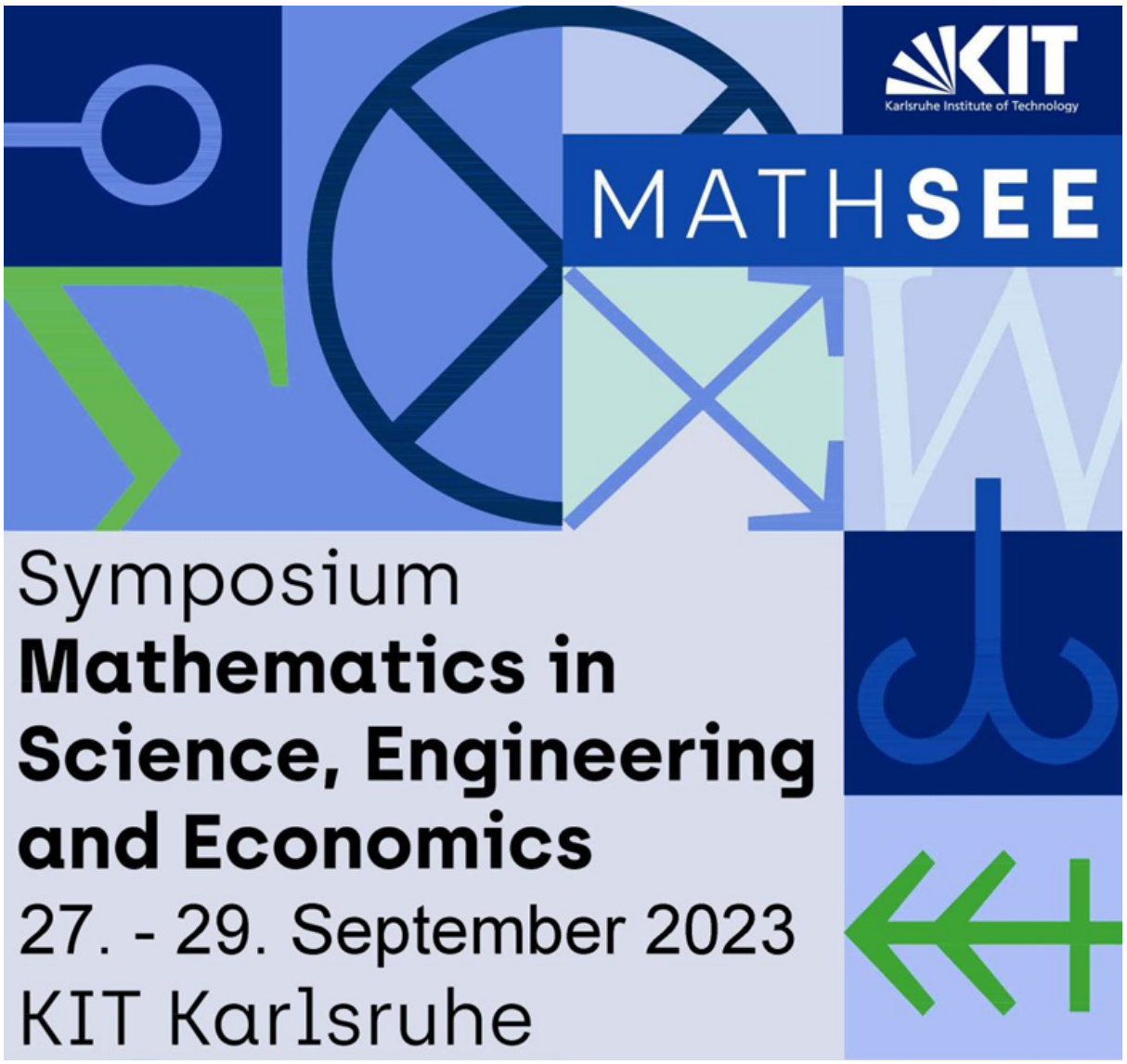
Karlsruher Institut für Technologie

MATHSEE



https://symposium.mathsee.kit.edu/

Welcome to the MathSEE Symposium 2023 | Mathematics in Sciences, Engineering and Economics at KIT

Foreword by Prof. Martin Frank, Scientific Speaker of KIT Center MathSEE

Right at the foundation of the KIT Center MathSEE in 2018, the core principles guiding the workings of MathSEE became evident; namely excellence in interdisciplinary research through generation of projects, co-equal working topics for mathematicians and SEE scientists and the support of next generation, early career scientists.

The Symposium on Mathematics in Sciences, Engineering and Economics helps us achieve these goals through networking scientists together and providing a platform for discussion, exchange and growth in research that requires both a strong background in a disciplinary field and the mathematical sciences. It is therefore one of our key instruments.

Guided along 4 methodological tracks, the symposium in 2023 will include several topical mini symposia along the following method areas:

- Mathematical structures: Shapes, Geometry, Number Theory and Algebra
- Mathematical Modeling, Differential Equations, Numerics and Simulation
- Inverse problems and Optimization
- Stochastic Modeling, Statistical Data Analysis and Forecasting

A panel discussion and a poster session with a Best Poster Award will further build the highlights at the event. With more than 160 participants, 8 invited plenary speakers and 98 contributions on a two-day symposium, the symposium offers a rich and broad program.

We encourage you to scroll through the program in this book and through the webpages to identify your topics of interest and encourage you to actively suggest topics for mini-symposia in the next MathSEE Symposium in 2025.

In this spirit, we thank you for your interest, for your contributions, submissions and participation in the first in-person MathSEE Symposium. We hope you enjoy this event and become a part of the MathSEE community!

Sincerely yours,

Martin Frank

Contents

All information shown in this programme corresponds to the state at the time of online publication (15th September 2023).

For subsequent updates of the programme, please visit our website:
www.symposium.mathsee.kit.edu

Symposium Schedule - Short Overview

Wednesday 27/09/2023

13:00 - 15:00 Plenary Talk by Nancy Rodriguez / Alethea Barbaro

15:30 - 17:30 Parallel Sessions

17:30 - 20:00 Poster Session

Thursday 28/09/2023

08:30 - 10:30 Plenary Talk by Ulrich Bauer / Lori Ziegelmeyer

11:00 - 12:00 Parallel Sessions

13:15 - 15:15 Plenary Talk by Peter Maaß / Tristan van Leeuwen

15:45 - 17:05 Parallel Sessions

17:15 - 18:15 Panel Discussion: Opportunities and Challenges in Interdisciplinary Mathematical Research

Friday 29/09/2023

08:30 - 10:30 Plenary Talk by Thordis L. Thorarinsdottir / Johanna Ziegel

11:00 - 13:00 Parallel Sessions

Plenary Speakers

Johanna Ziegel

Johanna Ziegel is currently Professor of Applied Stochastics at the University of Bern (UniBe), Switzerland, and Visiting Scientist at the Heidelberg Institute for Theoretical Studies, Germany. She is Scientific Advisory Board Member of the Oeschger Centre for Climate Change Research at UniBe. In January 2024, she will join ETH Zurich, Switzerland, as a Professor of Statistics. Johanna obtained her PhD in 2009 at ETH Zurich, Switzerland. She held postdoctoral positions at the University of Melbourne, Australia, and at Heidelberg University, Germany, before joining UniBe in 2012 as an Assistant Professor tenure track. She is an elected ISI member and has been a Council Member of the Bernoulli Society. Currently she is part of the editorial board of Bernoulli, JASA: Theory & Methods, International Journal of Forecasting, and Journal of Financial Econometrics. In 2022, she won the Credit Swiss Award for Best Teaching at UniBe.

Talk: Isotonic distributional regression

Abstract: Isotonic distributional regression (IDR) is a nonparametric distributional regression approach under a monotonicity constraint. It has found application in statistical postprocessing of weather forecasts, as a generic method for uncertainty quantification, and is an integral part of distributional single index models. IDR has favorable calibration and optimality properties in finite samples. Furthermore, it has an interesting population counterpart called isotonic conditional laws that generalize conditional distributions with respect to σ-algebras to conditional distributions with respect to σ-lattices. In this talk, an overview of the theory and some applications of IDR are presented.

Peter Maaß

Peter Maass is professor for Applied Mathematics at the Center for Industrial Mathematics at University of Bremen since 1999. His main research areas include inverse problems, machine learning, parameter identification and since several years deep learning based on neural networks. Prof. Maass studied mathematics in Karlsruhe, Cambridge and Heidelberg and obtained his doctorate in 1988 from TU Berlin and his habilitation in mathematics from Saarland University in 1993. Peter Maass was a full professor for Numerical Analysis at University of Potsdam from 1993 -1999. He received calls for professorships from the Universities in Paderborn, Mainz, Linz, Kaiserslautern, and he spent several long term visits to Cambridge University, Berkeley, Lund and Paris VI.

Peter Maass was awarded an honorary doctorate by the University of Saarland, Germany in 2018. Prof. Maass is taking a leading role in numerous research projects, e.g. he is the speaker of the DFG-funded Research Training Group 2224 ‘Parameter Identification – Analysis, Algorithms, Applications’ and was the deputy speaker of the DFG-SFB 747 ‘Micro Cold Forming’. Peter Maass is presently the deputy chairman of the Committee for Mathematical Modeling, Simulation and Optimization (KoMSO), member of the Advisory Boards of the Interdisciplinary Center for Scientific Computing (IWR), Heidelberg, the BioTechMed Center, Graz, and the Helmholtz Imaging Platform HIP. Prof. Maass is (co)-author of more than 100 publications in peer-reviewed literature, three monographs and 27 book chapters. Peter Maass holds seven patents and patent applications.

Talk: Industrial parameter identification problems: From mathematical research to technology

Abstract: As a particular example for ‘mathematics as a technology’ we consider deep learning concepts for parameter identification problems. Parameter identification problems arise in many applications e.g. in medical imaging, process monitoring or applications in predictive maintenance. These applications are characterized by indirect measurements, i.e. data is collected from sensors and the state of the object under consideration is reconstructed or analyzed using this data.

The mathematical models in the background typically lead to ill-posed inverse problems, which require to solve systems of linear or non-linear equations. These models are never complete, hence, data driven approaches over a natural way for its solution. However, using off the shelf deep learning concepts based on neural networks fail due to the intrinsic ill-posedness of the underlying problem. These concepts can only be applied reliably based on a thorough mathematical analysis of the interplay between neural networks and the functional analytic properties of the model.

We will exemplify this first of all for the most widely used inverse problem, namely computerized tomography. However, the main emphasis is on industrial applications and we will report on one or two of our industrial collaborations (e.g. Bosch, Siemens, Ariane). Finally, we would like to add a few remarks on what it needs beyond mathematical research in order to develop a mathematical technology.

Thordis L. Thorarinsdottir

Thordis Thorarinsdottir is an associate professor of statistics and data science at the University of Oslo in Norway. Prior to joining the University of Oslo in March 2023 she was a chief research scientist and research leader for climate and environment at the Norwegian Computing Center in Oslo. She is also a co-leader of Climate Futures, a center for research-based innovation focusing on developing climate predictions to handle climate risk that launched in October 2020. In her research, she develops stochastic models and methods for the environmental sciences, with a special emphasis on uncertainty quantification, probabilistic prediction and model evaluation.

Talk: Predicting extreme events: probabilistic predictions and their evaluation

Abstract: Predictions for events with significant inherent uncertainty should be probabilistic in nature to convey information on the uncertainty associated with the outcome. This holds, in particular, for settings where the prediction is subsequently used by many different users to derive further predictions for both expected outcomes and associated risks. Examples of such predictions include weather and climate forecasts such as predictions of extreme precipitation and flooding. For predicting extreme events and assessing risk, the evaluation is complicated by a lack of substantial observation set due to the rarity of the outcome of interest. We will discuss the implications of this within the frameworks of proper scoring rules and consistent scoring functions.

Lori Ziegelmeyer

Lori Ziegelmeier is an Associate Professor in the Department of Mathematics, Statistics, and Computer Science at the private liberal arts school Macalester College in Saint Paul, Minnesota, USA. She completed her doctoral degree at Colorado State University in 2013 and has been at Macalester since. Her research interests are in geometric and topological data analysis, particularly focused on developing and applying tools to uncover the structure of data. She is passionate about actively engaging students in the classroom and incorporating undergraduate students into her research. She is a founder and steering committee member of the Women in Computational Topology network.

Talk: Capturing Dynamics of Time-Varying Data via Topology

Abstract: One approach to understanding complex data is to study its shape through the lens of algebraic topology. While the early development of topological data analysis focused primarily on static data, in recent years, theoretical and applied studies have turned to data that varies in time. A time-varying collection of metric spaces as formed, for example, by a moving school of fish or flock of birds, can contain a vast amount of information. There is often a need to simplify or summarize the dynamic behavior. One such method is a crocker plot, a 2-dimensional image that displays the (non-persistent but varying with scale) topological information at all times simultaneously. We discuss how this method has shown promise in a variety of contexts: to perform exploratory data analysis, to choose between two models of collective motion, and to investigate parameter recovery via machine learning.

Nancy Rodriguez

Nancy Rodriguez is an associate professor in the applied mathematics department at the University of Colorado, Boulder. She received her PhD from UCLA under the guidance of Prof. Andrea Bertozzi. She was an NSF postdoctoral fellow at Stanford University before moving to UNC Chapel Hill where she was assistant professor for four years. Rodriguez is interested in using mathematical tools, such as partial differential equations, to study collective behavior in social and ecological phenomena. In her spare time, Rodriguez enjoys biking, hiking, skiing, and the great outdoors.

Talk: A journey through the use of mathematical models to gain insight into ecological and sociological phenomena

Abstract: While mathematical models have classically been used in the study of physics and engineering, recently, they have become important tools in other fields such as biology, ecology, and sociology. In this talk I will discuss the use of partial differential equations and dynamical systems to shed light onto social and ecological phenomena. In the first part of this talk, we will focus on an Ecological application. For an efficient wildlife management plan, it is important that we understand (1) why animals move as they do and (2) what movement strategies are robust. I will discuss how reaction-advection-diffusion models can help us shed light into these two issues. The second part of the talk will focus on social applications. I will present a few models in the study of gentrification, urban crime, and protesting activity and discuss how theoretical and numerical analysis have provided intuition into these different social phenomena. Moreover, I will also point out the many benefits of utilizing a mathematical framework when data is not available.

Alethea Barbaro

Alethea Barbaro received her PhD in Mathematics with an Emphasis in Computational Science and Engineering in 2008 from the University of California, Santa Barbara. She spent four years as a postdoctoral scholar at UCLA before becoming an Assistant Professor at Case Western Reserve University in 2012. While there, she graduated three PhD students and earned tenure, becoming an Associate Professor in 2019. In 2020, she joined the Mathematical Physics group at TU Delft as a Delft Technology Fellow and Associate Professor. Alethea's research revolves around designing and analyzing interacting particle models for socially interacting organisms. She has modeled fish migration, gang rivalry formation, and gang territorial development, among other applications. She is particularly interested in particle models exhibiting phase transitions, and the partial differential equations arising from these models.

Talk: Interacting particle models in interdisciplinary mathematics

Abstract: Interacting particle models are a versatile and powerful tool in the context of interdisciplinary research. This modelling framework bridges the divide between mathematics and other fields, allowing the modeller to translate the expertise of scientists into a mathematically accessible form. Scientists can contribute directly to the model and evaluate its validity, while mathematicians are able to find emergent behaviour and offer insight into situations in which this behaviour occurs. This approach builds on the expertise of both parties and the process of model building in an of itself can inspire new science. Here, we will discuss off-lattice and lattice-based interacting particle models, their usefulness as a modelling framework, and the mathematical tools available to analyse them. In particular, we will consider models in the context of ecology, sociology, chemistry, and medicine.

Tristan van Leewen

Tristan van Leeuwen received his BSc. and MSc. in Computational Science from Utrecht University. He obtained his PhD at Delft University in 2010 on geophysical imaging. After spending 3 years as a postdoctoral researcher at the University of British Columbia in Vancouver, Canada and 1 year at the Centrum Wiskunde & Informatica in Amsterdam, the Netherlands, he returned to Utrecht University in 2014 as an assistant professor at the mathematical institute. For his contributions to the mathematics of seismic imaging he received the SIAM Geosciences Junior Scientist prize in 2015 and the SEG Karcher Award in 2017. In 2021, he became group leader of the computational imaging group at the Centrum Wiskunde & Informatica in Amsterdam. He has made contributions to computational methods and optimization algorithms for inverse problems arising in various applications, including seismic and medical imaging, and non-destructive testing.

Talk: Uncertainty Quantification in Large-Scale Inverse Problems — Challenges and Opportunities

Abstract: In an inverse problem, one tries to infer the cause of a measured effect. Such problems are ubiquitous in science and engineering, and well-known examples include medical imaging and non-destructive testing. The basic approach is to fit a parametrised mathematical model of the underlying process to measurements, using (non-linear) optimisation techniques. Mathematical analysis tells us that such problems are often ill-posed, and additional prior information is needed to make the problem well-posed. Casting this in a Bayesian framework then allows us to quantify uncertainty (UQ) in the resulting estimates. Computing these uncertainties is still a challenge for large-scale applications. Research in the past few years aims to exploit advances in machine learning (ML) and the abundance of available (training) data to solve inverse problems more efficiently and more accurately. With such data-driven techniques the line between the model and prior information is blurring, and one of the challenges is to incorporate the known physics of the system in traditional black-box ML models. In this talk, I will give an overview of some of the recent developments in this area and present results on Bayesian UQ in medical imaging with normalising flows.

Ulrich Bauer

Ulrich Bauer works in the field of applied and computational topology. He focuses on questions regarding the connectivity of data on multiple scales. This is global information, concerning the data as a whole, and inaccessible by traditional methods of data analysis. In addition to investigating the theoretical foundations of these methods, he also develops leading computational methods for the analysis of large-scale data sets.

After graduating in computer science at TUM, Bauer worked at FU Berlin and the University of Göttingen, where he gradueted in mathematics with distinction in 2011. After a postdoc at the Institute of Science and Technology Austria, he joined the faculty of TUM in 2014, establishing the novel research group for Applied and Computational Topology.

Bauer is a member of the executive board of the collaborative research center Discretization in Geometry and Dynamics, the advisory board of the Centre for Topological Data Analysis, the Munich Data Science Institute, and the Munich Center of Machine Learning. He serves as editor for the journals Foundations of Computational Mathematics (FoCM), Journal of Applied and Computational Topology (JACT), and SIAM Journal on Applied Algebra and Geometry (SIAGA).

Talk: Connect the dots: from data through complexes to persistent homology

Abstract: In this talk, I will survey some recent results on theoretical and computational aspects of applied topology. I will illustrate various aspects of persistent homology: its structure, which serves as a topological descriptor, its stability with respect to perturbations of the data, its computation on a large scale, and connections to Morse theory.

These aspects will be motivated and illustrated by concrete examples and applications, such as

- reconstruction of a shape and its homology from a point cloud,
- faithful simplification of contours of a real-valued function,
- existence of unstable minimal surfaces, and
- identification of recurrent mutations in the evolution of COVID-19.

Symposium Schedule - Detailed Overview

Contributed talks (15 + 5 min.) take place in parallel sessions and are organized by tracks:

- Shapes, Geometry, Number Theory and Algebra
- Mathematical Modeling, Differential Equations, Numerics, Simulation
- Inverse Problems, Optimization
- Stochastic Modeling, Statistical Data Analysis and Forecasting

Wednesday, September 27

<table>
<tr><td>12:00 - 13:00</td><td colspan="4">Registration and Welcome Coffee (Atrium, Mathematics Building)</td></tr>
<tr><td>13:00 - 15:00</td><td colspan="4">Plenary Talks: Mathematical Modeling, Differential Equations, Numerics, Simulation
Fritz-Haller Lecture Hall, Building 20.40

Chair: Wolfgang Reichel
Nancy Rodriguez: A journey through the use of mathematical models to gain insight into ecological and sociological phenomena

Chair: Björn de Rijk
Alethea Barbaro: Interacting particle models in interdisciplinary mathematics</td></tr>
<tr><td>15:00 - 15:30</td><td colspan="4">Coffee Break and Registration (Atrium, Mathematics Building)</td></tr>
<tr><td>15:30 - 17:30</td><td colspan="4">Contributed Talks (Mathematics Building CS 20.30)</td></tr>
<tr><td></td><td>Shapes, Geometry, Number Theory and Algebra I
Room 2.058
Chair: Andreas Ott

Andrei Comăneci: A tropical approach to consensus tree methods</td><td>Fluid dynamics
Room: 2.066
Chair: Björn de Rijk

Herlina Herlina: Unsteady flow and mass transfer induced by Rayleigh-Bénard-Marangoni Convection

Markus Scherer: On simple invariant</td><td>Mathematical modelling and control
Room: 2.067
Chair: Niklas Baumgarten

Natalya Zeinalova: Numerical modelling of lava dome evolution

Vladimir Turetsky: Robust capture pursuit based on differential games</td><td>Spatial Statistics, Machine Learning and Forecasting
Room 0.014
Chair: Friederike Becker

Jieyu Chen: Spatial representation learning for ensemble weather simulations using invariant variational autoencoders</td></tr>
</table>

	Enrique Fita Sanmartin: Algebraic Path Problems for Graph Metrics *Maxim Beketov*: Topologically Autoencoding Cognitive Maps	solutions in rectangular duct flows **Integrated Engineering of fiber reinforced polymers** Room: 2.066 Chair: Loredana Kehrer & Tobias Karl *Juliane Blarr*: Mathematical methods for fiber orientation tensor interpolation and microstructure generation based on X-ray images of carbon fiber reinforced polymers *Tobias Karl*: Implicit fiber orientation tensor closures *Loredana Kehrer*: Viscoelastic modeling of PA6 under hydrothermal influences *Benedikt Sterr*: FFT-based homogenization and modeling of the viscosity of fiber suspensions	**Simulation techniques and software packages** Room: 2.067 Chair: Mehdi Elasmi *Fabian Castelli*: MESHFREE Simulations for Industrial Applications *Paulami Banerjee*: Machine Learning-Optimized Approach for Parameter Selection in MESHFREE Simulations: Enhancing Accuracy and Efficiency *Giorgio Taverna*: Neural network simulation for stiff ODEs representing chemical mechanisms	*Peter Schaumann*: Generating Synthetic Rainfall Fields by R-vine Copulas Applied to Seamless Probabilistic Predictions *Matthias Fischer*: Enhanced Universal Kriging for Uncertainty Quantification and Parameter Optimization: Application to West African Monsoon Simulations *Ghulam Qadir*: Deep Learning for Spatial Statistics via Neural Tangent Kernels *Benedikt Schulz*: Aggregating distribution forecasts from deep ensembles *Marius Puke*: Testing components of Mincer-Zarnowitz-regression based score decompositions
17:30 - 20:00	**Poster Session with Snacks and Drinks** Atrium, Mathematics Building			

List of Posters

#	Presenter	Title
1	Yossi Bleile	(WITHDRAWN) Microstructure analysis using geometric and topological data analysis
2	Julius Jeßberger	Numerical optimization of a micromixer
3	Maximilian Kruse	Large-Scale Statistical Inverse Problems Governed by PDEs
4	Annalena Albicker	Monotonicity in inverse scattering for Maxwell’s equations
5	Laura Stengel	Stable finite element approximations for cardiac elastomechanics
6	Folke Rolf	Mimicking Cochlea Processing using Critically Coupled MEMS Sensors

7	Niklas Baumgarten	The Finite Element Library M++
8	David Schneiderhan	Optimal control of elliptic PDEs under uncertainties using SGD and ADAM
9	Lukas Bengel	Pinning in an extended Lugiato-Lefever model
10	Chinmay Patwardhan	Asymptotic-Preserving Dynamical Low-Rank Approximation for Simulation of Marshak Waves
11	Mariia Sukhova	Map of transmission coefficients for open bent waveguides with constant curvature
12	Raphael Schoof	Simulation of the Deformation for Cycling Chemo-Mechanically Coupled Battery Active Particles with Mechanical Constraints
13	Markus M. Knodel	Fully 3D spatio-temporal resolved models of virus replication evaluated at realistic reconstructed cell geometries
14	Damaris Mulwa	A Machine learning algorithm for Rift Valley fever outbreaks prediction and classification in Kenya
15	Christopher Bülte	Uncertainty quantification for data-driven weather models
16	Attila Genda	Study of random w-trees and automaton synchronization
17	Kristof Kraus	Analysis of Earthquake Forecasting in Italy
18	Jannik Wilhelm	TEEMLEAP - A new TEstbed for Exploring Machine LEarning in Atmospheric Prediction
19	Han Cao	(WITHDRAWN) dsLassoCov: a federated Lasso approach incorporating covariate control
20	Max Thannheimer	Bayesian inference for functional extreme events defined via partially unobserved processes
21	Jaroslav Borodavka	Robust Data-Driven Coarse-Graining for Surrogate Modeling
22	Nils Koster	MS/MS Prediction in Metabolomics with Kernels
23	Mingliang Zhong	Generalized polynomial chaos based Lattice Boltzmann method
24	Lea Kunkel	A Wasserstein perspective of Vanilla GANs
25	Annette Möller	D-Vine Copula based Postprocessing of Wind Speed Ensemble Forecasts
26	Lukas Wermuth	Correlation Coefficients for Discrete Random Variables

Thursday, September 28

08:30 - 10:30	**Plenary Talks: Shapes, Geometry, Number Theory and Algebra** Fritz-Haller Lecture Hall, Building 20.40 Chair: Andreas Ott *Ulrich Bauer*: Connect the dots: from data through complexes to persistent homology *Lori Ziegelmeier*: Capturing Dynamics of Time-Varying Data via Topology			
10:30 - 11:00	**Coffee Break and Registration** (Atrium, Mathematics Building)			
11:00 - 12:00	**Contributed Talks** (Mathematics Building, CS 20.30)			
	Shapes, Approximations and Optimisation I Room 0.014 Chair: Christian Füllner *Hoang Truong-Vinh*: Efficient A-Optimal Bayesian Experimental Design using Projection-Based Conditional Expectation Approximation (PACE) *Damián-Emilio Gibaja-Romero*: On the Uniqueness of Equilibrium Prices in a Bayesian Assignment Game *Hossein Moosaei*: Exploring Challenges and Advancements in Absolute Value Equations	**Simulation of lithium ion batteries** Room 2.066 Chair: Fabian Castelli *Raphael Schoof*: Efficient Simulation of Chemo-Elastic-Plastically Coupled Battery Active Particles *Mehdi Elasmi*: A PINN-based LOD for the solution of multiscale problems *Falco Schneider*: Microstructure Simulation of Lithium-Ion Battery Degradation due to Solid Electrolyte Interphase Growth	**Forecast Evaluation: Theory** Room 2.058 Chair: Fabian Krüger *Clement Dombry*: Characterization of translation invariant MMD on R^d and connections with Wasserstein distances *Johannes Resin*: Quantile-based approximation and decomposition of the Cramér distance *Andreas Eberl*: Asymptotics and Asymmetries of the Coefficient of Predictive Ability (CPA): Bridging Correlation and Discrimination Ability	**Health Statistics** Room 2.059 Chair: Johannes Bracher *Amira Meddah*: A stochastic hierarchical model for low grade glioma evolution *André Victor Ribeiro Amaral*: Extended Excess Hazard Models for Spatially Dependent Survival Data *Daniel Wolffram*: Collaborative nowcasting of COVID-19 hospitalization incidences in Germany
12:00 - 13:15	**Lunch Break**			
13:15 - 15:15	**Plenary Talks: Inverse Problems, Optimization** Fritz-Haller Lecture Hall, Building 20.40 Chair: John Alasdair Warwicker *Peter Maaß*: Industrial parameter identification problems: From mathematical research to technology			

	Tristan van Leeuwen: Uncertainty Quantification in Large-Scale Inverse Problems — Challenges and Opportunities			
15:15 - 15:45	**Coffee Break and Registration** (Atrium, Mathematics Building)			
15:45 - 17:05	**Contributed Talks** (Mathematics Building CS 20.30)			
	Shapes, Approximations and Optimisation II Room 0.014 Chair: Markus Gabl *Marvin Knöller*: Maximizing the electromagnetic chirality for metallic nanowires in the visible spectrum *Raphael Schurr*: Optimal design of obstacles with respect to their electromagnetic chirality *Markus Gabl*: Concave tents: a new tool for optimizing nonlinear convex functions over nonconvex sets	**Experiments in small scale fluid dynamics** Room 2.066 Chair: Bettina Frohnapfel *Iliya Stoev*: Phase-Sensitive, Active Microrheology via Probe-Free Application of Thermoviscous Flows *Christian Sax*: Simulation of 3D Interferometric Particle Imaging Experiments for the Measurement of Multi-Phase Flows *Clarissa Schönecker*: Modeling flow and slip over superhydrophobic and liquid-infused surfaces via a constant-shear boundary condition *Sebastian Zimmermann*: Modeling flow through slippery pipes – A modernized approach to Philip's classic solution	**Forecast Evaluation: Methods** Room 2.058 Chair: Marc Pohle *Sam Allen*: Assessing the calibration of multivariate probabilistic forecasts *Tanja Zahn*: Uncertainty Quantification in Forecast Comparisons *Lotta Rüter*: Direction Augmentation in the Evaluation of Armed Conflict Predictions	**Mathematical Statistics and Stochastic Processes** Room 2.059 Chair: Andreas Eberl *Sebastian Krumscheid*: Multilevel Monte Carlo methods for parametric expectations: distribution and robustness measures *Maximilian Steffen*: Statistical guarantees for stochastic Metropolis-Hastings *Sebastian Höfer*: Continuous-time Mean Field Markov Decision Models
17:15 - 18:15	**Panel Discussion, followed by Symposium Dinner (starting 18.45h)** **"Opportunities and Challenges in Interdisciplinary Mathematical Research"** Atrium, Mathematics Building **Panelists**: *Alexander Dyck,* Representative of the MathSEE doctoral students, KIT *Tristan van Leeuwen,* Centrum Wiskunde & Informatica Amsterdam *Bernadette Stolz-Pretzer*, École Polytechnique Fédérale de Lausanne *Alexandria Volkening,* Purdue University *Marc Weber*, Head of the KIT-Division Mathematics and Physics, KIT **Moderator**: *Martin Frank,* Scientific Speaker MathSEE, KIT			

Friday, September 29

<table>
<tr><td>08:30 - 10:30</td><td colspan="5">Plenary Talks: Stochastic Modeling, Statistical Data Analysis and Forecasting
Fritz-Haller Lecture Hall, Building 20.40
Chairs: Sebastian Lerch & Julian Quinting

Thordis Thorarinsdottir: Predicting extreme events: probabilistic predictions and their evaluation

Johanna Ziegel: Isotonic distributional regression

Best Poster Award</td></tr>
<tr><td>10:30 - 11:00</td><td colspan="5">Coffee Break and Registration (Atrium, Mathematics Building)</td></tr>
<tr><td>11:00 - 13:00</td><td colspan="5">Contributed Talks (Mathematics Building)</td></tr>
<tr><td></td><td>Shapes, Geometry, Number Theory and Algebra II
Room 0.014
Chair: Andreas Ott

Geert Verdoolaege: Geodesic Least Squares: Robust Regression Using Information Geometry

Dhananjay Bhaskar: Capturing Spatiotemporal Signaling Patterns in Cellular Data with Geometric Scattering Trajectory Homology

Fanqi Meng: Intersection properties of Brownian motion</td><td>Inverse Problems
Room 2.066
Chair: Lukas Pieronek

Maria Paszkiewicz: Approximation methods for fast calculation of transmission in multimode waveguides

Oliver Kuster: Inverse design of polariton cavities

Erik Bründermann: Solving inverse problems posed by laser and particle accelerator diagnostics – what we can and what we need – an application-centered perspective

Lukas Pieronek: Full Waveform inversion and</td><td>Analysis of nonlinear physical systems
Room: 2.067
Chairs: Ivan Fernandez-Corbaton and Nasim Shafieeabyaneh

Ivan Fernandez-Corbaton: A Scalar Product for Computing Fundamental Quantities in Matter

Maxim Vavilin: Polychromatic T-Matrix: Group-theoretical Perspective and Applications

Attila Genda: Cross-Correlation and Averaging: An Equivalence Based on the Classical Probability Density

Anju Saini: Computing the flow of a dusty fluid in a Circular pipe with a porous medium

Markus M. Knodel: Application of fully</td><td>Machine Learning for Weather and Climate Modelling
Room: 2.058
Chair: Annette Möller

Maybritt Schillinger: Machine Learning for High-Resolution Climate Projections: Generative Models Meet Proper Scoring Rules

Manuel Baumgartner: Forecasting lightning probabilities derived from the Lightning Potential Index using neural networks

Cristina Primo Ramos: Comparison of Model Output Statistics and Neural Networks to postprocess wind gusts

Fabian Mockert: Multivariate post-processing of sub-seasonal</td><td>Statistical Methods in Economics
Room 2.059
Chair: Lotta Rüter

Fabian Krüger: Prediction intervals for economic fixed-event forecasts

Friederike Becker: Uncertainty Quantification for Macroeconomic Panel Forecasts

Stefan Großkinsky: Wages and capital returns in a generalized Pólya urn

Maximilian Diehl: Compression and Simulation of Large Insurance Portfolios with New Business

Philipp Geiger: On Mathematical</td></tr>
</table>

		mathematical challenges *Kevin Ganster*: Linear seismic imaging and approximate inversion *Linus Seelinger*: Enabling Uncertainty Quantification in Scientific Applications	implicit Nested Newton solvers to multicomponent multiphase flow in porous media and to elastoplastic deformations of biological tissue *Nasim Shafieeabyaneh*: A high-order numerical method for solving non-periodic scattering problems in three-dimensional bi-periodic structures	weather regime forecasts *Selina Kiefer*: Combining physical knowledge and statistical models to forecast weather on subseasonal timescales *Nina Horat*: Deep learning for post-processing global probabilistic forecasts on sub-seasonal time-scales	Guarantees in Machine Learning for Safe Autonomous Driving
13:00	**End of the Symposium**				

Campus Plan KIT

Venues and Travel

MathSEE Symposium 2023 will take place on the KIT campus (website: https://www.kit.edu/campusplan).

The registration, poster session and panel discussion will take place in KIT building 20.30, Department of Mathematics, Atrium.

The plenary talks and contributed talks will take place in KIT building 20.40, Department of Architecture:

- Fritz-Haller Lecture Hall
- Egon-Eiermann Lecture Hall

The KIT campus is centrally located within Karlsruhe and can be reached conveniently by public transportation or by car.

By Private Transportation: If you are travelling by car, parking places are available at:

- Parking Garage at the Karlsruhe Castle (Am Schlossplatz 76131 Karlsruhe)
- Parking Garage at Waldhornstraße (Zirkel 2, 76131 Karlsruhe)

By Public Transportation: If you are travelling by tram, destination stops are:

- Durlacher Tor / KIT Campus South
- Kronenplatz (U)

The exact departure times can be found on the Karlsruhe Verkersverbund (KVV) website: https://www.kvv.de/en/index.html

Symposium - General Information

Welcome Desk
The welcome desk opens from 12:00 on Wednesday 27th September in the Atrium of the Mathematics building (20.30), and will remain open between sessions throughout the symposium. Please register at the welcome desk at your earliest convenience.

Network Connection
Access to the *eduroam* network is guaranteed at all locations on the campus. For more information, please visit: https://eduroam.org/.

Further, at many places in Karlsruhe (including at KIT), the WLAN networks *KA-WLAN* (unencrypted) and *KA-sWLAN* (encrypted) are available and may be used free of charge. For more information, please visit: https://www.ka-wlan.de/info_en.html

Social Program
Coffee breaks
We will serve coffee, tea, non-alcoholic beverages and snacks during the coffee breaks (see the program overview).

Lunch breaks
Many lunch options are available around the symposium venue. The KIT-Mensa building 01.13 is shown on the campus plan. A wide variety of meals are available, including vegetarian and vegan options (expected price - 10€).
For full menu options, see: https://www.sw-ka.de/de/hochschulgastronomie/speiseplan/mensa_adenauerring/
Note: the cost for lunch is not covered by the registration.

Poster Session
There will be a poster session in the Atrium of the Mathematics building (20.30) on Wednesday from 17:30 - 20:00. Snacks and drinks will be available for registered participants.

Panel Discussion
The panel discussion will take place in the Atrium of the Mathematics building (20.30) on Thursday from 17:15 - 18:15. This will be followed by snacks and drinks for registered participants.

Theme:
"Opportunities and Challenges in Interdisciplinary Mathematical Research"

Panelists:
Alexander Dyck, Representative of the MathSEE doctoral students, KIT
Tristan van Leeuwen, Centrum Wiskunde & Informatica Amsterdam
Bernadette Stolz-Pretzer, École Polytechnique Fédérale de Lausanne
Alexandria Volkening, Purdue University
Marc Weber, Head of the KIT-Division Mathematics and Physics, KIT

Moderator:
Martin Frank, Scientific Speaker MathSEE, KIT