Alena Kopaničáková

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Personal information

Date of birth	13 May 1992
Family status	Single
Address	Providence, Rhode Island, USA

Employment history

06/2022 –	**Visiting Scholar in Applied Mathematics**
Providence, USA	Brown University, Host: Prof. G. Karniadakis
02/2021 – 05/2022	**Post-doctoral Researcher**
Lugano, Switzerland	Università della Svizzera italiana, Advisor: Prof. R. Krause
10/2015 – 1/2021	**Research Assistant**
Lugano, Switzerland	Università della Svizzera italiana, Advisor: Prof. R. Krause
07/2017 – 12/2017	**Research Intern**
Los Angeles, USA	Walt Disney Animation Studios, Advisor: Dr. R. Tamstorf
06/2015 – 09/2015	**Student Assistant**
Lugano, Switzerland	Università della Svizzera italiana, Advisor: Prof. R. Krause

Education

10/2015 – 11/2020	**Ph.D. in Computational Science**
Lugano, Switzerland	Università della Svizzera italiana
	Thesis: *Multilevel minimization in trust-region framework - Algorithmic and software developments.* Advisor: Prof. R. Krause
08/2014 – 07/2015	**Master of Science in Informatics**
Lugano, Switzerland	Università della Svizzera italiana
	Thesis: *Investigating Optimization Strategies for Quadratic Programming Components of a Data Analysis Framework.* Advisor: Prof. I. Horenko
02/2014 – 07/2014	**Erasmus exchange program**
Lugano, Switzerland	Università della Svizzera italiana
09/2013 – 08/2014	**Master of Artificial Intelligence**
Košice, Slovakia	Technical University of Košice
	Transferred to Università della Svizzera italiana, Lugano after 1st year
09/2010 – 07/2013	**Bachelor of Business Informatics**
Košice, Slovakia	Technical University of Košice

Research projects and collaborators

Research projects:

06/2022 –	Multilevel training of DeepONets - multiscale and multiphysics applications, Swiss National Science Foundation (SNSF) Postdoc-Mobility grant (2 years, approx. 110,000 CHF), Role: **PI**
04/2021 – 05/2022	ML^2 - Multilevel and Domain Decomposition Methods for Machine Learning (PI: Prof. Krause), Role: **Post-doctoral researcher**
09/2016 – 09/2019	Large-scale simulation of pneumatic and hydraulic fracture with a phase-field (PI: Prof. Krause, Prof. Weinberg, Prof. Hesch), Role: **Ph.D. student**

Collaborations:

10/2018 –	Dr. A. Fadel, and A. Fink from Swiss National Supercomputing Centre, Switzerland
04/2018 –	F. Chegini and Dr. M. Weiser from the Zuse Institute Berlin (ZIB), Germany
06/2018 – 09/2019	Prof. P. Deuflhard from ZIB, Germany
09/2016 – 09/2019	C. Bilgen, Prof. K. Weinberg from UNI Siegen, Germany

Research visits:

10/2021 – 11/2021	Research visit at ZIB, Germany, Host: Dr. M. Weiser

Supervision of junior researchers

During my stay at Università della Svizzera italiana (USI), I have co-supervised (senior advisor Prof. R. Krause) several junior researchers.

Co-supervised Bachelor theses (BSc in Informatics):

09/2021 – 02/2022	Stefano Gonçalves, *Implementation of a hybrid data-parallel algorithm for neural network training with reduced communication targeted to GPU-based supercomputers*
09/2020 – 07/2021	Filippo Cesana, *Python Front-End for Utopia with Algorithmic Implementations Related to Financial Machine Learning*, together with Dr. P. Zulian (USI)

Co-supervised Master theses (MSc in Computational Science/Mathematics):

09/2021 – 03/2022	Andrea Angino, *Knight descent - a parallel stochastic method for non-linear optimization problems*, together with Prof. M. Donatelli (Insubria, Como, Italy)
09/2019 – 09/2020	Samuel Cruz, *Learning multilevel hierarchies*
09/2019 – 07/2020	Vanessa Braglia, *Multilevel training for neural networks*

Co-mentored Ph.D. students:

01/2021 –	Samuel Cruz, *Domain decomposition methods and deep-learning*

Co-supervised student assistants:

02/2022 –	Marc Salvadó, *Multilevel methods and large-scale maximum inner product quantization*
07/2021 – 10/2021	Francesco Lacommare, *Multilevel variant of Adam optimizer*
06/2020 – 10/2021	Filippo Cesana, *Python interface for UTOPIA*, together with Dr. P. Zulian (USI)
06/2020 – 05/2021	Dylan Ramelli, *xSDK integration for UTOPIA*, together with Dr. P. Zulian (USI)
08/2020 – 01/2021	Nicholas Robertson, *Domain decomposition and machine learning*
06/2019 – 12/2020	Lisa Gaedke-Merzhäuser, *Multilevel training of deep residual networks*
01/2019 – 09/2020	Samuel Cruz, *Learning multigrid transfer operators using reinforcement learning*
06/2019 – 07/2020	Vanessa Braglia, *Multilevel variance reduction methods*
06/2016 – 12/2016	Eric Botter, *Continous integration using CDash*

Teaching activities

I have served as a teaching assistant and substitute lecturer at Università della Svizzera italiana, Lugano.

Lecture list (substitute lecturer):

02/2022 – 06/2022	Solution and Optimization Methods for Large Scale Problems (MSc/Ph.D.)

Lecture list (teaching assistant):

02/2019 – 07/2019	Solution and Optimization Methods for Large Scale Problems (MSc/Ph.D.)
09/2018 – 01/2019	Calculus (BSc)
08/2018	Functional and Numerical Analysis (MSc/Ph.D.)
02/2018 – 07/2018	Multiscale methods (MSc/Ph.D.)
02/2017 – 07/2017	Optimization methods (BSc)
09/2016 – 01/2017	Enterprise Resource Planning (MSc)

Mentoring:

03/2022	Teens in AI Hackathon (Lugano event)

Active memberships in scientific societies, fellowships in renowned academies and reviewing activities

10/2021 –	Member of Association of Applied Mathematics and Mechanics (GAMM)
09/2021 –	Member of Swiss Mathematical Society (SWISSCOMAS)
01/2019 –	Member of Society for Industrial and Applied Mathematics (SIAM)

Organisation of conferences

05/2021 – 07/2021	Co-organizer, FoMICS-DADSi seminars on Physics Informed Neural Networks
07/2015, 2016, 2017	Student Volunteer, Platform for Advanced Scientific Computing Conference

Prizes, awards, fellowships

07/2022	ESMC2022 - Women in STEM Conference Support Award
10/2019, 10/2018	Selected for Eurohack19/18: GPU programming hackathon
02/2009, 02/2010	Academic merit scholarship, Technical university of Košice

Personal skills

Languages	Slovak (Native), English (Fluent), German (Basic), Italian (Basic)
Operating Systems	Linux, macOS, Microsoft Windows
Programming languages	C/C++, Python, MATLAB
Scientific libraries	PETSc, LibMesh, MOOSE, FEniCS, Firedrake, JAX, Keras/TensorFlow, PyTorch, NumPy
Technical tools	bash, Vim, Git, Docker, Slurm
Vizualization tools	Paraview, VisIt
Documentation	LaTeX/TikZ/Pgfplot/Beamer, Microsoft office, Keynote

OUTPUT LIST
ALENA KOPANIČÁKOVÁ

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Google Scholar: Profile

Publications in peer-reviewed scientific journals

[J1] **A. Kopaničáková**, H. Kothari, and R. Krause. Nonlinear Field-split Preconditioners for Solving Monolithic Phase-field Models of Brittle Fracture. *Under review in Computer Methods in Applied Mechanics and Engineering*, 2022. Link to preprint

[J2] **A. Kopaničáková** and R. Krause. Globally Convergent Multilevel Training of Deep Residual Networks. *Accepted for publication in SIAM Journal on Scientific Computing*, 2022. Link to preprint

[J3] P. Zulian*, **A. Kopaničáková***, M. G. C. Nestola, N. Fadel, A. Fink, J. VandeVondele, and R. Krause. Large scale simulation of pressure induced phase-field fracture propagation using Utopia. *CCF Transactions on High Performance Computing*, 2021. **(*Equal contribution)**, Link to published article

[J4] F. Chegini, **A. Kopaničáková**, R. Krause, and M. Weiser. Efficient identification of scars using heterogeneous model hierarchies. *EP Europace*, 23(Supplement_1):i113–i122, 2021. Link to published article

[J5] C. Bilgen, **A. Kopaničáková**, R. Krause, and K. Weinberg. A detailed investigation of the model influencing parameters of the phase-field fracture approach. *GAMM-Mitteilungen*, 43(2):e202000005, 2020. Link to published article

[J6] **A. Kopaničáková** and R. Krause. Recursive multilevel trust region method with application to fully monolithic phase-field models of brittle fracture. *Computer Methods in Applied Mechanics and Engineering*, 360:112720, 2020. Link to published article, Link to preprint

[J7] **A. Kopaničáková**, R. Krause, and R. Tamstorf. Subdivision-based nonlinear multiscale cloth simulation. *SIAM Journal on Scientific Computing*, 41(5):S433–S461, 2019. Link to published article, Link to postprint

[J8] C. Bilgen, **A. Kopaničáková**, R. Krause, and K. Weinberg. A phase-field approach to conchoidal fracture. *Meccanica*, pages 1–17, 2017. Link to published article

Publications in peer-reviewed conference proceedings

[C1] L. Gaedke-Merzhäuser*, **A. Kopaničáková***, and R. Krause. Multilevel minimization for deep residual networks. In *Proceedings of French-German-Swiss Optimization Conference (FGS'2019)*, 2021. **(*Equal contribution)**, Accepted, Link to preprint

[C2] C. von Planta, **A. Kopaničáková**, and R. Krause. Training of residual networks with stochastic MG/Opt. In *ICML 2021 Workshop: Beyond First Order Methods in Machine Learning*, 2021. Link to published article

[C3] V. Braglia*, **A. Kopaničáková***, and R. Krause. A multilevel approach to training. In *ICML 2020 Workshop: Beyond First Order Methods in Machine Learning*, 2020. **(*Equal contribution)**, Link to published article

[C4] C. Bilgen, **A. Kopaničáková**, R. Krause, and K. Weinberg. A phase-field approach to pneumatic fracture. In *PAMM*, volume 17, pages 71–74, 2017. Link to published article

Peer-reviewed book chapters

[B1] C. Bilgen, **A. Kopaničáková**, R. Krause, and K. Weinberg. A phase-field approach to pneumatic fracture. In J. Schröder and P. Wriggers, editors, *Non-standard Discretisation Methods in Solid Mechanics*, pages 217–241, 2022. Link to published article

[B2] F. Chegini, **A. Kopaničáková**, M. Weiser, and R. Krause. Quantitative analysis of nonlinear multifidelity optimization for inverse electrophysiology. In *Domain Decomposition Methods in Science and Engineering XXVI*. Springer, 2021. Accepted, The preprint can be provided upon request

[B3] **A. Kopaničáková** and R. Krause. Multilevel Active-Set Trust-Region (MASTR) Method for Bound Constrained Minimization. In *Domain Decomposition Methods in Science and Engineering XXVI*. Springer, 2021. Accepted, Link to preprint

[B4] H. Kothari, **A. Kopaničáková**, and R. Krause. A Matrix-free Multigrid Preconditioner for Jacobian-free Newton-Krylov Methods. In *Domain Decomposition Methods in Science and Engineering XXVI*. Springer, 2021. Accepted, Link to preprint

Presentations and poster contributions

Invited talks:

[T1] **A. Kopaničáková** and R. Krause. Multilevel minimization and Deep Residual Networks (ResNets). Invited talk in the group of Prof. M. Jaggi, 2020

[T2] **A. Kopaničáková** and R. Krause. Trust-region based minimization techniques for phase-field fracture simulations. Invited talk in the group of Prof. L. de Lorenzis, 2019

Selected oral presentations:

[T3] **A. Kopaničáková**, H. Kothari, and R. Krause. Nonlinear additive and multiplicative preconditioning strategies for monolithic phase-field fracture models. 8th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS CONGRESS), 2022

[T4] **A. Kopaničáková** and R. Krause. Affine Similar Trust-Region Method with Application to Phase-Field Models of Brittle Fracture. The US National Congress on Computational Mechanics (USNCCM 16), 2021

[T5] **A. Kopaničáková** and R. Krause. A large scale phase-field fracture simulations. The Platform for Advanced Scientific Computing (PASC) Conference, 2021

[T6] **A. Kopaničáková** and R. Krause. Globally Convergent Multilevel Training of Deep Residual Networks. 20th Copper Mountain Conference On Multigrid Methods, 2021

[T7] **A. Kopaničáková** and R. Krause. Multilevel training of deep residual networks. 26th International Domain Decomposition Conference, (DDXXVI), 2020

[T8] **A. Kopaničáková** and R. Krause. A recursive multilevel trust region method with application to fully monolithic phase-field models of brittle fracture. The US National Congress on Computational Mechanics (USNCCM 15), 2019

[T9] **A. Kopaničáková**, R. Krause, and R. Tamstorf. Subdivision-based nonlinear multiscale cloth simulation. Eccomas Thematic Conference on eXtended Discretization MethodS (X-DMS), 2019

[T10] **A. Kopaničáková** and R. Krause. Recursive multilevel trust region strategy with application to phase-field fracture. The 13th World Congress in Computational Mechanics (WCCMXIII), 2018

[T11] **A. Kopaničáková**, R. Krause, and R. Tamstorf. Subdivision-based nonlinear multiscale cloth simulations. Copper Mountain Conference On Iterative Methods, 2018

[T12] **A. Kopaničáková**, C. Bilgen, K. Weinberg, and R. Krause. Recursive multilevel trust region method, application to phase-field fracture. SIAM Conference on Parallel Processing for Scientific Computing (SIAM-PP), 2018

[T13] **A. Kopaničáková** and R. Krause. A non-linear multilevel method for phase-field fracture models. The Platform for Advanced Scientific Computing (PASC) Conference, 2017

Posters:

[P1] **A. Kopaničáková**, S. Cruz, H. Kothari, and R. Krause. Distributed Training of Deep Neural Networks. The Platform for Advanced Scientific Computing (PASC) Conference, 2022

[P2] P. Zulian, **A. Kopaničáková**, M. Nestola, D. Ganellari, N. Fadel, J. VandeVondele, and R. Krause. Utopia: a Hardware Portable Library for Large Scale Simulations in Computational Geophysics. The Platform for Advanced Scientific Computing (PASC) Conference, 2022

[P3] P. Zulian, **A. Kopaničáková**, M. G. C. Nestola, and R. Krause. Open-source software library for non-conforming domain decomposition methods targeting computational energy. The Future Swiss Electrical Infrastructure (SCCER-FURIES) Annual Conference, 2019

[P4] P. Zulian, M. G. C. Nestola, **A. Kopaničáková**, and R. Krause. Fluid-structure interaction methods and software libraries for in-silico analysis of the aortic heart valve. Towards the Digital Twin (TRM) Forum, 2019

Other artefacts with documented use

Software:

UTOPIA	Open-source C++ embedded domain specific language designed for parallel non-linear solution strategies and finite element analysis. (Core developer) Link to repository
ROOK	Large-scale finite-element framework for (pressure-induced) phase-field fracture simulations. (Solo developer)
MultiscAI	Stochastic multilevel optimization framework for training ODE-based deep neural networks. (Solo developer)
Heart	Parallel framework for inverse problems in electrophysiology. (Contributor)