Our section, Mathematics, carries out fundamental mathematics research. We form the mathematical knowledge base for emerging new areas in the technical sciences, and we explore new applications of pure mathematics.

In addition, we excel at teaching. All bachelor students at DTU take a mathematics course during their first year, which is organised by our section.

Currently, three staff members from have been elected Teacher of the Year (in 2014, 2023, and 2025).

The mathematics section cooperates with colleagues from industry, mathematical research groups as well as engineering and natural science research groups in Denmark and abroad.

Research areas

The research areas are elaborated on the reverse side.

Algebra: Focusing on the mathematical foundations of reliable communication and data storage.

Functional analysis: Focusing on harmonic analysis and (generalized) Fourier analysis, as well as the mathematical foundation of machine learning.

Geometry: Describing and approximating shapes; associated partial differential equations.

Dynamical Systems: Focusing on singular perturbations of nonlinear ordinary differential equations, dynamics of vortices in fluids, and complex dynamics.

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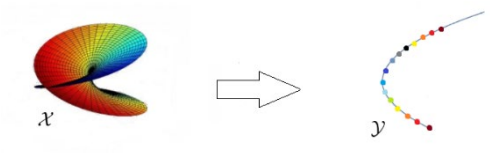
Technical University of Denmark

Algebra

Algebra describes the underlying structure of mathematical objects as prime numbers, polynomials, symmetries, vector spaces, and on the lighter side also games, puzzles and even origami. It is therefore not surprising that there is a strong interplay between algebra and applications, especially applications involving discrete mathematics.

An important example of this interplay studied by the algebra group is the theory of algebraic curves. Such curves can be used in information theory to construct excellent error-correcting codes for use in data communication, as well as locally recoverable codes that are used for distributed data storage in the cloud.

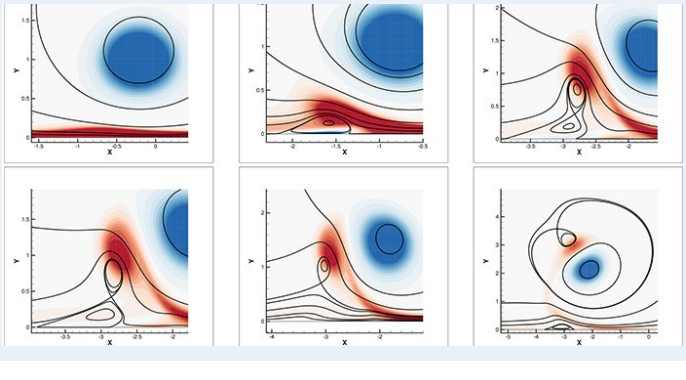
Similarly, higher dimensional algebraic varieties are also used in information theory, notably for the construction of maximum rank-distance codes used in fast data transmission in computer networks.

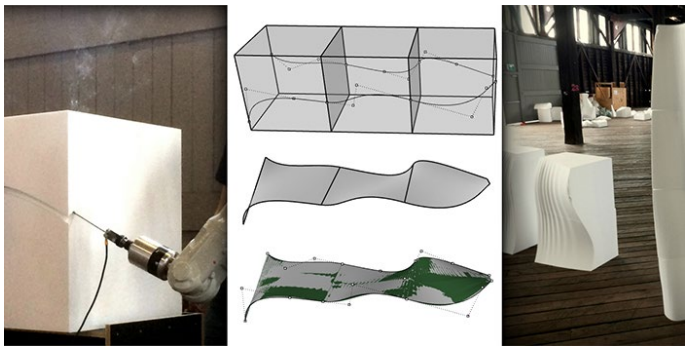


Dynamical Systems

A dynamical system is a system that changes over time in accordance with certain rules. Dynamical systems are central to both mathematics, science, and engineering. In the Dynamical Systems Group we study differential equations, as well as difference equations, from a dynamical systems point of view.

We develop new theory and new methods, primarily around singular perturbation/slow-fast theory and the theory of complex dynamics. We also apply dynamical system theory to a range of problems in science and engineering.





Geometry

The geometry group develops novel theories, concepts, and applications related to the construction, analysis, and optimization of shapes in the most general sense of this very broad category, but also in its low dimensional concrete ramifications and approximations.

The research strategy of the group is focused on this - two-way - bridge between the general and the concrete.

Functional Analysis

Functional analysis is a branch of mathematical analysis, concerned with infinite-dimensional vector spaces and its operators. Functional analysis is a research topic by itself, but it is also a toolbox that provides insight into the underlying mathematical structure of problems in dynamical systems, geometry, optimization and other areas of applied mathematics.

The Functional analysis group focuses on two central aspects, namely, (1) harmonic analysis and (2) applications within machine learning.

In harmonic analysis, a key issue is how to decompose complex signals into elementary building blocks; such decompositions are achieved via the general theory of frames and its concrete manifestations in terms of structured frames in function spaces.

Concerning (2), the focus is on developing the mathematical foundations of machine learning. A concrete project that connects (1) and (2) is the construction of frames that can be generated using a neural network.

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