

Dr. Thomas M. Surowiec

Mathematician

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Professional Experience

- 2022– **Chief Research Scientist**, Dept. of Numerical Analysis and Scientific Computing (SCAN), Simula Research Laboratory, Oslo, Norway
- 2025 **J.T. Oden Faculty Fellowship Visitor**, Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin, Austin, TX, USA
- 2023– **Visiting Scholar**, Div. of Applied Mathematics, Brown University, Providence, RI, USA
- 2016–2022 **Professor, Mathematical Optimization**, Dept. of Mathematics and Computer Science, Philipps-Universität Marburg, Germany
- 2014–2016 **Assistant Professor, Nonsmooth Optimization and Variational Analysis**, Dept. of Mathematics, Humboldt-Universität zu Berlin (HU Berlin), Germany
- 2009–2014 **Research Associate**, Dept. of Mathematics, HU Berlin, Germany
- 2006–2009 **Research Assistant**, Dept. of Mathematics, HU Berlin, Germany
- 2004–2006 **Teaching Assistant**, Dept. of Mathematical Sciences, Stevens Institute of Technology, Hoboken, NJ, USA

Education

- 2006–2010 **PhD (doc. rer. nat.)**, Humboldt-Universität zu Berlin, Berlin, Germany, Mathematics
PhD Supervisor 1: René Henrion, Weierstraß-Institut für Angewandte Analysis und Stochastik, Berlin
PhD Supervisor 2: Jiří V. Outrata, UTIA Czech Academy of Sciences, Prague
- 2004–2006 **Master of Science**, Stevens Institute of Technology, Hoboken, NJ, USA, Stochastic Systems
- 2000–2004 **Bachelor of Science**, Stevens Institute of Technology, Hoboken, NJ, USA, Mathematical Sciences

Research Interests

- Optimization methods for the numerical solution of partial differential equations (PDEs)
Data-driven optimization and optimization under uncertainty
Theory and algorithms for variational inequalities and nonsmooth PDE-constrained optimization
Applications in digital microfluidics, semiconductors, medicine, engineering

Publications

I Algorithms for Variational Inequalities and Nonsmooth Operator Equations

Keith, B., **Surowiec, T.M.**, *Proximal Galerkin: A structure-preserving finite element method for pointwise bound constraints*. arXiv preprint arXiv:2307.12444 (2023), Accepted, Foundations of Computational Mathematics. This text is the origin of LVPP, developed here for the obstacle problem.

Farrell, P. E., Croci, M., **Surowiec, T.M.**, *Deflation for semismooth equations*. Optimization Methods and Software vol. 35, no. 6, pp. 1248–1271, (2020), Won the Charles Broyden Prize. The techniques for computing multiple solutions of semismooth equations will provide insight into the nonconvex problems in WP1 and WP3.

Adam, L., Hintermüller, M., **Surowiec, T.M.**, *A semismooth Newton method with analytical path-following for the H^1 -projection onto the Gibbs simplex*. IMA Journal of Numerical Analysis, vol. 39, no. 3, pp. 1276–1295, (2019), This paper offers the alternative, non-feasible, non-structure preserving perspective to solving a bound-constrained elliptic VI with partition of unity constraints on the vector-valued solutions.

II Theory, Algorithms, and Applications for PDE-Constrained Optimization

Surowiec, T.M., Walker, S.W., *Optimal control of the Landau–de Gennes model of nematic liquid crystals*. SIAM Journal on Control and Optimization vol. 51, no. 4, pp. 2546–2570 (2023), This is the first rigorous mathematical study for the optimal control of the tensor-valued Landau-de Gennes model of LCs.

Hintermüller, M., **Surowiec, T.M.**, *A bundle-free implicit programming approach for a class of elliptic MPECs in function space*. Mathematical Programming (Series A) vol. 160, pp. 271–305 (2016), This presents a new function-space-based algorithm for the optimal control of elliptic variational inequalities of obstacle type.

Hintermüller, M., **Surowiec, T.M.**, Kämmler, A., *Generalized Nash equilibrium problems in Banach spaces: theory, Nikaido–Isoda-based path-following methods, and applications*. SIAM Journal on Optimization vol. 25, no. 3, pp. 1826–1856 (2015), The variational problems studied here arise, e.g., in multi-objective optimal control of PDEs and fall under the category of quasi-variational inequalities.

III Optimization under Uncertainty

Milz, J., **Surowiec, T.M.**, *Asymptotic consistency for nonconvex risk-averse stochastic optimization with infinite dimensional decision spaces*. *Mathematics of Operations Research* (2023), Awaiting print version for volume, pages. This is the first text to address the complex statistical questions arising in the numerical analysis of nonconvex nonsmooth infinite-dimensional stochastic optimization problems. The insights here are crucial for the analysis in WP3.

Kouri, D.P., **Surowiec, T.M.**, *A primal-dual algorithm for risk minimization*. *Mathematical Programming (Series A)* (2022), This is the first fully continuous non-smoothing-based algorithm for solving risk-averse PDE-constrained optimization problems. The paper contains a full convergence analysis in infinite dimensions and numerical experiments, which demonstrate its superiority to the alternatives.

Garreis, S., **Surowiec, T.M.**, Ulbrich, M., *An interior-point approach for solving risk-averse PDE-constrained optimization problems with coherent risk measures*. *SIAM Journal on Optimization* vol. 31, no. 1, pp 1-29 (2021), This paper continues some of the ideas in the 2016 paper below but offers a new perspective via classical interior point methods. The paper contains rigorous analysis, variational convergence results, infinite-dimensional algorithms, and numerical experiments.

Kouri, D.P., **Surowiec, T.M.**, *Risk-averse PDE-constrained optimization using the Conditional Value-At-Risk*. *SIAM Journal on Optimization* vol. 26, no. 1, pp 365-396 (2016), This is the first paper to suggest the use of risk management tools in the context of PDE-constrained optimization under uncertainty in order to obtain more robust engineering solutions. The paper contains both theory and two new algorithmic approaches.

Prizes

- 2025 **The Langtangen Prize**, with Brendan Keith (Brown)) Awarded for the paper "Proximal Galerkin: A Structure-Preserving Finite Element Method for Pointwise Bound Constraints." Recognized for outstanding contributions to the foundations of numerical simulation technology., <https://link.springer.com/article/10.1007/s10208-024-09681-8>
- 2020 **Charles Broyden Prize 2020**, with Patrick E. Farrell (Oxford) and Matteo Croci (Oxford)) for the best paper published in the 2020 volume of Optimization Methods and Software, <https://doi.org/10.1080/10556788.2019.1613655>

Funded Research Projects

- 2025-2030 **SURE-AI: The Norwegian Centre for Sustainable, Risk-Averse, and Ethical AI**, Deputy Centre Director, 200 million NOK funded by the Research Council of Norway
- 2026-2029 **LaVa: The Latent Variable Proximal Point Method: A structure-preserving approach to constrained variational problems**, PI, 12 million NOK funded by the Research Council of Norway
- 2019–2022 **Constrained Mean Field Games: Analysis and Algorithms**, PI in Marburg (PI in Berlin: M. Hintermüller), funded by DFG, The goal of this project was to derive, analyze, and solve new forms of mean field games (MFGs) in which the controls and state variables are subject to pointwise bound constraints. Roughly speaking, MFGs can be understood as coupled systems of nonlinear PDEs resembling nonlinearly coupled Hamilton-Jacobi-Bellman and Fokker-Planck equations, which arise as an infinite-dimensional approximation of multi-agent systems when the number of agents tends to infinity. Including bound constraints turns the PDEs into variational inequalities or nonsmooth evolutionary operator equations.
- 2016–2021 **Generalized Nash Equilibrium Problems with Partial Differential Operators: Theory, Algorithms, and Risk Aversion**, PI in Marburg (PI in Berlin: M. Hintermüller), funded by DFG, The subject of this project was generalized Nash equilibrium problems with PDE constraints under uncertainty and their extension to new classes of equilibrium problems in function space. The new classes of PDE-constrained problems under consideration offer a wide range of mathematical novelty including the derivation of existence and stationarity results, numerical methods for nonstandard PDE-constrained problems, optimization under uncertainty, and accounting for risk averse behavior.
- 2014–2017 **Mathematical Modeling, Analysis, and Optimization of Strained Germanium-Microbridges**, joint PIs (with M. Hintermüller, A. Mielke, M. Thomas) funded by the Einstein Center for Mathematics, The goal of the project Mathematical Modeling, Analysis, and Optimization of Strained Germanium-Microbridges was to optimize the design of a strained Germanium microbridge with respect to the light emission. It was a joint project with the Humboldt-University Berlin (M. Hintermüller, T. M. Surowiec) and the Weierstrass Institute (A. Mielke, M. Thomas), which involved the close collaboration with the Department for Materials Research at IHP (Leibniz-Institute for Innovative High Performance Microelectronics, Frankfurt Oder).

Recent and Upcoming Invited Presentations (Selected)

1. *The Latent Variable Proximal Point Method: A new approach to solving free boundary problems and nonlinear PDEs*, Invited lecture series, biennial European Mathematical Society School on Applied Mathematics at Kacov, Czechia. (06.2025)
2. *An introduction to optimization under uncertainty*, Invited lecture series, Numerical Methods for Random Differential Models 2024 (NUMRAD24), Summer School at EPFL Lausanne. (6.2024)
3. *The proximal Galerkin method* ICERM, Providence, RI (3.2024)
4. *Almost sure state constraints in PDE-constrained optimization under uncertainty* SIAM Optim., Seattle WA, (6.2023)
5. *Risk-averse optimization of random elliptic variational inequalities* SIAM CS&E, Amsterdam (3.2023).
6. *Asymptotic properties of Monte Carlo methods for PDE-Constrained optimization under uncertainty* SIAM UQ, Atlanta, GA (4.2022).

7. An interior point approach for a class of risk-averse PDE-constrained optimization problems with coherent risk measures Oberwolfach Workshop 2107 "Challenges in Optimization with Complex PDE-Systems" (02.2021)
8. A primal-dual algorithm for risk minimization in PDE-constrained optimization CRM Applied Mathematics Seminar, Montreal, Canada (11.2020) [Link to video](#)
9. Perspectives on PDE-constrained optimization under uncertainty Oberwolfach Workshop 1834 "New Directions in Stochastic Optimisation" 08.2018
10. Risk-averse optimization of partial Differential equations with random inputs Numerical Analysis Seminar, University of Oxford, 04.2017

Research Visits (lasting one or more weeks)

03.2024	Brown University	09.2016	Sandia National Laboratories, (Albuquerque)
09.2018	University of Oxford	03.2015	University of Maryland College Park
04.2018	Sandia National Laboratories, (Albuquerque)	03.2015	George Mason University
04.2018	University of Oxford	03.2015	Sandia National Laboratories, (Albuquerque)
03.2017	Stevens Institute of Technology	09.2014	University of Maryland College Park
03.2017	Duke University	09.2014	George Mason University
09.2016	TU München		

Reviewing and Editorial Work

- I regularly write reviews for SIAM J. on Optimization, SIAM J. on Control and Optimization, SIAM J. Scientific Computing, SIAM/ASA J. Uncertainty Quantification, Optimization, Optimization Methods and Software, Set-Valued and Variational Analysis, Control Optimization and Calculus of Variations, Mathematical Programming, Numerische Mathematik, German Research Foundation (DFG), Austrian Science Fund (FWF), KU Leuven Research Council
- 09.2023- Associate Editor (Mathematics) for Optimization and Engineering
 2021- Area Editor (Optimization) for Advances in Continuous and Discrete Models: Theory and Applications

Conference Organization (Selection)

I actively take part in the organization of conferences, minisymposia, and summer schools. This includes:

1. Organizer of Optimization in Oslo (UiO) Seminar (since 2022) [YouTube](#)
2. Member of Scientific Committee for *European Conference on Computational Optimization (EUCCO)* Universität Klagenfurt, September 2025
3. Member of Scientific Committee for *EUCCO* Universität Heidelberg, September 25-27, 2023
4. Member of Organizing Committee for *Frontiers of Stochastic Optimization and its Applications in Industry* Weierstrass Institute Berlin, May 10-12, 2023
5. Organizer of the *DFG-SPP 1962 Summer School on Optimization under Uncertainty* at Philipps-Universität Marburg (September 8-10, 2021, virtual). Info: <https://thomas-surowiec.github.io/> and Slides: [Google Drive Folder](#)
6. Co-organizer of the BIRS Workshop: Optimization under Uncertainty: Learning and Decision Making with C. Schillings, J. Royset, L. Ruthotto. February 7-12, 2021, Banff Canada (virtual due to COVID-19)
7. Cluster Chair for Complementarity and Variational Inequalities at the ICCOPT 2019 in Berlin (with M. Ferris)
8. Co-organizer of a minisymposium on *PDE-Constrained Optimization under Uncertainty and Applications* at the 15th International Conference on Stochastic Programming 2019 in Trondheim, Norway. (with D.P. Kouri)
9. Co-organizer of the spring school on *New Directions in PDE Constrained Optimisation* at the IIT Bombay, Mumbai, India, March 2018. (with H. Antil, A. Kumar, N. Nataraj) <https://www.atmschools.org/2018/atmw/ndpco/speakers-and-syllabus>
10. Co-organizer of a minisymposium on *Risk-Averse Optimization for Engineering Applications* at the SIAM Conference on Optimization, Vancouver, Canada, May 2017. (with D.P. Kouri, S. Uryasev)
11. Co-organizer of Einstein Center for Mathematics Colloquiums together with C. Hartmann, C. Gräser, R. Kruse (05.06.2015 "Uncertainty Quantification", 01.08.2016 "Geometric PDEs and free boundary problems", 22.04.2016 "Sparsity: Statistics, Optimization and Applications")
12. Organizer of a two-part minisymposium on *Optimization of Non-smooth and Complementarity-based Systems with PDE-constraints* at the ISMP 2015 Conference in Pittsburgh.
13. Co-organizer of the *International Conference on Complementarity Problems* at HU Berlin August, 2014. (with M. Hintermüller)

Teaching Experience

I have held dozens of lectures during my tenure in Marburg and Berlin. These include:

Linear Programming

Nonlinear Optimization

Mathematical Optimization for Machine Learning

Stochastic Optimization

PDE-constrained optimization

Infinite-Dimensional Convex Analysis

Nonsmooth Optimization

Variational Inequalities

Supervision and Mentoring

Supervising students and young scientists is something that I have always taken seriously. To date, I have directly supervised two PhD students, 11 masters students, and 17 bachelor theses and dozens more master and bachelor theses as a co-supervisor in Oslo, Marburg, and Berlin.

Departmental Work

At Philipps-Universität Marburg I was deeply involved in running the department. This includes

1. Member of faculty council (elected position)
2. Director of the examination board
3. Member the tenure-track committee
4. Student counselor for operations research (German: Wirtschaftsmathematik)

I have also been involved in a number of search and hiring committees at Marburg and Berlin and I have been in many PhD committees both internally and external reviewer (Charles University Prague, ETH Zürich, TU Darmstadt, Humboldt-Universität zu Berlin).