THERON GUO

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Github ◇ LinkedIn ◇ Google Scholar ◇ Personal webpage

EXECUTIVE SUMMARY

My research focuses on multiscale phenomena and their efficient numerical modeling in heat transfer and solid mechanics. I develop computationally efficient and rigorously certified numerical methods for applications in material design, optimization, and inverse problems. I believe these methods can significantly contribute to advancements in metamaterials, unlocking new possibilities for their design and functionality.

Keywords: Reduced Order Modeling, Gaussian Process Regression, Continuum Mechanics, PDEs, Finite Element Method, Metamaterials, Multi-scale Modeling, Deep Learning

EDUCATION

Eindhoven University of Technology, Netherlands Feb. 2020 - Feb. 2024
PhD in Computational Science

RWTH Aachen University, Germany Oct. 2017 - Nov. 2019
MSc in Computational Engineering Science, GPA: 4.0/4.0 (cum laude)

RWTH Aachen University, Germany Oct. 2013 - Sep. 2017
BSc in Computational Engineering Science, GPA: 3.7/4.0 (cum laude)

EXPERIENCES

Massachusetts Institute of Technology, United States Mar. 2024 - Current
Postdoctoral Associate *Prof. Anthony Patera*

· Project: Spatial and Temporal Multiscale Considerations in Heat Transfer Estimation Procedures
· Developing high-performance computing codes for conjugate heat transfer using the spectral element method, including large-scale dataset generation for machine learning and the investigation of time homogenization techniques

Eindhoven University of Technology, The Netherlands Feb. 2020 - Feb. 2024
PhD Candidate *Prof. Karen Veroy & Ondřej Rokoš, PhD*

· Project: Model Order Reduction Techniques in Two-Scale Solid Mechanics
· Developed and explored new methods for dimensionality reduction of multi-scale problems, utilizing machine learning techniques, such as principal component analysis, Gaussian process regression, autoencoders, etc.

RWTH Aachen University, Germany Jan. 2019 - Oct. 2019
Graduate Research Assistant *Prof. Stefanie Reese & Marie-Christine Reuvers, MSc*

· Project: A Thermomechanical Interface Formulation Describing Separation and Friction in Ceramic Matrix Composites
· Developed and employed a cohesive zone element formulation to model contact, friction and thermal effects in ceramic matrix composites which was implemented in the Finite Element software FEAP, and carried out simulations to validate the new formulation

University of Tokyo, Japan Apr. 2018 - Aug. 2018
Graduate Research Assistant *Prof. Muneo Hori & Prof. Lalith Wijerathne*

· Project: Isogeometric Analysis of Shell Structures
· Reviewed the concepts of isogeometrical analysis and shell theory, and implemented a framework in MATLAB

RWTH Aachen University, Germany Sep. 2017 - Dec. 2018
Graduate Research Assistant *Prof. Mikhail Itskov & Markus Hillgärtner, MSc*

· Project: Implementation of Biomechanical Material Models in ABAQUS Using Automatic Differentiation
· Implemented hyperelastic material models in the user subroutines VUMAT and UMAT, and explored automatic differentiation of material laws with the framework TAPENADE

University of British Columbia, Canada Jun. 2017 - Aug. 2017
Visiting International Research Student *Prof. Mauricio Ponga*

· Project: Fatigue Modeling of Additively Manufactured Heterogeneous Materials
· Employed peridynamics for crack simulations in LAMMPS, implemented a new algorithm to perform efficient fatigue cracking, and compared simulations with the analytical solution

RWTH Aachen University, Germany Mar. 2017 - Jun. 2017
Undergraduate Research Assistant *Dr. Julian Bock*

· Project: Trajectory Planning through Supervised Learning of a Regression Model using Recurrent Neural Networks
· Utilized LSTM neural networks to predict trajectories given the previous positions and an intended direction (left, straight, right), tested on a simulated dataset, generated in PTV Vissim, and a real dataset, created on the Aldenhoven Testing Center, and performed a hyperparameter optimization

Robert Bosch GmbH, Germany Aug. 2016 - Dec. 2016
Undergraduate Intern *Dr. Stefan Bühler*

· Project: Interdisciplinary Simulation and Optimization
· Worked with uncertainty quantification methods, such as non-intrusive spectral projection (NISP) and Monte-Carlo simulations, compared these methods for a few models, implemented a MATLAB/Python interface, and employed Ansys OptiSLang to perform genetic optimization

RWTH Aachen University, Germany Oct. 2014 - Aug. 2015
Undergraduate Research Assistant *Dr. Alexander Jaust*

· Wrote scripts in Python to automatically run simulations for a wide range of parameters, helped with visualizing the results in VTK format, and optimized existing solver code with respect to memory access in C++

OTHER EXPERIENCES

University of Tokyo, Japan Apr. 2018 - Aug. 2018
Exchange Program

Imperial College London, United Kingdom Oct. 2015 - Jun. 2016
ERASMUS+ Exchange Program

JOURNAL PUBLICATIONS

Published

1. Guo, T., Kouznetsova, V.G., Geers, M.G.D., Veroy, K., & Rokoš, O. "Reduced order modeling for second-order computational homogenization with applications to geometrically parameterized elastomeric metamaterials". International Journal for Numerical Methods in Engineering 126(1) (2025): e7604.
2. Sperling, S.O., Rokoš, O., Guo, T., Peerling, R.H.J., Kouznetsova, V.G., & Geers, M.G.D., "A comparative study of enriched computational homogenization schemes applied to two-dimensional pattern-transforming elastomeric mechanical metamaterials". Computational Mechanics (2024): 72(6).

3. Guo, T., Rokoš, O., & Veroy, K. "A reduced order model for geometrically parameterized two-scale simulations of elasto-plastic microstructures under large deformations". Computer Methods in Applied Mechanics and Engineering 418 (2024): 116467.

4. Guo, T., Silva, F.A.B., Rokoš, O., & Veroy, K. "Learning constitutive models from microstructural simulations via a non-intrusive reduced basis method: Extension to geometrical parameterizations". Computer Methods in Applied Mechanics and Engineering 401 (2022): 115636.

5. Guo, T., Rokoš, O., & Veroy, K. "Learning constitutive models from microstructural simulations via a non-intrusive reduced basis method". Computer Methods in Applied Mechanics and Engineering 384 (2021): 113924.

In preparation

6. Guo, T., Kaneko, K., Le Bris, C., & Patera, A. "Homogenization in time applied to the Robin heat equation".

7. Guo, T., Le Bris, C., & Patera, A. "Data-Driven Classification and Length Scale Selection for Heat Transfer Correlations".

CONFERENCE PROCEEDINGS

1. Hillgärtner, M., Guo, T., & Itskov, M. "Automatic differentiation of strain-energy functions in the context of user-defined materials for the FEM." PAMM 20.1 (2021): e202000050.

CONFERENCE TALKS

1. "Reduced order modeling for second-order computational homogenization", 10th GACM Colloquium on Computational Mechanics, September 10 – September 13, 2023

2. "Efficient Two-Scale Simulations of Geometrically Parameterized Elasto-Plastic Microstructures", XVII International Conference on Computational Plasticity, Fundamentals and Applications, September 5 – September 7, 2023

3. "A Reduced Order Model for Geometrically Parameterized Two-Scale Simulations", X International Conference on Coupled Problems in Science and Engineering, June 5 – June 7, 2023

4. "Hyper-reduction of geometrically parameterized nonlinear microstructures", Model Reduction and Surrogate Modeling (MORE), September 19 – September 23, 2022

5. "Accelerating geometrically parameterized nonlinear microstructures via a reduced basis method and hyper-reduction", Gesellschaft für angewandte Mathematik und Mechanik, August 15 – August 19, 2022

6. "A PDE-Based Transformation Method for Model Order Reduction of Nonlinear Geometrically Parameterized Microstructures", 15th World Congress on Computational Mechanics, July 31 – August 5, 2022

7. "Accelerating geometrically parameterized nonlinear microstructures via a non-intrusive reduced basis method", 8th European Congress on Computational Methods in Applied Science and Engineering, June 5 – June 9, 2022

8. "A reduced basis method for accelerating parameterized non-linear microstructures", Meeting Materials Conference, April 5, 2022

9. "Accelerating two-scale simulations with a non-intrusive reduced order model", VIII Conference on Mechanical Response of Composites, September 22 – September 24, 2021

10. "Learning Constitutive Models with a Non-intrusive Reduced Basis Method ", 16th U.S. National Congress on Computational Mechanics, July 25 – July 29, 2021

11. "A non-intrusive reduced basis method for computational homogenization", VI ECCOMAS Young Investigators Conference, July 7 – July 9, 2021

12. "A Non-Intrusive Reduced Basis Method for Accelerating Two-Scale Simulations", IX International Conference on Coupled Problems in Science and Engineering, June 13 – June 16, 2021

WORKSHOPS

MFO, Oberwolfach, Germany Apr. 2025
Computational Multiscale Methods

IMSI, Chicago, United States Jan. 2025
Reduced-Order Modeling for Complex Engineering Problems

CIRM, Marseille, France Jul. 2023
CEMRACS 2023 on Scientific Machine Learning

University of Potsdam, Potsdam, Germany Mar. 2022
SFB1294 Spring School on Data Assimilation

Tsinghua University, Peking, China Jul. 2016
Summer School on Big Data

AWARDS & ACHIEVEMENT

MORTECH 2023 – Best poster award

SFB1294 Fellowship – Scholarship for spring school on Data Assimilation

DAAD PROMOS – Scholarship for exchange semester at the University of Tokyo

RWTH Aachen University Dean's List 2017/2018 – Top 5% students in a year

DAAD RISE – Scholarship for research internship at the University of British Columbia

TEACHING

Eindhoven University of Technology, The Netherlands
Teaching Assistant

· Linear Algebra (2DL60), dr. Rik Kaasschieter Sep. 2022 – Nov. 2022
· Advanced Calculus for CEC (6A3X0), Georgios Skantzaris, MSc Nov. 2021 – Jan. 2022
· Advanced Calculus (2DBN10), dr. Georg Prokert Sep. 2021 – Nov. 2021
· Advanced Calculus for CEC (6A3X0), Georgios Skantzaris, MSc Nov. 2020 – Jan. 2021

Supervised Students

· Eren Fidan (2023), Bachelor End Project
  Title: Design space dimensionality reduction for shape optimization
· Ezgi Köse (2023), Internship Project
  Title: Machine learning-based prediction for constitutive model of microstructural composites

TECHNICAL STRENGTHS AND LANGUAGES

Programming Languages	Python, MATLAB, Julia, C++, FORTRAN
Python Packages	NumPy, SciPy, PyTorch, GPy, Keras
Softwares	ABAQUS, LaTeX, Paraview, Gmsh, LAMMPS, Microsoft Office
Languages	English (Fluent), German (Native), Chinese (Native), Dutch (Beginner), Japanese (Beginner)