University of Stuttgart
Institute of Applied Mechanics (CE)   DAE   LEUPHANA
UNIVERSITY OF LÜNEBURG   Helmholtz-Zentrum
Geesthacht

GAMM

6th GAMM AG Data Workshop

October 20th-21st, 2020

Final Program

Online (ZOOM)

GAMM ACTIVITY GROUP DATA-DRIVEN MODELING AND NUMERICAL SIMULATION OF MICROSTRUCTURED MATERIALS

The GAMM AG Data aims at coordinating the activities of the members of the International Association of Applied Mathematics and Mechanics (GAMM) in the field of data-based modeling, simulation and analysis in the context of microstructured materials.

In recent years, the field of imaging based experimental methods has experienced significant technological improvements. For instance, the quality and the speed of computed tomography based imaging techniques have advanced considerably, while at the same time, X-ray computed tomography devices are now available in many research facilities. By virtue of the obtained three-dimensional images, microstructures of modern natural and artificial materials can be analyzed and used directly in numerical simulations. Incorporating three dimensional microstructure data is, however, highly non-trivial from a numerical point of view. Special data-processing techniques that are able to operate on billions of unknowns, are required. Developing algorithms and data processing techniques for processing three-dimensional data sets constitute major topics within the GAMM AG Data. Innovative image processing techniques for automatic phase segmentation and microstructure reconstructions are of equal importance.

Objectives of the Workshop

- To discuss the state of the art and recent trends in data-driven approaches
- Exchange between researchers in this field
- To plan the AG Data activities

Topics of the workshop

- data-supported modeling of the constitutive behavior of materials
- data-driven simulation techniques
- machine learning tools for materials engineering
- high-performance data-processing
- microstructure generation, simulation and analysis, e.g. via machine learning or AI tools

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Program

Tuesday, 20.10.2020 (ZOOM Link will be send to all participants before the workshop)

13:00-13:10   **Opening / Welcome**

13:10-14:00   F. Chinesta (keynote(invited) lecture)
Data-driven engineering and engineered data
PIMM Lab & ESI Group Chair, Arts et Metiers Institute of Technology

14:00-14:25   T. Titscher, I. C. Lima, J. F. Unger
Model selection and model calibration for a digital twin
Federal Institute for Materials Research and Testing

14:25-14:50   J. Kneifl, J. Fehr
Machine Learning Algorithms for Learning Nonlinear Terms of Reduced Mechanical Models in Explicit Structural Dynamic
Institute of Engineering and Computational Mechanics,University of Stuttgart

14:50-15:15   **Coffee break / Breakout Sessions**

15:15-15:40   S. Freitag, S. Peters, P. Edler, G. Meschke
Artificial neural networks for topology optimization considering polymorphic uncertainty
Institute for Structural Mechanics, Ruhr University Bochum

15:40-16:05   R. Eggersmann, L. Stainier, M. Ortiz, S. Reese
Model-free data-driven computing extended by tensor voting
Institute of Applied Mechanics, RWTH Aachen University

16:05-16:30   M. Fernández, J. Jamshidian, T. Böhlke, K. Kersting, O. Weeger
Bringing together material theory and machine learning for anisotropic hyperelastic material modeling of metamaterials
Cyber-Physical Simulation Group, Technical University of Darmstadt

16:30-17:00   **Coffee break / Breakout Sessions**

17:00-17:25   A. Mielke, T. Ricken
Exploring Design Spaces with Conditional Variational Autoencoders
Institute of Mechanics, Structural Analysis, and Dynamics of Aerospace Structures, University of Stuttgart

17:25-17:50   F. E. Bock, L. A. Blaga, B. Klusemann
Evaluation of Machine Learning Approaches for the Mechanical Property Prediction of Friction Riveting Joints consisting of Dissimilar Materials
Institute of Materials Research, Materials Mechanics, Helmholtz-Zentrum Geesthacht

17:50-18:15   J. Lißner, F. Fritzen
Modeling uncertainty in 3d-microstructure behaviour using machine learning
Data Analytics in Engineering, Institute of Applied Mechanics (CE), University of Stuttgart

18:15-18:45   next steps GAMM AG Data

18:45   **end of first day**

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Wednesday, 21.10.2020

09:00-09:25 M. Hodapp, A. Shapeev
In operando active learning of interatomic interaction during large-scale simulations
Skolkovo Institute of Science and Technology (Skoltech)

09:25-09:50 S. Keshav, F. Fritzen
Highly efficient multiphysics Fourier-Accelerated Nodal Solvers (FANS) for multiscale problems
Data Analytics in Engineering, Institute of Applied Mechanics (CE), University of Stuttgart

09:50-10:15 K.P. Abdolazizi, K. Linka, J. Sprenger, M. Neidhardt, A. Schlaefer, C.J. Cyron
Modeling Concentration-Specific Viscoelastic Behavior of Gelatin Based on Artificial Neural Networks
Department of Continuum and Materials Mechanics, Hamburg University of Technology

10:15-10:30 **Coffee break / Breakout Sessions**

10:30-10:55 J. Kuhn, M. Schneider, P. Sonnweber-Ribic, T. Böhlke
Fast and accurate generation of polycrystalline microstructures
Robert Bosch GmbH

10:55-11:20 C. Richert, N. Huber
Experimentally informed micromechanical modeling of nanoporous metals: From structural descriptors to predictive structure-property relationships
Institute of Materials Research, Materials Mechanics, Helmholtz-Zentrum Geesthacht

11:20-11:45 N. Magino, J. Köbler, H. Andrä, F. Welschinger, R. Müller, M. Schneider
A multiscale approach to the simulation of fatigue damage in short-fiber-reinforced polymers
Department Flow and Material Simulation, Fraunhofer Institute for Industrial Mathematics

11:45-12:00 **Coffee break / Breakout Sessions**

12:00-12:25 F. Ernesti, M. Schneider, S. Winter, D. Hug, G. Last, T. Böhlke
Characterizing digital microstructures by the Minkowski-tensor based QNT
Institute of Engineering Mechanics, Karlsruhe Institute of Technology (KIT)

12:25-13:00 S. Hermann (invited lecture)
Requirements for the management of research data
Stuttgart Center for Simulation Science (SimTech), University of Stuttgart

13:00-13:15 **Concluding Remarks / Closing**

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List of Participants

- M. Sc. Kian Abdolazizi, Hamburg University of Technology
- M. Sc. Shadi Alameddin, University of Stuttgart
- Dr. Heiko Andrä, Frauenhofer ITWM
- M. Sc. Dey Argha Protim, Robert Bosch GmbH
- M.Sc. Frederic E. Bock, Helmholtz-Zentrum Geesthacht
- Prof. Dr.-Ing. Thomas Böhlke, Karlsruhe Institute of Technology
- Prof. Francisco Chinesta, Arts et Métiers ParisTech
- M.Sc. Robert Eggersmann, RWTH Aachen University
- M.Sc. Felix Ernesti, Karlsruhe Institute of Technology
- M.Sc. Hannes Erdle, Karlsruhe Institute of Technology
- Dr.-Ing. Mauricio Fernández, Technical University of Darmstadt
- Dr.-Ing. Steffen Freitag, Ruhr University Bochum
- Prof. Dr.-Ing. Dipl.-Math. techn. Felix Fritzen, University of Stuttgart
- M.Sc. Sebastian Gajek, Karlsruhe Institute of Technology
- M.Sc. Johannes Görthofer, Karlsruhe Institute of Technology
- Dr. Sibylle Hermann, University of Stuttgart
- Prof. Dr.-Ing. Norbert Huber, Helmholtz-Zentrum Geesthacht & Hamburg University of Technology
- Max Hodapp, PhD., Skolkovo Institute of Science and Technology
- M.Sc. Dominik Horny, Karlsruher Institut für Technologie (KIT)
- Dr. Matthias Kabel, Fraunhofer ITWM
- Dipl.-Ing. Karl Kalina, TU Dresden
- M.Sc. Sören Keller, Helmholtz-Zentrum Geesthacht
- M. Sc. Sanath Keshav, University of Stuttgart
- Prof. Dr.-Ing. Benjamin Klusemann, Leuphana University Lüneburg & Helmholtz-Zentrum Geesthacht
- M.Sc. Jonas Kneifl, University of Stuttgart
- M.Sc. Maximilian Krause, Karlsruhe Institute of Technology
- MSc. Jannick Kuhn, Robert Bosch GmbH
- Dr.-Ing. Tom-Alexander Langhoff, Karlsruhe Institute of Technology
- M. Sc. Julian Lißner, University of Stuttgart
- M. Sc. Nicola Magino, Fraunhofer ITWM
- Dipl.-Phys André Mielke, University of Stuttgart
- Dr. Tarkes Dora Pallicity, Karlsruhe Institute of Technology
- M.Sc. Erik Prume, RWTH Aachen University
- M.Sc. Dominik Pöltl, Leuphana University of Lüneburg
- Dipl.-Ing. Alexander Raßloff, TU Dresden
- M.Sc. Claudia Richert, Helmholtz-Zentrum Geesthacht
- Prof. Dr.-Ing. Tim Ricken, University of Stuttgart
- Dr. Frank Sarfert, Robert Bosch GmbH
- M.Sc. Berta Pi Savall, University of Stuttgart
- Dipl.-Ing. Martha Seiler, TU Dresden

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- Prof. PD Dr.-Ing. Katrin Schulz, Karlsruhe Institute of Technology & Hochschule für Technik und Wirtschaft Karlsruhe
- M. Sc. Marlon Suditsch, University of Stuttgart
- Dr. Thomas Titscher, Federal Institute for Materials Research and Testing (BAM)
- Dr.-Ing. Fabian Welschinger, Robert Bosch GmbH
- M. Sc. Kolja Zoller, Karlsruhe Institute of Technology

Organizers

- Prof. Dr.-Ing. Benjamin Klusemann

  Institute of Product and Process Innovation, Leuphana University of Lüneburg

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  https://www.leuphana.de/institute/ppi.html

  https://www.hzg.de/institutes_platforms/materials_research/materials_mechanics/solid_state_joining_processes/index.php.en

- Prof. Dr.-Ing. Dipl.-Math.techn. Felix Fritzen

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