Nasjonalt matematikermøte 2026

10.–11. september, 2026
Trondheim, Norge

Plenumsforedrag

Speaker: Helge Holden (NTNU)

Title: *What are the compact sets in Lebesgue and Bochner spaces?*

Time slot: *Thursday, 10:00–10:45*
Room: *Trondhjemssalen 2*

Abstract:

Compactness in Lebesgue spaces is fully characterized by the classical Kolomogorov–Riesz theorem. We present how this theorem and the classical Arzelà–Ascoli theorem can be derived from a very elementary lemma. Furthermore, we show that one of the conditions of the Kolomogorov–Riesz theorem is redundant.

Next we ask the same question in Bochner spaces. Here we discuss how we can derive the Aubin–Lions–Dubinskii theorem on compactness in Bochner spaces in this setting. We will briefly discuss very recent extensions to other compactness results.

Speaker: Boris Kruglikov (UiT)

Title: *Conformal geodesics: geometry, variationality, dynamics*

Time slot: *Thursday, 10:45–11:30*
Room: *Trondhjemssalen 2*

Abstract:

Conformal geodesics constitute an analog of metric geodesics in conformal geometry. It appeared in general relativity in relation to asymptotic and near horizon geometry. Contrary to the standard theory, conformal geodesics are governed by third order differential equations, which make their geometry more complicated. For physical reasons, it is important to understand whether the equations satisfy the principle of minimal action. I will discuss this as a part of the inverse problem of the calculus of variations (joint work with Vladimir Matveev and Wijnand Steneker), and also of the invariant Euler-Lagrange theory (joint work with Eivind Schneider and Wijnand Steneker). Finally, I will mention an ongoing project (joint with Andrzej Maciejewski, Maria Przybylska, Wijnand Steneker) on integrability of the conformal flow dynamics.

Speaker: Evrim Acar (Simula)

Title: *(Coupled) Tensor Factorizations – as a tool to develop knowledge-guided, data-driven methods for extracting insights from complex data: Models, Algorithms & Applications*

Time slot: *Thursday, 15:00–15:45*
Room: *Trondhjemssalen 2*

Abstract:

To gain insights about complex systems such as the human brain and human metabolome, and to detect early risk factors for various diseases, we often face the challenge of analyzing longitudinal, multimodal data and revealing interpretable patterns. For instance, how can we analyze metabolomics measurements of blood samples collected over time during a meal challenge test and capture the underlying patterns which may reveal markers of various phenotypes? How to jointly analyze such data with other datasets such as other omics data? How to reveal subject-specific temporal patterns? How to inform our analysis with prior information encapsulated in computational models of human metabolism?

Multivariate measurements collected from multiple subjects over time can often be represented as a third-order tensor (also referred to as a multiway array). Tensor factorizations have been successfully used to reveal the underlying patterns from such higher-order datasets in many domains, and have been extended to joint analysis of multimodal data through coupled tensor factorizations. In this talk, we will discuss the recent progress in terms of models and algorithms in (coupled) tensor factorizations. We will also discuss how we can use (coupled) tensor factorizations as a general framework to extract interpretable patterns from longitudinal and/or multimodal data, and to develop knowledge-guided methods bringing together data and computational models. Throughout the talk, we will cover applications from different fields, in particular, focusing on metabolomics and neuroimaging data analysis.

Speaker: Helge Ruddat (UiS)

Title: *Clusters, Twistors and Stability*

Time slot: *Friday, 13:45–14:30*
Room: *Trondhjemssalen 2*

Abstract:

I explain ongoing work with Tom Bridgeland where we construct a holomorphic twistor family for a finite type quiver. Its fibers relate very different spaces that are often associated to a quiver: a cover of the cluster X variety is the general fiber while the stability manifold of the derived category of the quiver gives the special fiber. The mechanics that allows us to place them in a holomorphic family is a continuous tropicalization process. We will look at the elementary example of the A_2 quiver where the twistor family is governed by the cubic oscillator. The twistor space is of interest because it encodes Donaldson-Thomas invariants and is expected to produce a Joyce structure.

Parallelle foredrag 1

Speaker: Guttorm Alendal (UiB)

Title: *When Mathematics Meets Society: Models, Data and Lessons from MATH4SDG*

Time slot: *Thursday, 13:00–13:45*
Room: *Trondhjemssalen 2*

Abstract:

Mathematics is a field in its own right. Many mathematical questions arise from within the discipline and are pursued without an application in mind. That is as it should be. I am an applied mathematician, however, and I am interested in what happens when we try to use mathematics on problems coming from society.

The main difficulty is not always solving the model. It can begin much earlier. What is the problem we should formulate? Do the data we need exist, and can we get access to them? And if the mathematics produces an answer, how can that answer reach those who might use it?

MATH4SDG is a collaboration between the University of Dar es Salaam, Makerere University, and the University of Bergen. Eleven PhD candidates are working in applied mathematics statistics, and mathematics education. Their topics span from developing models for infectious diseases to research connected to the teaching and learning of mathematics in schools.

More recently, we've initiated a separate project centered around Lake Victoria. This initiative emerged from recognizing the cross-disciplinary research opportunities associated with the lake and its surrounding region, involving mathematics, environmental sciences, and several other fields. Additionally, it raises questions about the availability of data and the potential for collaboration among researchers and institutions from diverse disciplines and countries. This is particularly relevant given the rapid advancements in machine learning and data science methods we are currently experiencing. Not everything in MATH4SDG has gone as planned. Access to health data has been particularly difficult. Meetings with industry and other stakeholders have also reminded us that we need to listen before deciding what mathematics to offer. The problem as they see it may not be the problem we first had in mind.

I'll share some of my experiences, including what has worked and what hasn't. I'll also talk about the importance of data, trust, and long-term relationships. Finally, I'll discuss whether CoRE-MATH, the emerging Africa–Europe Cluster of Research Excellence in Mathematics, can help sustain some of the collaboration after MATH4SDG concludes.

Speaker: Ulrik Skre Fjordholm (UiO)

Title: *The zero-noise limit for hyperbolic conservation laws*

Time slot: *Thursday, 13:00–13:45*
Room: *Lilleby*

Abstract:

Over the past two decades, the phenomenon of regularization by noise has received an enormous amount of attention. Put simply, this is a general phenomenon in which a stochastic differential equation might exhibit better properties – e.g., existence or uniqueness of solutions, or increased regularity – compared to its deterministic counterpart. An early example is the seminal work of Flandoli, Gubinelli & Priola (Inventiones Mathematicae, 2010), where the authors prove that a specific stochastically perturbed transport equation is well-posed even for very irregular (Hölder-continuous) velocity fields.

The purpose of this work is threefold. First, we design a novel stochastical perturbation of general scalar conservation laws, and prove that this SPDE is well-posed, without imposing any entropy conditions. Second, we show that there is sufficient compactness to pass the noise parameter to zero. Third, we use a novel stability property of scalar conservation laws to prove that the zero-noise limit is in fact the entropy solution of the deterministic problem. In this way, the addition of (a vanishing amount of) noise acts as a selection mechanism, which coincides with the standard entropy conditions.

This is joint work with Ola Mæhlen (Université Paris-Saclay) and Magnus Ch. Ørke (University of Oslo).

Speaker: Drew Heard (NTNU)

Title: *A non-spatial frame of smashing ideals*

Time slot: *Thursday, 13:00–13:45*
Room: *Gamle Bybro*

Abstract:

The smashing tensor ideals of a rigidly-compactly generated tensor-triangulated category form a frame, but it has remained unclear whether this frame must be spatial. I will give a negative answer, already for the unbounded derived category of a (necessarily non-noetherian) commutative ring, via an embedding of the frame of idempotent ideals into the frame of smashing ideals. This is joint with Tobias Barthel.

Speaker: Eduard Ortega (NTNU)

Title: *Protecting quantum information with waves*

Time slot: *Thursday, 13:00–13:45*
Room: *Nardo*

Abstract:

Quantum computers are extremely sensitive to noise. Tiny perturbations from the environment may destroy the quantum information stored in a physical system, making quantum error correction one of the central challenges in quantum technologies.

In this talk, I will discuss a mathematical framework for continuous-variable quantum error correction inspired by ideas from time–frequency analysis and Gabor theory. The starting point is the Gottesman–Kitaev–Preskill (GKP) code, where quantum information is encoded into wave-like states in phase space and protected against small displacement errors.

I will present recent joint work with Franz Luef in which tools from Gabor analysis, Heisenberg modules, and the Zak transform are used to reinterpret GKP-type codes from a time–frequency perspective. In this framework, lattices in phase space play the role of stabilizers, while Gabor frames provide structured and stable expansions of quantum states. This viewpoint naturally connects error correction with redundancy, localization, and harmonic analysis.

The goal of the talk is to give an accessible overview of how ideas originating in signal analysis and operator algebras can contribute to the mathematical foundations of quantum information and quantum error correction.

Parallelle foredrag 2

Speaker: Kristian Gjøsteen (NTNU)

Title: *The mathematics of post-quantum cryptography*

Time slot: *Thursday, 13:45–14:30*
Room: *Trondhjemssalen 2*

Abstract:

We need cryptography to protect our digital world. Quantum computers threaten to break the cryptography of the past 40 years. We need to deploy new cryptography based on problems that are hard for quantum computers to solve. We give an overview of three cryptographically important problems and some indications of why these should be hard to solve, even for quantum computers.

Speaker: Henrik Kalisch (UiB)

Title: *Data driven methods for ocean waves*

Time slot: *Thursday, 13:45–14:30*
Room: *Lilleby*

Abstract:

Short-term real-time wave forecasting is of considerable importance for the operation of wave energy converters and a range of other maritime applications, including offshore docking, vessel seakeeping, and lifeboat deployment. In this study, we investigate the use of an Echo State Network (ESN) with a reservoir architecture inspired by current understanding of signal processing in the mammalian auditory cortex to forecast ocean-wave time series. The model produces phase-resolved predictions of the free-surface elevation at a fixed location. In the context of wave energy harvesting, this is essential information which can be used to optimizing energy uptake in wave energy converters.

Results demonstrate that the proposed network can predict wave time series with reasonable accuracy over forecasting horizons of up to approximately two wave periods. The ESN architecture is computationally efficient, requiring only a comparatively small reservoir, and can readily adapt to changing sea states through continuous online retraining during normal operation. This rapid adaptation is achieved by updating only the output weights connecting the reservoir to the output layer, while leaving the internal reservoir dynamics unchanged. These characteristics make the proposed approach a promising tool for real-time wave forecasting in marine applications.

Speaker: Achim Krause (UiB)

Title: *Effective Spectra*

Time slot: *Thursday, 13:45–14:30*
Room: *Gamle Bybro*

Abstract:

In this talk I will report on work in progress with the goal of developing a computer-algebraic approach to stable homotopy theory, based on infinity-categorical descent ideas.

Speaker: Makoto Yamashita (UiO)

Title: *Operator K-theory and higher sheaves*

Time slot: *Thursday, 13:45–14:30*
Room: *Nardo*

Abstract:

I report on my recent projects with Valerio Proietti on the operator K-theory of dynamical systems and spectra-valued sheaves. It expands on the triangulated categorical approach to the Baum-Connes conjecture due to Meyer and Nest, by incorporating the language of stable infinity categories and the higher topos theory. This viewpoint led to applications for the relation between the Crainic-Moerdijk groupoid homology and operator K-groups of associated C^*-algebras, and the gap labeling conjecture for actions of free commutative groups on the Cantor space.

Parallelle foredrag 3

Speaker: Morten Brun (UiB)

Title: *Persistent Homotopy Classes of Maps*

Time slot: *Friday, 10:45–11:30*
Room: *Trondhjemssalen 2*

Abstract:

I will report on a project that studies computable persistent invariants obtained from homotopy classes of maps between persistent objects.

Persistent cohomology can be viewed as arising from persistent homotopy classes [G,K] of maps from a filtered space (G) into an Eilenberg–Mac Lane space (K). We propose instead to study and compute persistent homotopy classes [T,G] of maps from a finite test space (T) into a filtered space (G). Varying the test space gives a family of invariants that can detect different features of the target. To make such computations feasible, we use graphs as combinatorial models of spaces and work with a notion of weak equivalence that is slightly finer than the one usually used for topological spaces.

I will give an overview of the project, ranging from the modelling of spaces by graphs and the definition of the invariants to computational questions, implementation issues, and explicit examples.

Speaker: Lars Halvard Halle (University of Bologna)

Title: *Wild quotient singularities and arithmetic invariants of curves*

Time slot: *Friday, 10:45–11:30*
Room: *Gamle Bybro*

Abstract:

Roughly, a quotient singularity looks, locally, like a quotient of a non-singular variety by a finite group. It is called "wild" if the cardinality of the group is divisible by the (positive) characteristic of the residue field of the singular point. Wild quotient singularities are poorly understood, though interesting progress has been made in recent years.

In this talk, I will present some results on wild quotient surface singularities. I will moreover explain why these results are relevant for the computation of Chai's base change conductor of degenerating families of curves. This is joint work with D. Eriksson and J. Nicaise.

Speaker: Markus Köbis (NTNU)

Title: *Simulating cellular behavior through time-optimal control*

Time slot: *Friday, 10:45–11:30*
Room: *Lilleby*

Abstract:

Metabolism of cellular life is often described by means of the so-called constraint-based modeling approach. Models of this type are typically formulated as optimization problems over dynamical systems subject to biochemical constraints. We introduce time-optimal adaptation (TOA), a constraint-based framework based on minimizing the time required for a system to reach a prescribed target state while satisfying both dynamic and static constraints. Mathematically, TOA is a class of time-optimal control problems that subsumes and extends several existing constraint-based modeling approaches. We present a general optimization framework encompassing a broad family of metabolic models and formulate TOA within this setting. Using a coarse-grained self-replicator model, we characterize optimal adaptation strategies and show that they naturally generate phenomena observed experimentally, including for example storage accumulation in constant environments.

Speaker: Anna Pachol (USN)

Title: *When Geometry Goes Quantum: A Drinfeld twist approach*

Time slot: *Friday, 10:45–11:30*
Room: *Nardo*

Abstract:

I will provide a broad overview of algebraic structures that arise in fundamental questions of theoretical physics (such as quantum gravity). The talk will focus on ideas from noncommutative geometry, quantum groups (Hopf algebras) and Drinfeld twist deformation.

Noncommutative geometry provides a mathematical framework in which quantum structures, such as noncommuting observables (as in quantum theory), are incorporated directly into the description of spaces and space-time. This offers a way to extend the language of general relativity, which is inherently formulated in terms of Riemannian geometry, toward settings where quantum and geometric aspects intertwine.

Parallelle foredrag 4

Speaker: Fabian Harang (BI & Simula)

Title: *Learning from paths with memory using signatures*

Time slot: *Friday, 13:00–13:45*
Room: *Nardo*

Abstract:

Sequential data contain more than collections of observations: the order in which changes occur, and the interactions between them, often carry essential information. Path signatures provide a systematic way to encode this information through iterated integrals. Beginning with elementary geometric examples, I will explain how the first few signature terms describe displacement, area, order and interaction, and why signatures form a universal family of features for learning from paths. This leads naturally to applications in data science, ranging from linear regression on signature features to their use as representation layers in neural networks.

Classical signatures, however, do not explicitly distinguish between recent and distant events. Many real-world systems are non-Markovian: their present behaviour depends on how the past is remembered. I will introduce the Volterra signature, which incorporates a temporal kernel into the signature construction and thereby equips path features with an explicit memory structure. The resulting framework retains strong approximation properties while connecting naturally to state-space models such as Mamba and, through attention-type kernels, to Transformers. No prior knowledge of rough paths theory or advanced machine learning will be assumed.

Speaker: Kundan Kumar (UiB)

Title: *Coupled flow and mechanics in a fractured porous medium*

Time slot: *Friday, 13:00–13:45*
Room: *Lilleby*

Abstract:

Coupled multi-physics govern critical processes in subsurface energy, carbon sequestration, and geotechnical engineering. We present a mixed-dimensional model to simulate coupled flow, geomechanics, and contact mechanics in fractured poro-elastic system. Our approach models fractures as lower-dimensional interfaces embedded within a bulk matrix governed by the Biot poro-elasticity. Flow within the fracture network obeys Darcy model with aperture-dependent permeability. Contact mechanics are incorporated using normal compliance and Coulomb friction formulations. This formulation yields a coupled system of partial differential equations and non-linear variational inequalities.

We prove the well-posedness of the coupled model and construct a provably contractive iterative solution scheme. Furthermore, we use conformal finite elements for spatial discretization and implicit Euler time-stepping. We demonstrate the existence, uniqueness, stability, and optimal a priori error convergence of the discrete formulation. Numerical experiments demonstrate agreement with theoretical error rates, confirming the accuracy and stability of the proposed approach. Finally, we show that the iterative scheme can be used as a pre-conditioner for the linear system.

This is a joint work with Maarten V de Hoop (Rice University), and colleagues from Bergen, Marius Nevland, Inga Berre, Jakub Wiktor Both, and Eirik Keilegavlen.

Speaker: Stefanie Muff (NTNU)

Title: *Statistical Methods to Understand and Predict Evolution*

Time slot: *Friday, 13:00–13:45*
Room: *Trondhjemssalen 2*

Abstract:

In order to understand evolution and the robustness of wild animal populations, biologists are increasingly sampling DNA data for various species. The analyses of these complex data sets require advanced statistical methodology. While large genomic data sets have been available to animal and plant breeders, as well as in human genomics, the methods used in those fields cannot be readily transferred to analyze the data from wild systems, as the latter usually have much smaller sample sizes and at the same time very complex and heterogeneous environmental effects, as well as genetically heterogeneous gene pools.

Here I outline open methodological challenges and will give examples on how we address them. Data from six different wild study systems from collaborators across the globe, as well as various open questions related to those systems, are the underlying drivers of this work.

Speaker: Claudia He Yun (UiT)

Title: *Computing stable homology representations of graph configuration spaces*

Time slot: *Friday, 13:00–13:45*
Room: *Gamle Bybro*

Abstract:

Configuration spaces parametrize distinct labelled points in a topological space. They have rich geometry and have been studied extensively. In 2011, Church and Farb introduce the idea of representation stability for a sequence of representations V_n of groups G_n. Configuration spaces lend themselves naturally to this framework. In this talk, we will focus on configuration spaces of families of graphs with a fixed number of points and discuss their stability behavior, where V_n is taken to be the rational homology and G_n the automorphism group of the underlying graph. We carry out extensive computational work to determine the stable homology representations for several families with 2 points, such as the star graphs, the complete graphs, and the complete bipartite graphs. We also give combinatorial interpretations to some stable subrepresentations. This is joint work with Eric Ramos. Our paper can be found on the arXiv with handle 2606.13813.