

Dr. Mario Mulansky

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Personal

born on February 4th, 1984 in Dresden, Germany.

Languages: German (native), English (fluent), Spanish (basic).

Education and Research Positions

2002: High School Degree (Abitur) in Dresden, 2002.

2003: Civil Service in Dresden, 2003.

2003 – 2008: Physics studies at TU Dresden.

2003 – 2008: Part-time position as developer at easy-soft GmbH Dresden.

2007: study abroad semester in Sydney, Australia.

2009: **Diploma Degree in Physics**, University of Potsdam.

2009 – 2012: PhD Student of Prof. Pikovsky at the University of Potsdam.

2012: **PhD degree in Theoretical Physics (summa cum laude)**, University of Potsdam.

April – August 2013: PostDoc at the Louisiana State University (DAAD PostDoc Fellowship).

October 2013 – July 2014: Guest scientist at the Max-Planck Institute for the Physics of Complex Systems (Dresden).

September 2014 – April 2016: Experienced Researcher at the Institute for Complex Systems ISC-CNR, Firenze (Marie Skłodowska-Curie Fellow).

since June 2016: Senior Software Engineer in a Special Projects Group (SPG) working on Autonomous Systems at Apple, California.

Projects

- since 2009:** Main developer of Boost.odeint – a C++ library for numerically solving ODEs: www.odeint.com.
- 2010:** Project manager for a small-scale industry cooperation on “Applications of Complex Networks”.
- 2011:** Project manager for a small-scale industry cooperation on “Modeling of Complex Software”.
- 2011:** Participant in the Google Summer of Code with the project “Finalizing odeint”.
- 2011:** Six weeks research visit to the CINECA supercomputing center in Bologna and the ISC-CNR in Florence as part of the HPC-Europa2 program.
- 2013:** Mentor of the Google Summer of Code project: “Parallelization backends for odeint”.
- since 2013:** Member of the STE||AR group: <http://stellar-group.org/>
- since 2014:** Development of PySpike – a Python library for spike train analysis: www.pyspike.de.

Teaching

- 2009/2010 and 2010/2011:** Seminar on Computational Physics I (26 hours).
- 2010 and 2011:** Seminar on Computational Physics II (26 hours).
- 2011/2012:** Lecture on Scientific Computing (26 hours).
- 2014:** Seminar on Computational Physics (13 hours).
- 2014:** Introductory Python Course (6 hours).
- 2016:** Lectures/Seminars on Computational Physics (12+12 hours).
- 2016/2017:** Project-internal talks on C++ Programming techniques.

Scientific Interest

Nonlinear dynamics and chaos, high-dimensional Hamiltonian chaos.
Computational Neuroscience, Spike train analysis, Neural algorithms.
Computational Physics, Numerical Algorithms, HPC, GPU Computing

Programming Interest

Modern C++ programming techniques like Functional Programming, Template Metaprogramming.

C++ community, member of the cppcon program committee, regularly attending community meetings in Dresden, Berlin, Italy.

Scientific Python.

Performance, Parallelization, Exascale Computing.

Technical Skills

Nonlinear Dynamics: Profound knowledge on bifurcations, chaos, Hamiltonian chaos, KAM theorem, resonant interactions, Lyapunov exponents and chaotic diffusion.

Computational Neuroscience: Expertise in statistical methods for spike train analysis, experience with simulations of neural networks and neural algorithms.

Computational Physics: Vast experience with applying numerical tools to physical problems, especially integration of ODEs, bifurcation analysis by continuation and Monte-Carlo studies.

Programming: Deep knowledge of modern C++ including performance oriented coding and Template Metaprogramming. Also experience with High Performance Computing and GPU computing (CUDA) as well as OpenMP, MPI and new approaches to exascale computing (HPX). Expertise in scientific Python.

Grants

2011: Project “Finalizing odeint” funded with USD 5,000 by Google Inc.

2011: Project “Spreading in two-dimensional disordered nonlinear systems” funded with EUR 2,500 by the HPC-Europa2 program.

2013: Project “Highly Parallelized ODE Solvers” funded with EUR 9,167 by the German Academic Exchange Program (DAAD).

2013: Project “Microscopic Spreading Mechanisms in Disordered Nonlinear Lattices” funded with EUR 36,000 from the Max-Planck Institute for the Physics of Complex Systems (Dresden).

2014: Project “Classical and Quantum Dynamics of Disordered Spin Chains: Diffusion, Chaos or Many-Body Localization?” funded with EUR 65,000 by the German Research Foundation (DFG) – declined in favor of the Marie Skłodowska-Curie position at the ISC-CNR Florence.

Publications

Peer Reviewed Journal Articles

Eero Satuavuori, Mario Mulansky, Andreas Daffertshofer and Thomas Kreuz
Using spike train distances to identify the most discriminative neuronal subpopulation

Journal of Neuroscience Methods, in print, 2018.

Eero Satuavuori, Mario Mulansky, Nebojsa Bozanic, Irene Malvestio, Fleur Zeldenrust, Kerstin Lenk and Thomas Kreuz

Measures of spike train synchrony for data with multiple time scales

Journal of Neuroscience Methods 287, 25-38, 2017.

Thomas Kreuz, Eero Satuavuori, Martin Pofahl and Mario Mulansky

Leaders and followers: Quantifying consistency in spatio-temporal propagation patterns

New Journal of Physics 19 (4), 043028, 2017.

Mario Mulansky and Thomas Kreuz

PySpike – A Python library for analyzing spike train synchrony

SoftwareX 5, 183-189, 2016.

Mario Mulansky, Nebojsa Bozanic, Andreea Sburlea and Thomas Kreuz

A guide to time-resolved and parameter-free measures of spike train synchrony

Int. Conf. on Event-based Control, Communication, and Signal Processing, pp.1-8, 2015.

Thomas Kreuz, Mario Mulansky and Nebojsa Bozanic

SPIKY: A graphical user interface for monitoring spike train synchrony

Journal of Neurophysiology Vol. 113 no. 9, 3432-3445, 2015.

Mario Mulansky

Scaling of Chaos in Nonlinear Disordered Lattices

Chaos 24, 024401, 2014.

Mario Mulansky and Arkady Pikovsky

Scaling of Energy Spreading in Strongly Nonlinear Lattices

New Journal of Physics 15, 053015, 2013.

Mario Mulansky and Arkady Pikovsky

Scaling properties of energy spreading in nonlinear Hamiltonian two-dimensional lattices

Physical Review E 86, Page 056214, 2012.

Mario Mulansky and Arkady Pikovsky

Re-localization due to finite response times in a nonlinear Anderson chain

European Journal of Physics B, Volume 85, Issue 3, 2012.

Mario Mulansky, Karsten Ahnert, Arkady Pikovsky and Dima Shepelyansky

Strong and weak chaos in weakly nonintegrable many-body Hamiltonian systems

Journal of Statistical Physics Volume 145, Issue 5, Pages 1256-1274, 2011.

Mario Mulansky, Karsten Ahnert and Arkady Pikovsky
Scaling of energy spreading in strongly nonlinear disordered lattices
Physical Review E 83, Number 2 , Page 26205, 2011.

Mario Mulansky and Arkady Pikovsky
Spreading in disordered lattices with different nonlinearities
Europhysics Letters 90, 1, 2010.

Mario Mulansky, Karsten Ahnert, Arkady Pikovsky and Dima L. Shepelyansky
Dynamical Thermalization of Disordered Nonlinear Lattices
Physical Review E 80, Number 5, Page 56212, 2009.

Book Chapters

Mario Mulansky
Implementation of ODE solvers
Chapter in *Discovering Modern C++ by Peter Gottschling, C++ In-Depth Series, Addison-Wesley*, 2015

Karsten Ahnert, Denis Demidov and Mario Mulansky
Solving Ordinary Differential Equations on GPUs
Numerical Computations with GPUs, Springer Int. Publishing, p. 125-157, 2014.

Conference Proceedings

Karsten Ahnert and Mario Mulansky
odeint - Solving Ordinary Differential Equations in C++
AIP Conference Proceedings Vol. 1389, 1586-1589, 2011.

Mario Mulansky and Karsten Ahnert
Generic Programming applied to Numerical Problems
AIP Conference Proceedings ICNAAM 2011, 2011.

Thesis

Mario Mulansky
Chaotic Diffusion in Nonlinear Hamiltonian Lattices
PhD Thesis, 2012.

Mario Mulansky
Localization Properties of Nonlinear Disordered Lattices
Diploma Thesis, 2009.

Other Articles

Nebojsa Bozanic, Mario Mulansky and Thomas Kreuz
SPIKY
Scholarpedia, 9(12):32344, 2014.

Mario Mulansky and Karsten Ahnert
Odeint library
Scholarpedia, 9(12):32342, 2014.

Conferences, Workshops, Invited Talks

- 2017:** cppcon in Seattle, USA.
- 2016:** Invited talks on “odeint – Solving ODEs in C++” and “Cache optimization and SIMD instructions” at ADC++ in Erding, Germany.
- 2015:** Talk on “Cache optimization and SIMD instructions” at MeetingCPP in Berlin, Germany.
- 2015:** Invited talk on “Programming for Scientists” at the University of Potsdam, Germany.
- 2015:** Invited speaker at the “First COSMOS Meeting” in Florence, Italy.
- 2015:** NETT conference on “System Level Approaches to Neural Engineering” in Barcelona, Spain.
- 2015:** NETT workshop on “Neural Engineering in Medicine and Related Fields” in Nancy, France.
- 2015:** IEEE conference on “Event-Based Control, Communication, and Signal Processing” in Krakow, Poland.
- 2015:** Invited talk at the University of Milano, Italy on “Measures of Spike Train Synchrony”.
- 2015:** DFG Spring Meeting in Berlin, Germany.
- 2014:** Workshop on “Nonlinear Physics at the Nanoscale: A Cross-Fertilization on Stochastic Methods” at the MPIPKS in Dresden, Germany.
- 2014:** Workshop on “Emergent Phenomena in the Dynamics of Quantum Matter” in New York, USA.
- 2014:** NETT Workshop 2014 “Dynamics of Neural Circuits” in Florence, Italy.
- 2014:** DFG Spring Meeting in Dresden, Germany.
- 2014:** Mardi Gras Conference 2014 “Application Development for Exascale Computing” in Baton Rouge, USA.
- 2013:** Workshop on “Methods of Chaos Detection and Predictability: Theory and Applications” in Dresden, Germany.
- 2013:** Invited talk at FOSDEM’13 in Brussels, Belgium about “odeint - Solving ODEs in C++”.
- 2012:** Conference “Dynamics Days Europe” in Gothenburg, Sweden.
- 2012:** Conference “C++Now” in Aspen, USA.
- 2012:** Trimester program “Disordered Quantum System” at the Institut Henri Poincaré, Paris.

2011: Invited talk at the TU Dresden about odeint and “Generic Programming”.

2011: “International Conference of Numerical Analysis and Applied Mathematics” in Halkidiki, Greece.

2011: SIAM Conference “Dynamical Systems” in Snowbird, USA.

2010: Workshop on “Advanced Workshop on Anderson Localization, Nonlinearity and Turbulence: a Cross-Fertilization” in Trieste, Italy.

2010: Workshop on “Nonlinear Dynamics on Networks” in Kiev, Ukraine.

2009: Conference “XI Latin American Workshop on Nonlinear Phenomena” in Buzios, Brazil.