Workshop ESF OPTPDE Workshop InterDyn2013, 10 - 12 September 2013, Université Paris-Dauphine, Paris, France. (ESF Grant 26.000 Eur)
- Multi-ITN STRIKE and WWCSC Mini-Workshop in Stochastic Computing and Optimization, Würzburg, Germany, September 30 - October 2, 2014

- 27th IFIP TC7 Conference 2015 on System Modelling and Optimization, Sophia Antipolis, France, 29.6. - 3.7.2015: Two Minisymposia: 1) Quantum optimal control; 2) Sparse reconstruction and medical imaging.

Some Invited Talks

- On the modelling of particle and pedestrian motion with Fokker-Planck equations, MOX Seminars Series, Department of Mathematics, Politecnico di Milano, April 2019, Milano, Italy.
- On the modelling of particle and pedestrian motion with Fokker-Planck equations, Department of Mathematics, Imperial College London, February 2019, London, UK.
- On the optimal control of a Kohn-Sham quantum model, Workshop PRACQSYS 2018: Principles and Applications of Control in Quantum Systems, Henri Poincaré Institute, July 2018, Paris, France.
- From Brownian to pedestrian motion and Fokker-Planck Nash games, Lothar-Collatz-Kolloquium für Angewandte Mathematik, Fachbereich Mathematik, Universität Hamburg, June 2018, Hamburg, Germany.
- From Brownian to pedestrian motion and Fokker-Planck Nash games, Lomonosov State University, April 2018, Moscow, Russia.
- From Brownian motion to pedestrian avoidance, Mathematisches und Mathematikdidaktisches Kolloquium, Universität Oldenburg, November 2017, Oldenburg, Germany.
- On the solution of some PDE control problems in the framework of the Pontryagin's maximum principle, Workshop INDAM 'Numerical methods for optimal control problems: algorithms, analysis and applications', June 2017, Rome, Italy.
- On a Fokker-Planck Nash game to model pedestrian motion, Schwerpunktskolloquium, University of Konstanz, October 2017, Germany.
- Fast iterative schemes for solving PDE control problems with the Pontryagin maximum principle, Institute of Numerical Mathematics (INM) at the Steklov Institute of Mathematics, February 2017, Moscow, Russia.
- Analysis of a pseudospectral scheme for the Wigner function equation, Workshop Mathematical Models for Quantum and Classical Mechanics, SEMODAY 2016, Nov. 17-18, 2016, Florence, Italy.
- On a time-dependent Kohn-Sham equation and related optimal control problems, CECAM Workshop Numerical methods for optimal control of open quantum systems, Sept. 26-28, 2016, FU Berlin, Berlin, Germany.
- Advances in the numerical solution of quantum control problems, Workshop Quantum Cybernetics & Control 2015 (QCC2015), Jan. 19-23, 2015, Nottingham, UK.
- A Fokker-Planck strategy to control stochastic processes, Marian Smoluchowski Symposium on Statistical Physics, Sept. 22-26, 2014, Zakopane, Poland.
- A Fokker-Planck Strategy to Control Stochastic Processes, Kolloquium, 2014 April, Johann Radon Institute for Computational and Applied Mathematics (RICAM), Austrian Academy of Sciences, Linz, Austria.
- Fast and accurate computational methods for quantum control problems, 536th W.E. Heraeus Seminar on Optimal Control of Quantum Systems June 16th to 19th 2013, Physikzentrum Bad Honnef, Germany.

- A Fokker-Planck-Kolmogorov control framework for stochastic processes, Workshop Numerical Methods for Uncertainty Quantification, May 13-17, 2013, Hausdorff Center for Mathematics, Bonn, Germany.
- An Optimal Control Strategy for Probability Density Functions of Stochastic Processes and Piecewise Deterministic Processes, Mathematisches Kolloquium, Univ. Bayreuth, Jan. 2013, Germany.

Newspapers, TV, Youtube Videos

Newspapers

- Süddeutsche Zeitung, Section 'Panorama', 11. Oktober 2017, Nr. 234: **Alfio Borzi, der ein mathematisches Modell gegen Zusammenstöße entwickelt hat**; see also <http://www.sueddeutsche.de/panorama/ein-anruf-bei-alfio-borz-1.3702529>
- Main Post, Section 'Wissen', 7. Oktober 2017, Nr. 231: **Formeln für Fußgänger**; see also <http://www.mainpost.de/regional/wuerzburg/Mathematiker-Mathematische-Modell-art735,9761234>
- einBlick, das Online-Magazin der Universität Würzburg: 1) 22. September 2017: **Mit der Spieltheorie auf Kollisionskurs**; see also <http://www.presse.uni-wuerzburg.de/aktuell/einblick/single/news/mit-der-spieltheorie-auf-kollisionskurs-1/>; 2) 16. Juli 2013: **Die Formel für mehr Aroma und Ertrag**; see also https://opus.bibliothek.uni-wuerzburg.de/opus4-wuerzburg/frontdoor/deliver/index/docId/6736/file/einBlick_201328.pdf; 3) 9. Juli 2013: **Workshop für einen Pionier**; see also <http://www.presse.uni-wuerzburg.de/aktuell/einblick/single/news/workshop-f->; 4) 30. Oktober 2012: **Mathematik gegen die Krise**; see also <http://www.presse.uni-wuerzburg.de/fileadmin/uniwue/Presse/EinBLICK/Archiv/2012/ar201239.pdf>; 5) 8. Februar 2011: **Die dritte Säule des Erkenntniserwerbs**; see also <http://www.presse.uni-wuerzburg.de/fileadmin/uniwue/Presse/EinBLICK/Archiv/2011/ar201105.pdf>

Television & radio

- Bayerische Rundfunk Fernsehen, Frankenschau aktuell Das Wichtigste aus Franken, 14. März 2018: **Pi-Tag**; see also <https://www.br.de/mediathek/video/frankenschau-aktuell-5a71a5a08e1343001858eb4c> and <https://youtu.be/6B6R9SUPgIA>
- SWR1 'Leute', 12.07.2018. <https://www.swr.de/swr1/bw/programm/leute/borzi-prof/-/id=1895042/did=21937368/nid=1895042/o1p3rc/index.html>

Youtube Videos

- **Alfio's Math** : https://www.youtube.com/watch?v=ju6rG_7Z_5I
- **Quantenmechanik - Von Democritus bis Schrödinger** : https://www.youtube.com/watch?v=BTiPcnT_QKc
- **Quantenkontrolle - Die Zukunft der Wissenschaft!** : <https://www.youtube.com/watch?v=00KMy90zXuM>
- **Malthus & Verhulst, die Bevölkerungsentwicklung und die Weingärung** : <https://www.youtube.com/watch?v=NtLnp1cUPmc>
- **Einstein & Co. und die Revolution des Aktienhandels** : <https://www.youtube.com/watch?v=Qb4obyF7c9I>

- **On the optimal control of a Kohn-Sham quantum model - Workshop PRACQSYS 2018 at IHP Paris** : <https://www.youtube.com/watch?v=6chQr02uInY&index=53&list=PL9kd4mpdvWcAMYt4Fhw0dgBPF24bQmDGz>

Books

- A. Borzi, **Modelling with Ordinary Differential Equations: A Comprehensive Approach**, CRC/Chapman and Hall, London, to be published in 2019.
- A. Borzi, G. Ciaramella and M. Sprengel, **Formulation and Numerical Solution of Quantum Control Problems**, SIAM, Philadelphia, 2017 (ISBN 978-1-611974-83-6).
- A. Borzi and V. Schulz, **Computational Optimization of Systems Governed by Partial Differential Equations**, SIAM, Philadelphia, 2012 (ISBN 978-1-611972-04-7).
- A. Borzi and M. Wogrin, **Equazioni Differenziali Ordinarie**, Hevelius Edizioni, Benevento, 2009 (ISBN 978-88-86977-63-0).
- A. Borzi, **In den Brunnen gefallen beim Sterne schauen - Eine sehr kurze Geschichte der Mathematik -**, epubli, Berlin, 2017 (ISBN 978-3-7450-3862-0). (Also in Russian.)

Ten Selected Publications

- M. Annunziato and A. Borzi, **A Fokker-Planck control framework for multidimensional stochastic processes**, Journal of Computational and Applied Mathematics, 237 (2013), 487-507.
- A. Borzi, **Multigrid methods for parabolic distributed optimal control problems**, J. Comp. Appl. Math, 157 (2003), 365-382.
- A. Borzi and G. Borzi, **Algebraic multigrid methods for solving generalized eigenvalue problems**, International Journal for Numerical Methods in Engineering, 65(8) (2006), 1186-1196.
- A. Borzi and G. Propst, **Numerical Investigation of the Liebau Phenomenon**, ZAMP, 54 (2003), 1050 - 1072.
- A. Borzi and V. Schulz, **Multigrid methods for PDE optimization**, SIAM Review, 51 (2009), 361-395.
- A. Borzi, G. Stadler, and U. Hohenester, **Optimal quantum control in nanostructures: Theory and application to a generic three-level system**, Phys. Rev. A 66, 053811 (2002).
- A. Borzi and G. von Winckel, **Multigrid methods and sparse-grid collocation techniques for parabolic optimal control problems with random coefficients**, SIAM J. Sci. Comp., 31 (2009), 2172-2192.
- S. Roy and A. Borzi, **A new optimisation approach to sparse reconstruction of log-conductivity in acousto-electric tomography**, SIAM Journal on Imaging Sciences, 11 (2018), 1759-1784.
- S. Roy, A. Borzi, and A. Habbal, **Pedestrian motion modelled by Fokker - Planck Nash games**, Royal Society open science, 4: 170648, 2017.
- S. Wongkaew and A. Borzi, **Modeling and control through leadership of a refined flocking system**, Mathematical Models and Methods in Applied Sciences (M3AS), 25 (2015), 255-282.

Special Issues

- A. Borzì, J. Brannick, F. Gaspar and I. Yavneh, Special Issue - Weizmann Workshop 2013, Numerical Mathematics: Theory, Methods and Applications, 8 (2015).
- A. Borzì and C. W. Oosterlee, Special Issue - OPTPDE 2011, ESF OPTPDE Workshop, 2011, Numerical Linear Algebra with Applications, 20 (2013), 539-711
- A. Borzì and C. W. Oosterlee, Special Issue in Numerical Mathematics: Theory, Methods and Applications (NM-TMA), European Multigrid Conference, EMG 2010, Numerical Mathematics: Theory, Methods and Applications, 5 (2012).
- A. Borzì and C. W. Oosterlee, Special Issue in Computing and Visualization in Science (CVS), European Multigrid Conference, EMG 2010, Computing and Visualization in Science, 14 (2011).

Algorithms

- **COKOSNUT**: a code for the control of the time-dependent Kohn-Sham model (2017); in Computer Physics Communications, CPC Program Library.
- **LONE**: a code for the sparse control of quantum systems (2016); in Computer Physics Communications, CPC Program Library.
- **SKRYN**: a fast semismooth-Krylov-Newton method for controlling Ising spin systems (2015); in Computer Physics Communications, CPC Program Library.
- **QUCON**: A fast Krylov-Newton code for dipole quantum control problems (2010); in Computer Physics Communications, CPC Program Library.
- **CNMS**: a cascadic monotonic time-discretized algorithm for finite-level quantum control computation (2008); in Computer Physics Communications, CPC Program Library.
- **SANTAFE**: a space-time multigrid method for open-loop (and receding-horizon) optimal control of time-dependent reaction-diffusion systems (2005). In MGNet Home Page, <http://www.mgnet.org>.
- **CONTROLLA**: a full multigrid method for the solution of an optimality system arising from a singular optimal control problem (2001). In MGNet Home Page, <http://www.mgnet.org>.
- **INTEGRA**: a multigrid code for the solution of systems of nonlinear integral equations (1998). In MGNet Home Page, <http://www.mgnet.org>.
- **TBA**: a multigrid code for the solution of the thermodynamic Bethe Ansatz equations (1993); in Computer Physics Communications, CPC Program Library.

Publications in Journals

115. T. Breitenbach, A. Borzì, On the SQH scheme to solve non-smooth PDE optimal control problems, Numerical Functional Analysis and Optimization, 2019.
<https://doi.org/10.1080/01630563.2019.1599911>
114. T. Breitenbach and A. Borzì, A sequential quadratic Hamiltonian method for solving parabolic optimal control problems with discontinuous cost functionals, Journal of Dynamical and Control Systems, 2018.
<https://doi.org/10.1007/s10883-018-9419-6>
113. M.-L. Kienle Garrido, T. Breitenbach, K. Chudej, and A. Borzì, Modeling and Numerical Solution of a Cancer Therapy Optimal Control Problem, Applied Mathematics, 9 (2018).
<http://www.scirp.org/Journal/PaperInformation.aspx?PaperID=86987>

112. S. Roy and A. Borzi, A new optimisation approach to sparse reconstruction of log-conductivity in acousto-electric tomography, *SIAM Journal on Imaging Sciences*, 11 (2018), 1759-1784.
111. M. Annunziato and A. Borzi, A Fokker-Planck control framework for stochastic systems, *EMS Surveys in Mathematical Sciences*, 5 (2018), 65-98.
<https://doi.org/10.4171/EMSS/27>
110. M. Sprengel, G. Ciaramella and A. Borzi, Investigation of optimal control problems governed by a time-dependent Kohn-Sham model, *Journal of Dynamical and Control Systems*, 2018. <https://link.springer.com/article/10.1007/s10883-017-9393-4>
109. D.K. Gathungu and A. Borzi, A multigrid scheme for solving convection-diffusion-integral optimal control problems, *Computing and Visualization in Science*, 2017. <https://link.springer.com/article/10.1007/s00791-017-0285-7>
108. K. Kułakowski, P. Gronek, and A. Borzi, Paradox of integration - mean field approach, *International Journal of Modern Physics C*, 28 (2017), 1750133.
107. S. Roy, A. Borzi, and A. Habbal, Pedestrian motion modelled by Fokker - Planck Nash games, *Royal Society open science*, 4: 170648, 2017.
106. S. Roy, A. Annunziato, A. Borzi, and C. Klingenberg, A Fokker-Planck approach to control collective motion, *Computational Optimization and Applications*, 69 (2018), 423-459.
105. T. Breitenbach, M. Annunziato and A. Borzi, On the optimal control of a random walk with jumps and barriers, *Methodology and Computing in Applied Probability*, 20 (2018), 435-462.
104. B. Gaviraghi, M. Annunziato, and A. Borzi,
Chapter 22: Splitting Methods for Fokker-Planck Equations Related to Jump-Diffusion Processes, pp. 409-422;
Chapter 23: A Fokker-Planck Based Approach to Control Jump Processes, pp. 423-439.
Novel Methods in Computational Finance, Springer, 2017. Edited by Matthias Ehrhardt, Michael Guenther, E. Jan W. ter Maten.
103. D.K. Gathungu and A. Borzi, Multigrid Solution of an Elliptic Fredholm Partial Integro-Differential Equation with a Hilbert-Schmidt Integral Operator, *Applied Mathematics*, 8 (2017), 967-986.
102. M. Sprengel, G. Ciaramella, and A. Borzi, A theoretical investigation of time-dependent Kohn-Sham equations, *SIAM Journal on Mathematical Analysis*, 49 (2017), 1681-1704.
101. S. Roy and A. Borzi, Numerical Investigation of a Class of Liouville Control Problems, *Journal of Scientific Computing*, 73 (2017), 178-202.
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Datum / Date	Forschungsprojekt (Titel) / Research Project (title)	Zuwendungsgeber / Funding Institution	Laufzeit / Project Period	Förderkennz./ Funding No.	Fördersumme/ Funding Amount (€)	Jahr/ Year
01.03.11	ESF OPTPDE Workshop: Schnelle Verfahren für die Simulation, Inversion und Steuerung von Wellengleichungsmodellen - Fast Solvers for Simulation, Inversion, and Control of Wave Propagation Problems	ESF (European Science Foundation)	26.-28.09.2011	3351	23.000,00 €	2011
01.10.11	Promotions-Stipendium von Frau Suttida Wongkaew aus Thailand	Königlich Thailändischen Regierung	1.10.11.-5.10.2016	15003.1/701	80.000,00 €	2011
01.10.12	Kontrollierbarkeit und optimale Steuerung interagierender quanten-dynamischer Systeme (COCIQS) - Controllability and Optimal Control of Interacting Quantum Dynamical Systems	DFG (Deutsche Forschungsgemeinschaft)	10.2011 - 10.2014	Bo3580/2-1	185.000,00 €	2011
01.09.12	Optimal Control of Stochastic and Crowd Models	BFHZ (Bayerisch-Französisches Hochschulzentrum)	10.2012 - 12.2013	FK10-12	4.500,00 €	2012
01.01.13	Shape and Material Optimization of mechanical and optical systems	BayFor (Bayerische Forschungsallianz)	12.2012-12.2013	BayIntAn_Uni_Würzburg_2014_3	4.500,00 €	2013
01.11.12	ESF OPTPDE Workshop on "Modeling and Control of Large Interacting Dynamical Systems"	ESF (European Science Foundation)	10.-12.09.2013	4540	24.000,00 €	2013
01.10.12	Multi-ITN STRIKE - Novel Methods in Computational Finance	Marie Curie Actions, Initial Training Networks (ITN)	01.2013 - 12.2016	304617	225.000,00 €	2013
25.06.13	ROENOBIO: Robuste Energie-Optimierung bei Gärprozessen in der Produktion von Biogas und Wein - Robust energy optimization of fermentation processes for the production of biogas and wine	BMBF (Bundesministerium für Bildung und Forschung)	07.2013 - 06.2016	05M13WWVA	240.000,00 €	2013
01.10.12	Entwicklung einer funktionellen 3D MR-basierten Diagnostik der intestinalen Obstruktion - Parallel Multigrad Imaging and Compressed Sensing for Dynamic 3D Magnetic Resonance Imaging	IZKF (Interdisziplinäres Zentrum für Klinische Forschung) der Universität Würzburg	01.2013 - 12.2015	F-254	132.000,00 €	2013
01.11.13	Promotions-Stipendium von Herrn Duncan Gathungu Kioi aus Kenia	DAAD (Dt. Akademischer Austauschdienst)	1.4.14 - vorauss. 30.3.2017	91548183	60.000,00 €	2014
01.07.15	Promotions-Stipendium von Herrn Myroslav Kryven aus der Ukraine	DAAD (Dt. Akademischer Austauschdienst)	1.10.15 - vorauss. 30.09.2018	91575661	60.000,00 €	2015
15.01.16	Sparse Control and Modeling of Multi-Agents systems	BFHZ (Bayerisch-Französisches Hochschulzentrum)	01.2016 - 12.2016	FK42-15	3.500,00 €	2016
25.06.13	Projektverlängerung ROENOBIO: Robuste Energie-Optimierung bei Gärprozessen in der Produktion von Biogas und Wein - Robust energy optimization of fermentation processes for the production of biogas and wine	BMBF (Bundesministerium für Bildung und Forschung)	07.2016 - 06.2017	05M13WWVA	75.000,00 €	2016
Eingeworbene Drittmittel gesamt seit 2011 (Stand 07/2016):						1.116.500,00 €