Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

FAU MoD Lecture Series

Measuring productivity and fixedness in lexico-syntactic constructions

Stephanie Evert

FRIEDRICH-ALEXANDER-UNIVERSITÄT
ERLANGEN-NÜRNBERG

WWW.MOD.FAU.EU

#FAUMoDLecture

WHEN

Wed. **November 13, 2024**
14:30H (Berlin time)

WHERE

On-site / Online

Friedrich-Alexander-Universität
Erlangen-Nürnberg
Room H13 Johann-Radon-Hörsaal
Cauerstraße 11, 91058
Erlangen - Bavaria, Germany

FAU Zoom link:
https://fau.zoom-x.de/j/62410943213

Meeting ID: **624 1094 3213**
PIN code: **694096**

In cognitive linguistics, constructions are understood as pairings of form (i.e. a lexico-grammatical pattern) and meaning (as a parameterised function if the pattern contains variable elements), which constitute the fundamental building blocks of speakers' linguistic knowledge. Between the extremes of purely syntactic constructions (such as the ditransitive) and purely lexical ones (individual words or multiword units), a large part of constructions fall somewhere in the middle of the lexis-grammar continuum. They often consist of multiple lexical and grammatical elements, which range from completely fixed lexical items to highly variable slots.

In this talk I argue that the variability of slots in a lexico-grammatical pattern forms a cline ranging from complete fixedness to full productivity. This cline cannot be quantified by a single integrated measure, but is a combination of three distinct, but overlapping aspects:
(i) fixedness is quantified by the frequency of an element (or rather, its conditional probability given the other items in the lexico-grammatical pattern);
(ii) at the opposite end of the cline, productivity is quantified by type-token measures and interpreted with the help of statistical LNRE models;
(iii) in the middle ground between productivity and fixedness, statistical association plays a central role in identifying salient, semi-fixed lexical items.
These methodological considerations are illustrated with a case study on shell noun constructions such as "It is a fact that you will have to listen to the entire talk."

Friedrich-Alexander-Universität
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FAU MoD Lecture Series

New avenues for the interaction of computational mechanics and machine learning

Paolo Zunino

MOX, POLITECNICO DI MILANO

WWW.MOD.FAU.EU

#FAUMoDLecture

WHEN

Thursday **October 24, 2024**
14:30H (Berlin time)

WHERE

On-site / Online

Friedrich-Alexander-Universität
Erlangen-Nürnberg
Room H2. Anorganische Chemie
Egerlandstraße 3, 91058
Erlangen - Bavaria, Germany

FAU Zoom link:
https://fau.zoom-x.de/j/62410943213

Meeting ID: **624 1094 3213**
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Neural networks and learning algorithms have gained substantial attention among researchers engaged in computational mechanics.

Notably, there are well-established methodologies for employing these tools in solving mathematical models based on partial differential equations.

Additionally, a significant overlap exists between the machine learning and computational science and engineering communities in the realm of data-driven reduced order models.

After reviewing the main trends in this field, we will discuss novel emerging approaches such as the application of learning algorithms to expedite the resolution of linear systems or to foster the approximation of multiscale problems.

Friedrich-Alexander-Universität
Research Center for
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FAU MoD Lecture Series

Thoughts on Machine Learning

Rupert Klein

FREIE UNIVERSITÄT BERLIN

WWW.MOD.FAU.EU

#FAUMoDLecture

WHEN

Friday **September 20, 2024**
14:30H (Berlin time)

WHERE

On-site / Online

Friedrich-Alexander-Universität
Erlangen-Nürnberg
Room H13 Johann-Radon-Hörsaal
Cauerstraße 11, 91058
Erlangen - Bavaria, Germany

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Meeting ID: **624 1094 3213**
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Techniques of machine learning (ML) find a rapidly increasing range of applications touching upon social, economic, and technological aspects of everyday life. They are also being used with great enthusiasm to fill in gaps in our scientific knowledge by data-based modelling approaches.

I have followed these developments for a while with interest, concern, and mounting disappointment. When these technologies are employed to take over decisive functionality in safety-critical applications, we would like to exactly know how to guarantee their compliance with pre-defined guardrails and limitations.

Moreover, when they are utilized as building blocks in scientific research, it would violate scientific standards -in my opinion- if these building blocks were used without a throrough understanding of their functionality, including inaccuracies, uncertainties, and other pitfalls.

In this context, I will juxtapose (a subset of) deep neural network methods with the family of entropy-optimal Sparse Probabilistic Approximation (sSPA) techniques developed recently by Illia Horenko (RPTU Kaiserslautern-Landau) and colleagues.

FAU MoD Lecture Series

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

SPEAKER

UNIVERSITY OF BRASÍLIA
BRAZILIAN MATHEMATICAL SOCIETY

Promoting Gender Equity in Mathematics: Strategies and Solutions

MON. JUNE 3, 2024 • 15:00H

www.mod.fau.eu

Promoting Gender Equity in Mathematics: Strategies and Solutions

Speaker: Prof. Dr. **Jaqueline Godoy Mesquita**
University of Brasília | Brazilian Mathematical Society

Organizer: FAU MoD, Research Center for Mathematics of Data
FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg

In this talk, I will explore the gender gap in mathematics, highlighting regional differences and examining the underlying causes of this disparity. We will delve into initiatives aimed at increasing the representation of women in mathematics and discuss strategies to combat bias within the field. Additionally, I will outline various opportunities available to women in mathematics, emphasizing the importance of fostering an inclusive environment that supports their growth and success.

WHEN?

Monday **June 3, 2024**
15:00H

WHERE?

On-site / Online

Room **04.363**
FAU. Friedrich-Alexander-Universität Erlangen-Nürnberg
Felix-Klein building. Department Mathematik
Cauerstraße 11, 91058 Erlangen (Germany)

Zoom link: https://shorturl.at/evR04
Meeting ID: **624 1094 3213** | PIN code: **694096**

#FAUMoDLecture

FAU MoD Lecture Series

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

Jaqueline Godoy Mesquita

UNIVERSITY OF BRASÍLIA
BRAZILIAN MATHEMATICAL SOCIETY

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#FAUMoDLecture

FAU MoD Lecture Series

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

Sebastian Peitz

UNIVERSITÄT PADERBORN

Using system knowledge for improved sample efficiency in data-driven modeling and control of complex technical systems

MON. MAY 13, 2024 • 14:30H

www.mod.fau.eu

Using system knowledge for improved sample efficiency in data-driven modeling and control of complex technical systems

Speaker: Prof. Dr. **Sebastian Peitz**
Universität Paderborn

Organizer: FAU MoD, Research Center for Mathematics of Data at FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

In this talk we will discuss some current and future challenges in high-dimensional image reconstruction, which is based on the solution of large-scale inverse problems involving various uncertainties. While classical methods were purely based on physical models for forward operators and regularizations, modern machine learning techniques create the antithesis of data-driven approaches. We will discuss some pitfalls that machine learning can encounter in inverse problems and discuss opportunities for the synthesis of model- and data-driven approaches.

WHEN?

Wednesday **March 20, 2024**
14:30H

WHERE?

On-site / Online

Room **H13 – Johann-Radon-Hörsaal**
FAU. Friedrich-Alexander-Universität Erlangen-Nürnberg
Felix-Klein building. Department Mathematik
Cauerstraße 11, 91058 Erlangen (Germany)

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#FAUMoDLecture

FAU MoD Lecture Series

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

Sebastian Peitz

UNIVERSITÄT PADERBORN

Using system knowledge for improved sample efficiency in data-driven modeling and control of complex technical systems

WED. MAY 15, 2024 • 14:00H

www.mod.fau.eu

Using system knowledge for improved sample efficiency in data-driven modeling and control of complex technical systems

Speaker: Prof. Dr. **Sebastian Peitz**
Universität Paderborn

Organizer: FAU MoD, Research Center for Mathematics of Data at FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg

Modern technical systems such as autonomous vehicles, the electric grid or nuclear fusion reactors are extremely complex, which requires powerful techniques for predicting or controlling their behavior. As in almost all areas of science as well as our daily lives, machine learning has had a huge impact on the area of modeling and control of technical systems in recent years. However, the complexity of these systems renders the learning very data-hungry. The aim of this talk is thus to discuss different approaches to leverage system knowledge – and in particular symmetries – such that we can significantly improve the sample efficiency. Our discussion ranges from learning the dynamics from data to reinforcement learning. We will emphasize the benefits of exploiting knowledge using various examples from fluid mechanics.

WHEN?

Wednesday **May 15, 2024**
14:00H

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On-site / Online

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#FAUMoDLecture

hacer poster resumen de 8 speakers (de 8 en 8)

FAU MoD Lecture Series

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

Martin Burger

DESY | UNIVERSITÄT HAMBURG

Image Reconstruction – The Dialectic of Modelling and Learning

WED. MARCH 20, 2024 • 14:30H

www.mod.fau.eu

Image Reconstruction – The Dialectic of Modelling and Learning

Speaker: Prof. Dr. **Martin Burger**
DESY | Universität Hamburg

Organizer: FAU MoD, Research Center for Mathematics of Data at FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

In this talk we will discuss some current and future challenges in high-dimensional image reconstruction, which is based on the solution of large-scale inverse problems involving various uncertainties. While classical methods were purely based on physical models for forward operators and regularizations, modern machine learning techniques create the antithesis of data-driven approaches. We will discuss some pitfalls that machine learning can encounter in inverse problems and discuss opportunities for the synthesis of model- and data-driven approaches.

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14:30H

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FAU MoD Lecture Series

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

Amaury Hayat

ÉCOLE DES PONTS PARISTECH

The role of Artificial Intelligence in the future of mathematics

THU. **JANUARY 11**, 2024 • 14:00H

www.mod.fau.eu

The role of Artificial Intelligence in the future of mathematics

Speaker: Prof. Dr. **Amaury Hayat**
École des Ponts ParisTech

Organizer: FAU MoD, Research Center for Mathematics of Data at FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

Artificial Intelligence (AI) has demonstrated remarkable achievements across various domains, from natural language processing to mastering complex games like chess. This naturally raises the question: can AI assist mathematicians in solving open problems in mathematics? This talk aims to address this question. We will explore how AI models can be trained to provide valuable insights into three mathematical questions from different areas of mathematics and applied mathematics. We will then showcase examples of AI models that are specifically trained to prove mathematical theorems by themselves.

WHEN?

Thursday **January 11, 2024**
14:00H

WHERE?

On-site / Online

Room **01.382 – Besprechungsraum Mathematik**
FAU. Friedrich-Alexander-Universität Erlangen-Nürnberg
Felix-Klein building. Department Mathematik
Cauerstraße 11, 91058 Erlangen (Germany)

Zoom link: https://shorturl.at/evR04
Meeting ID: **624 1094 3213** | PIN code: **694096**

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Friedrich-Alexander-Universität
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FAU MoD
Lecture Series

WED. **NOVEMBER 22**, 2023
13:45H

Michael Kohlhase

FRIEDRICH-ALEXANDER-UNIVERSITÄT
ERLANGEN-NÜRNBERG (FAU)
CARNEGIE MELLON UNIVERSITY

Edriss S. Titi

UNIVERSITY OF CAMBRIDGE
TEXAS A&M UNIVERSITY
WEIZMANN INSTITUTE OF SCIENCE

www.mod.fau.eu

In (informal) mathematics (pure and applied) a human studies rigorously represented objects or mathematical models of the real world, comes up with conjectures about their properties, proves or refutes them, submits them for review and finally publication in the academic literature. While it is commonly accepted that all of mathematics could be expressed and indeed developed in first-order logic based on (some axiomatic) set theory, this option is almost never executed in practice. Formalized mathematics aims to enable computer support of "doing mathematics" by representing objects, conjectures, proofs, and even publications in formal systems, usually expressive logical languages with machine-checkable proof calculi, and highly efficient algorithms for automating various aspects of "doing mathematics".
Highlights of formalized mathematics are
- machine-checked proofs of major theorems like the Kepler Conjecture,
- Feit/Thomson's "odd order theorem", or the four color theorem,
- search engines for mathematical formulae,
- synthesis and verification of computer algebra algorithms
- multiple libraries of formalized and verified mathematics
  with more than 100.000 theorems/proofs each.

This talks will give an overview over the issues and results and introduces some of the techniques.

In this talk, I will introduce downscaling data assimilation algorithms for weather and climate prediction based on discrete coarse spatial scale measurements of the state variables (or only part of them, depending on the underlying model). The algorithm is based on linear nudging of the coarse spatial scales in the algorithm’s solution toward the observed measurements of the coarse spatial scales of the unknown reference solution.

The algorithm’s solution can be initialized arbitrarily and is shown to converge at an exponential rate toward the exact unknown reference solution. This indicates that the dynamics of the algorithm is globally stable (not chaotic) unlike the dynamics of the model that governs the unknown reference solution.

Capitalizing on this fact, I will also demonstrate uniform in time error estimates of the numerical discretization of these algorithms, which makes them reliable upon implementation computationally.

Furthermore, I will also present a recent improvement of this algorithm by employing nonlinear nudging, which yields a super exponential convergence rate toward the unknown exact reference solution.

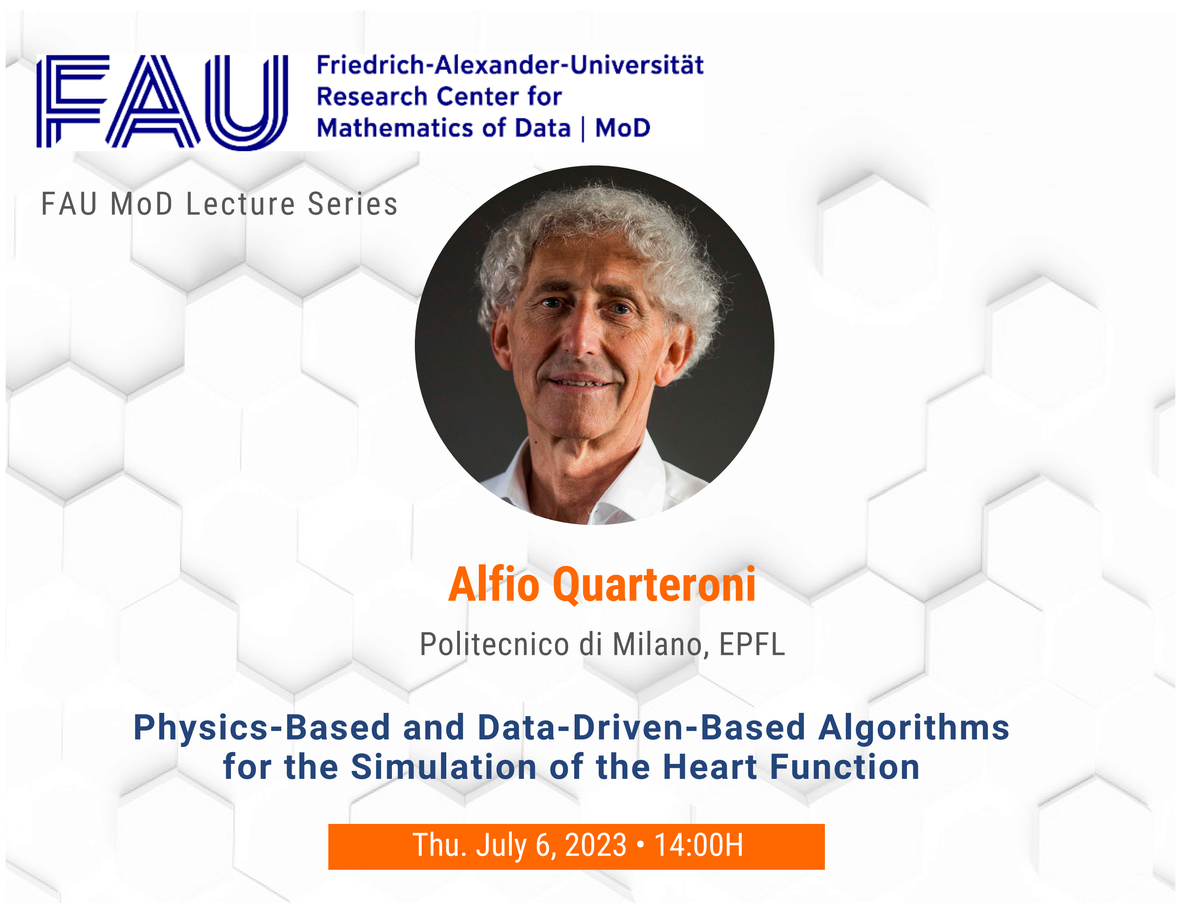
Free boundary regularity for the obstacle problem

Speaker: Prof. Dr. **Alessio Figalli**
ETH Zürich

Organizer: FAU MoD, Research Center for Mathematics of Data at
Friedrich-Alexander-Universität Erlangen-Nürnberg

The classical obstacle problem consists of finding the equilibrium position of an elastic membrane whose boundary is held fixed and constrained to lie above a given obstacle. By classical results of Caffarelli, the free boundary is smooth outside a set of singular points. However, explicit examples show that the singular set could be, in general, as large as the regular set.

This talk aims to introduce this beautiful problem and describe some classical and recent results on the regularity of the free boundary.



In this talk I will present a mathematical model that is suitable to simulate the cardiac function, thanks to its capability to describe the interaction between electrical, mechanical, and fluid-dynamical processes occurring in the heart.

The model comprises a system of nonlinear differential equations (either ordinary and partial) featuring a multi-physics and multi-scale nature. Efficient numerical strategies are devised to allow for the analysis of both heart function and dysfunction.These strategies rely on both classical physics-based numerical discretization methods and machine-learning algorithms, as well as on their interplay.

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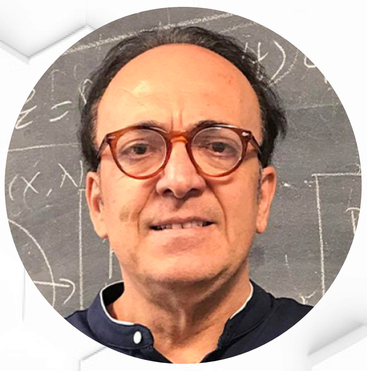

George Karniadakis

Brown University, MIT, PNNL

From Physics-Informed Machine Learning to Physics-Informed Machine Intelligence: QUO VADIMUS?

Tue. May 30, 2023 • 14:00H

We will review physics-informed neural networks (NNs) and summarize available extensions for applications in computational science and engineering. We will also introduce new NNs that learn functionals and nonlinear operators from functions and corresponding responses for system identification. The universal approximation theorem of operators is suggestive of the potential of NNs in learning from scattered data any continuous operator or complex system. We first generalize the theorem to deep neural networks, and subsequently we apply it to design a new composite NN with small generalization error, the deep operator network (DeepONet), consisting of a NN for encoding the discrete input function space (branch net) and another NN for encoding the domain of the output functions (trunk net). We demonstrate that DeepONet can learn various explicit operators, e.g., integrals, Laplace transforms and fractional Laplacians, as well as implicit operators that represent deterministic and stochastic differential equations. More generally, DeepOnet can learn multiscale operators spanning across many scales and trained by diverse sources of data simultaneously. Finally, we will present first results on the next generation of these architectures to biologically plausible designs based on spiking neural networks and Hebbian learning that are more efficient and closer to human intelligence.

Friedrich-Alexander-Universität
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FAU MoD Lecture Series

Miroslav Krstic

University of California San Diego

Learning-Based Optimization and PDE Control in User-Assignable Finite Time

Mon. September 19, 2022 • 16:00H

This year is the centennial of the 1922 invention of Extremum Seeking, one of the currently most active areas of learning-based control or model-free adaptive control. It has also been exactly a quarter century since the resurrection of this method through its proof of convergence in 1997. In this lecture I will present new results on accelerating the convergence of ES algorithms from exponential to convergence in user-prescribed finite time. The subject of stabilization in prescribed time emerged in 2017 as an interesting alternative to sliding mode control (SMC) for achieving convergence in a time that is independent of the initial condition, using time-varying feedback gain which grows to infinity as the time approaches the terminal (prescribed) time. Such unbounded gains, multiplying the state that goes to zero and making the control input bounded, are common in optimal control with a hard terminal constraint, such as in classical Proportional Navigation control law in aerospace applications, like target intercept. I will present results, achieved over the past year – 2021 – by two of my students, Velimir Todorovski (a graduate of FAU-Erlangen) and Cemal Tugrul Yilmaz, on extending prescribed-time stabilization to prescribed-time extremum seeking. Todorovski solves the problem of source seeking for mobile robots in GPS-denied environments. Yilmaz solves the problem of real-time optimization under large delays on the input and in the presence of PDE (partial differential equation) dynamics. Their designs are model-free and, most importantly, achieve convergence/optimality in a user-prescribed interval of time, independent of initial conditions.

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FAU MoD Lecture Series

Nick Trefethen

University of Oxford

Applications of AAA Rational Approximation

Wed. February 1, 2023 10:30H Lecture • 16:30H Chebfun

For the first time, a method has recently become available for fast computation of near-best rational approximations on arbitrary sets in the real line or complex plane: the AAA algorithm (Nakatsukasa-Sete-T. 2018). We will present the algorithm and then demonstrate a number of applications, including

- detection of singularities
- model order reduction
- analytic continuation
- functions of matrices
- nonlinear eigenvalue problems
- interpolation of equispaced data
- smooth extension of multivariate real functions
- extrapolation of ODE and PDE solutions into the complex plane
- solution of Laplace problems
- conformal mapping
- Wiener-Hopf factorization

(joint work with Stefano Costa and others)

Friedrich-Alexander-Universität
Research Center for
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FAU MoD Lecture Series

Eva Miranda

Universitat Politècnica de Catalunya·BarcelonaTech

From Alan Turing to contact geometry: Towards a "Fluid computer"

Wed. April 19, 2023 • 16:00H

Is hydrodynamics capable of performing computations? (Moore, 1991). Can a mechanical system (including a fluid flow) simulate a universal Turing machine? (Tao, 2016). Etnyre and Ghrist unveiled a mirror between contact geometry and fluid dynamics reflecting Reeb vector fields as Beltrami vector fields. With the aid of this mirror, we can answer in the positive the questions raised by Moore and Tao. This is done by combining techniques from Alan Turing with modern Geometry (contact geometry) to construct a "Fluid computer" in dimension 3. This construction shows, in particular, the existence of undecidable fluid paths. Tao's question was motivated by a research program to address the Navier–Stokes existence and smoothness problem. Could such a Fluid computer be used to address this Millennium prize problem? We will end up the talk with some speculative ideas of a Fluid computer construction à la Feynman.

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Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

FAU MoD Lecture Series

WED. **NOVEMBER 22**, 2023
13:45H

Michael Kohlhase

FRIEDRICH-ALEXANDER-UNIVERSITÄT
ERLANGEN-NÜRNBERG (FAU)
CARNEGIE MELLON UNIVERSITY

Edriss S. Titi

UNIVERSITY OF CAMBRIDGE
TEXAS A&M UNIVERSITY
WEIZMANN INSTITUTE OF SCIENCE

www.mod.fau.eu

Prospects of formalized mathematics

Prof. Dr. **Michael Kohlhase**
Friedrich-Alexander-Universität Erlangen-Nürnberg
Carnegie Mellon University

In (informal) mathematics (pure and applied) a human studies rigorously represented objects or mathematical models of the real world, comes up with conjectures about their properties, proves or refutes them, submits them for review and finally publication in the academic literature. While it is commonly accepted that all of mathematics could be expressed and indeed developed in first-order logic based on (some axiomatic) set theory, this option is almost never executed in practice. Formalized mathematics aims to enable computer support of "doing mathematics" by representing objects, conjectures, proofs, and even publications in formal systems, usually expressive logical languages with machine-checkable proof calculi, and highly efficient algorithms for automating various aspects of "doing mathematics".
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- multiple libraries of formalized and verified mathematics with more than 100.000 theorems/proofs each.

This talks will give an overview over the issues and results and introduces some of the techniques.

Rigorous analysis and numerical implementation of nudging data assimilation algorithms

Prof. Dr. **Edriss S. Titi**
University of Cambridge
Texas A&M University. Weizmann Institute of Science

In this talk, I will introduce downscaling data assimilation algorithms for weather and climate prediction based on discrete coarse spatial scale measurements of the state variables (or only part of them, depending on the underlying model). The algorithm is based on linear nudging of the coarse spatial scales in the algorithm's solution toward the observed measurements of the coarse spatial scales of the unknown reference solution.

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Furthermore, I will also present a recent improvement of this algorithm by employing nonlinear nudging, which yields a super exponential convergence rate toward the unknown exact reference solution.

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Wednesday **November 22, 2023**
13:45H

WHERE?

On-site / Online

Room **H16 Hörsaal**
FAU. Friedrich-Alexander-Universität Erlangen-Nürnberg
Cauerstraße 7-9, 91058 Erlangen (Germany)

Zoom link: https://shorturl.at/evR04
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FAU MoD Lecture Series

Friedrich-Alexander-Universität
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Michael Kohlhase

FRIEDRICH-ALEXANDER-UNIVERSITÄT
ERLANGEN-NÜRNBERG (FAU)

Prospects of formalized mathematics

WED. **NOVEMBER 22**, 2023 • 14:00H

www.mod.fau.eu

Prospects of formalized mathematics

Speaker: Prof. Dr. **Michael Kohlhase**
Friedrich-Alexander-Universität Erlangen-Nürnberg

Organizer: FAU MoD, Research Center for Mathematics of Data at FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

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FAU MoD Lecture Series

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Alessio Figalli

ETH ZÜRICH

Free boundary regularity for the obstacle problem

WED. **OCTOBER 11**, 2023 • 14:00H

www.mod.fau.eu

Free boundary regularity for the obstacle problem

Speaker: Prof. Dr. **Alessio Figalli**
ETH Zürich

Organizer: FAU MoD, Research Center for Mathematics of Data at FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

The classical obstacle problem consists of finding the equilibrium position of an elastic membrane whose boundary is held fixed and constrained to lie above a given obstacle. By classical results of Caffarelli, the free boundary is smooth outside a set of singular points. However, explicit examples show that the singular set could be, in general, as large as the regular set.

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WHEN?
Wednesday **October 11, 2023**
14:00H

WHERE?
Online

Zoom meeting link:
shorturl.at/hmDQU

Meeting ID: **614 4658 1599**
PIN: **914397**

#FAUMoDLecture

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

FAU MoD Lecture Series

Alfio Quarteroni

Politecnico di Milano, EPFL

Physics-Based and Data-Driven-Based Algorithms for the Simulation of the Heart Function

Thu. July 6, 2023 • 14:00H

www.mod.fau.eu

Physics-Based and Data-Driven-Based Algorithms for the Simulation of the Heart Function

Speaker: Prof. Dr. **Alfio Quarteroni**
Politecnico di Milano and Ecole Polytechnique Fédérale de Lausanne

Organized by: **FAU MoD**, Research Center for Mathematics of Data
FAU Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

In this talk I will present a mathematical model that is suitable to simulate the cardiac function, thanks to its capability to describe the interaction between electrical, mechanical, and fluid-dynamical processes occurring in the heart.

The model comprises a system of nonlinear differential equations (either ordinary and partial) featuring a multi-physics and multi-scale nature. Efficient numerical strategies are devised to allow for the analysis of both heart function and dysfunction.These strategies rely on both classical physics-based numerical discretization methods and machine-learning algorithms, as well as on their interplay.

WHEN?

Thursday **July 06, 2023**
14:00H

WHERE?

Online

Zoom meeting link:
shorturl.at/hmDQU

Meeting ID: **614 4658 1599**
PIN: **914397**

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Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

FAU MoD Lecture Series

Alfio Quarteroni

Politecnico di Milano, EPFL

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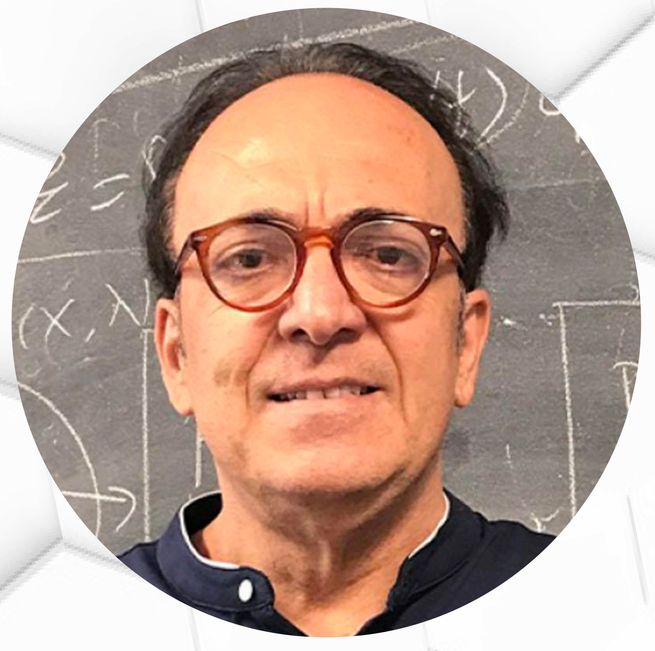
FAU MoD Lecture Series



George Karniadakis

Brown University,
MIT, PNNL

From Physics-Informed Machine Learning to Physics-Informed Machine Intelligence: QUO VADIMUS?

Tue. May 30, 2023 • 14:00H

www.mod.fau.eu

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Speaker: Prof. Dr. **George Karniadakis**, Charles Pitts Robinson and John Palmer Barstow Professor of Applied Mathematics and Engineering, Brown University.
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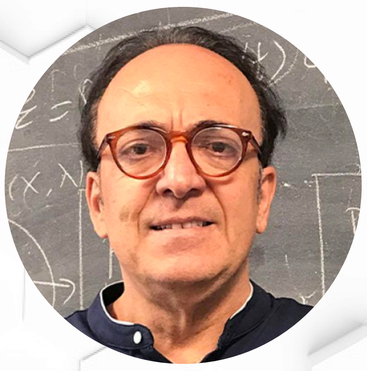

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FAU MoD Lecture Series

Miroslav Krstic

University of California San Diego

Learning-Based Optimization and PDE Control in User-Assignable Finite Time

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Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

FAU MoD Lecture Series

Nick Trefethen

University of Oxford

Applications of AAA Rational Approximation

Wed. February 1, 2023 10:30H Lecture • 16:30H Chebfun

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(joint work with Stefano Costa and others)

Friedrich-Alexander-Universität
Research Center for
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FAU MoD Lecture Series

Eva Miranda

Universitat Politècnica de Catalunya·BarcelonaTech

From Alan Turing to contact geometry: Towards a “Fluid computer”

Wed. April 19, 2023 • 16:00H

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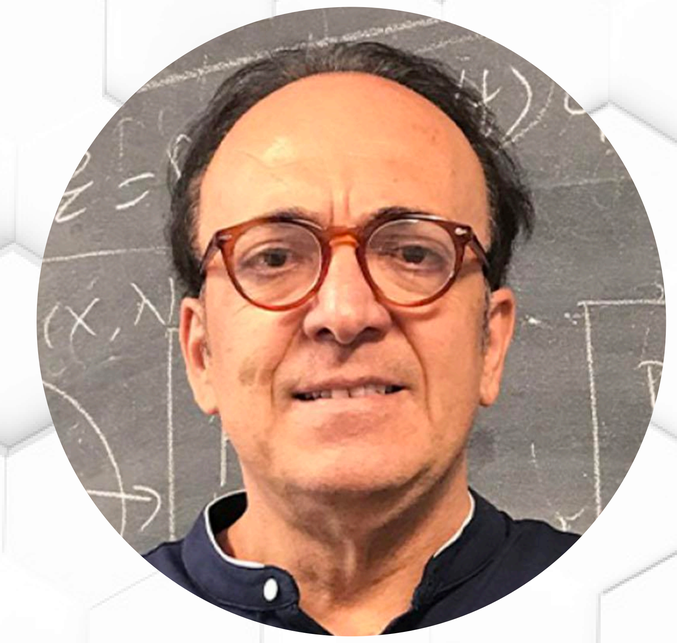

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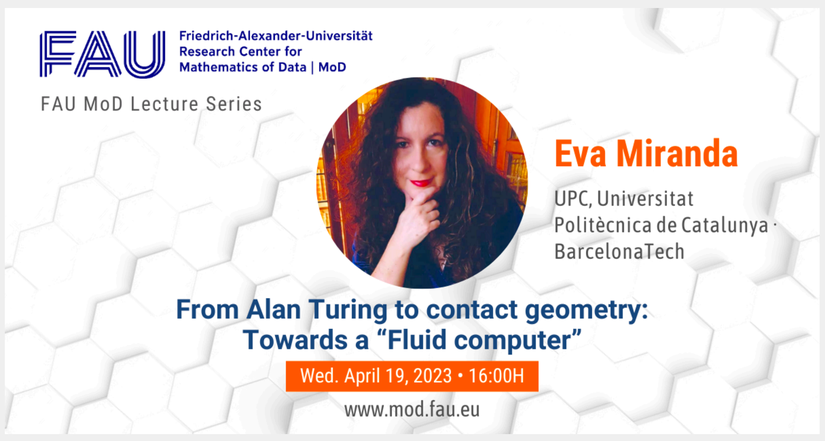

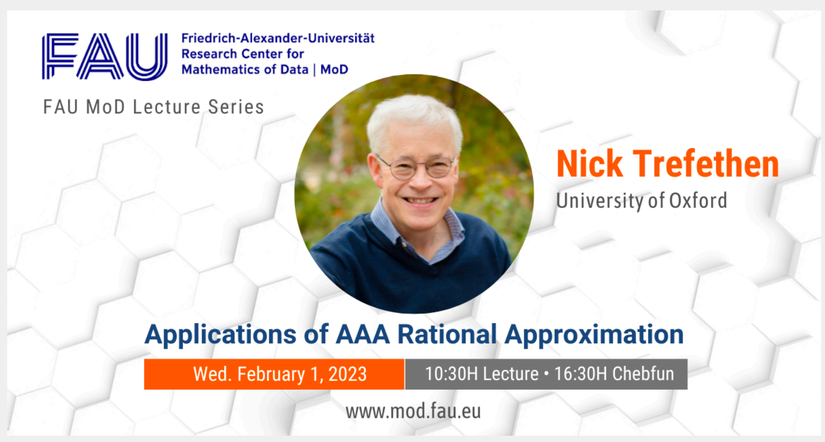

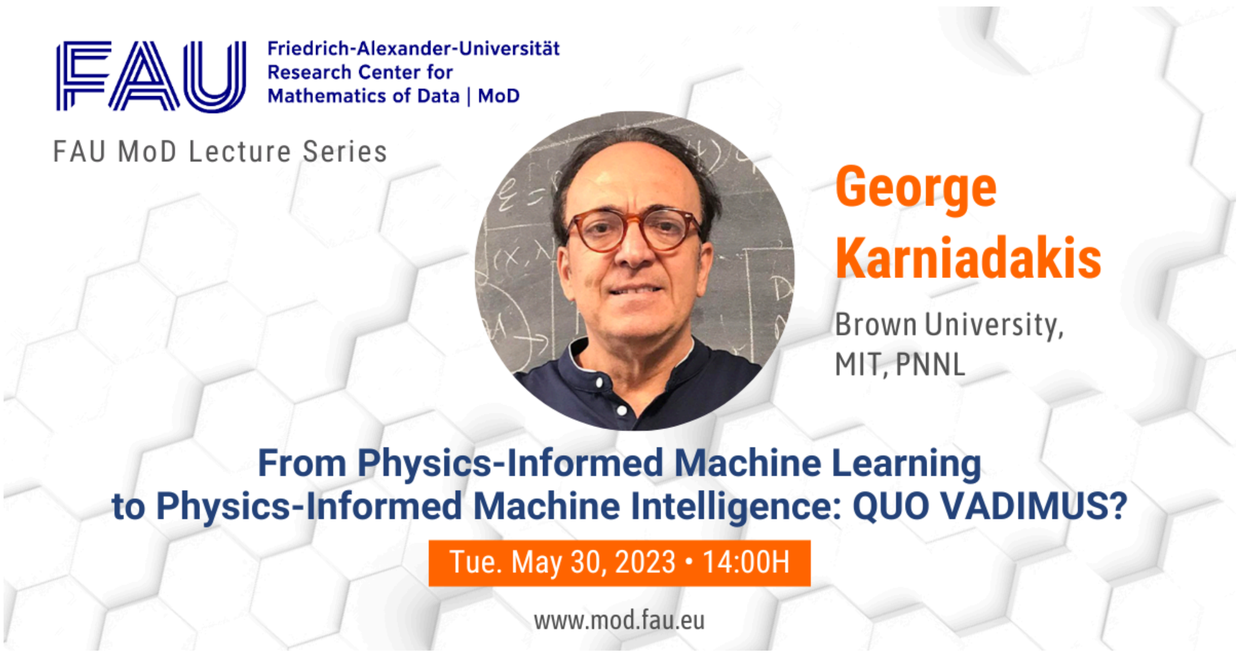

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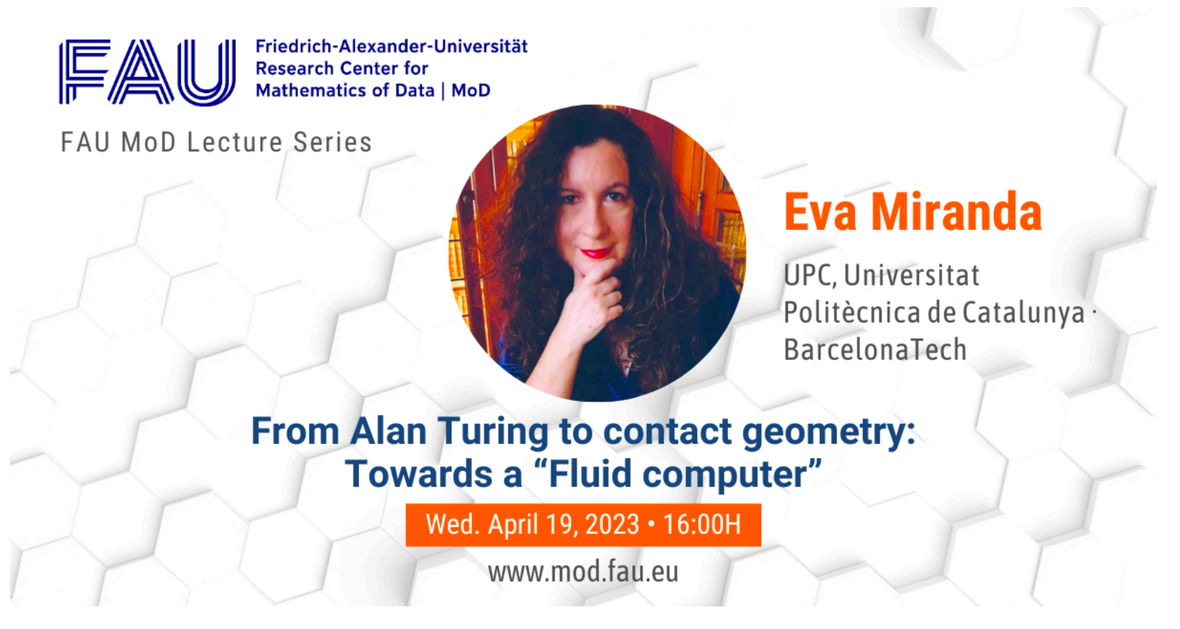

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Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

FAU MoD Lecture Series

Eva Miranda

Universitat Politècnica de Catalunya·BarcelonaTech

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Wed. April 19, 2023 • 16:00H

www.mod.fau.eu

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Speaker: Prof. Dr. **Eva Miranda**, UPC Universitat Politècnica de Catalunya · BarcelonaTech

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Department Mathematik.
Friedrich-Alexander-Universität Erlangen-Nürnberg.
Cauerstrasse 11, 91058 Erlangen.

Online
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FAU MoD Lecture Series

Nick Trefethen

University of Oxford

Applications of AAA Rational Approximation

Wed. February 1, 2023 | 10:30H Lecture • 16:30H Chebfun

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(joint work with Stefano Costa and others)

A Tour of Chebfun. A hands-on introduction session to Chebfun.
If you wish to play along, bring your laptop with Chebfun software pre-installed and ENJOY!
(Links available at the page of the event)

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Wednesday February 1, 2023

10:30H Main Lecture
(On-site / online)

16:30H Chebfun Session
(On-site)

WHERE?

On-site
Room 04.363 Seminarraum Mathematik.
Department of Mathematik.
Friedrich-Alexander-Universität Erlangen-Nürnberg
Cauerstrasse 11, 91058 Erlangen

Online
Zoom meeting link: **shorturl.at/jlHV5**
Meeting ID: **694 3141 3515** | PIN: **730757**

Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

FAU MoD Lecture Series

Miroslav Krstic

University of California
San Diego (USA)

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Mon. September 19, 2022 • 16:00H

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Affiliation: University of California San Diego (USA)

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Online:
Zoom meeting link: **https://bit.ly/3xkOW73**
Meeting ID: **697 5255 8798** | PIN: **737047**

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Friedrich-Alexander-Universität
Department Data Science | DDS

Chair
DYNAMICS, CONTROL
AND NUMERICS
FAU

Alexander von Humboldt
Stiftung/Foundation

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Meeting ID: TBA | PIN: TBA

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Friedrich-Alexander-Universität
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DYNAMICS, CONTROL
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Alexander von Humboldt
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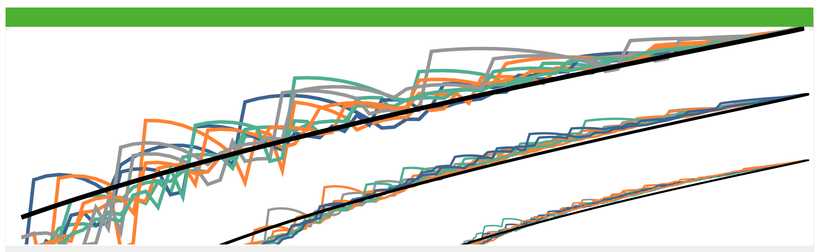
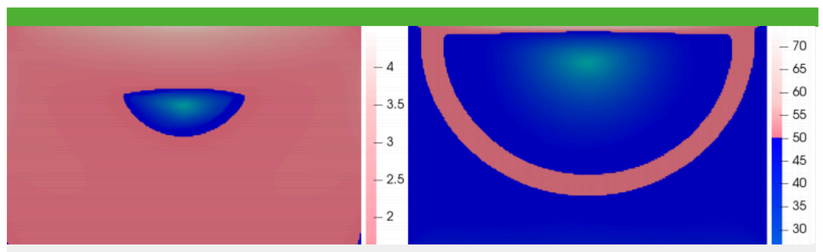
Chair for Dynamics, Control and Numerics - Alexander von Humboldt Professorship



Stochastic simulation and optimization for dynamical systems

We propose a new stochastic simulation method for the efficient simulation and optimal control of large-scale linear dynamical systems. An example shows a 3x speedup when compared to conventional methods.

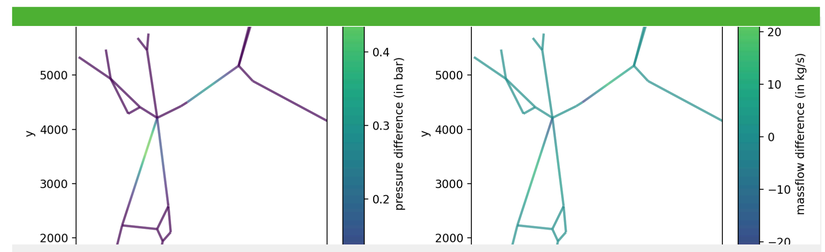
Daniël Veldman, Enrique Zuazua



Semismooth Newton Method for Viscoplastic Flow

The numerical simulation of viscoplastic flow remains a challenging task due to the non-smooth nature of the problem. In this work, we develop a semismooth Newton method for the system employing a recently introduced regularisation that brings new advantages.

Alexei Gazca



Observer-based Data Assimilation in Time-dependent Flows in Gas Networks

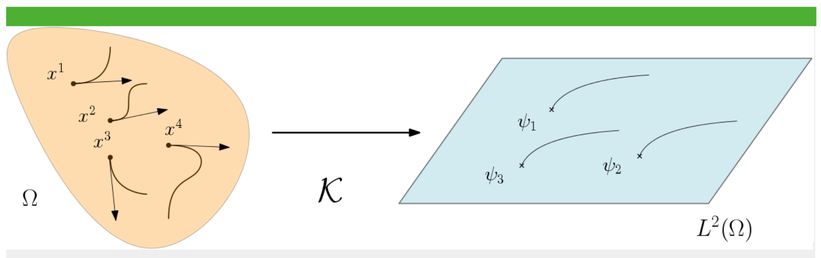
For the operation of gas networks, it is important to have an observer system for the corresponding network system of hyperbolic balance laws. The original system and the observer system are coupled either with data from pointwise measurement or by distributed coupling.

Martin Gugat, Jan Giesselmann, Teresa Kunkel, Sven Weiland

Model predictive control with random batch methods for a guiding problem

The optimal control problem for many individuals commonly requires a heavy computation, nearly unaffordable. We adopt the random batch methods and model predictive control to derive an approximative scheme to guide sheep by controlling dogs.

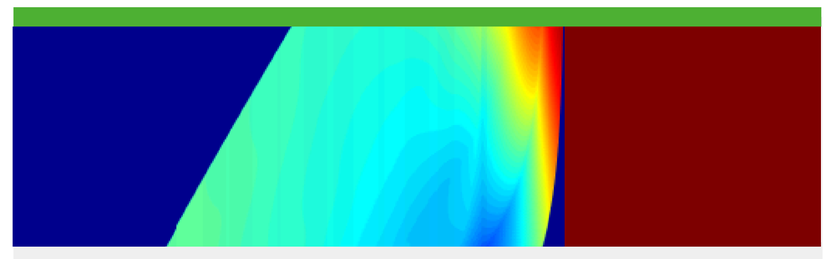
Dongnam Ko, Enrique Zuazua



System Identification by Koopman Operators: Quantitative Analysis

We give estimates on the convergence and cost of a data-driven system identification method based on the Koopman operator in finite element spaces. In 1D, we produce numerical examples showing that interpolation is more cost-effective.

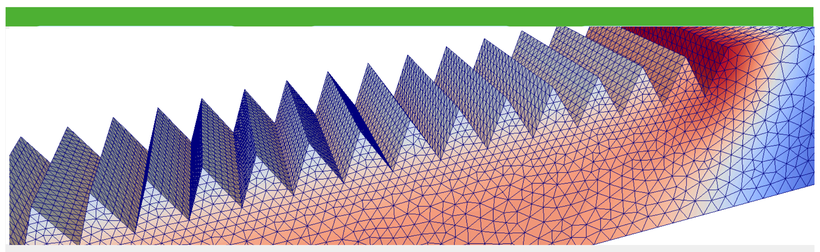
Christophe Zhang, Enrique Zuazua



The Singular limit of Nonlocal conservation Laws to Local Conservation Laws

We aim to close the gap between local and nonlocal modeling of phenomena governed by conservation laws. We prove convergence of solutions of a singularly perturbed problem to a solution of the original problem.

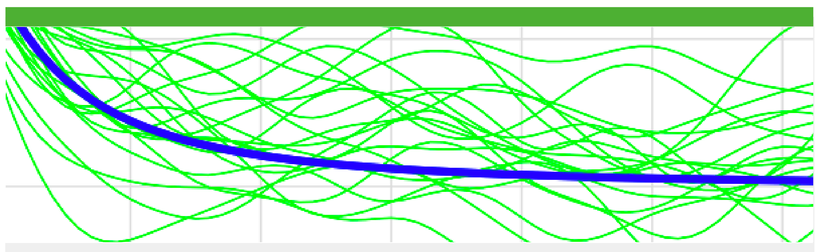
Giuseppe Maria Coclite, Jean-Michel Coron, Nicola de Nitti, Alexander Keimer, Lukas Pflug



Parabolic Problems Arising in Real-World Applications

There are many real-world applications of models of parabolic type with inherently nonsmooth data for which classical methods fail to apply. We show how the framework of maximal parabolic regularity can allow us to overcome these challenges.

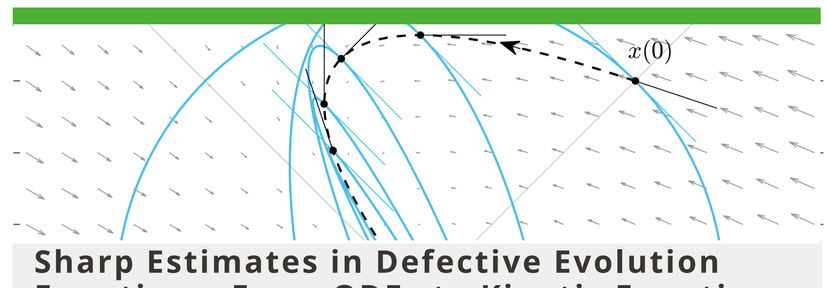
Hannes Meinlschmidt, Joachim Rehber



Nodal control and the Turnpike phenomenon

The aim is to prove turnpike results for optimal nodal control problems in gas networks.
Probabilistic constraints are included since they allow to take into account the uncertainty of e.g. the customer demand.

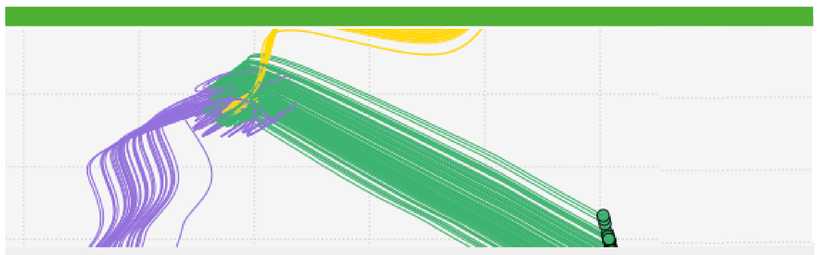
Martin Gugat, Rüdiger Schultz, Michael Schuster



Sharp Estimates in Defective Evolution Equations: From ODEs to Kinetic Equations with Uncertainties

With the goal of quantifying model sensitivity with respect to uncertainty for linear kinetic PDEs, we construct Lyapunov functionals that capture the sharp long-time behavior of solutions for the sensitivity equations.

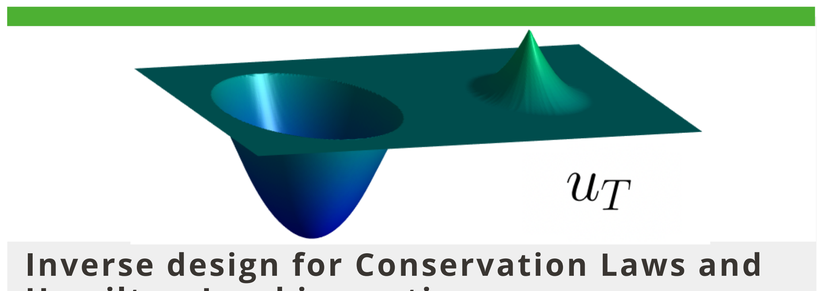
Tobias Wöhrer, Anton Arnold, Shi Jin



Machine learning via control of Neural ODEs

A workhorse behind the recent successes of DL are residual neural networks. Due to the dynamical nature of these networks, an associated ODE formulation allows us to understand learning via high-dimensional simultaneous control, and the stabilizing impact of the depth via the turnpike property in optimal control.

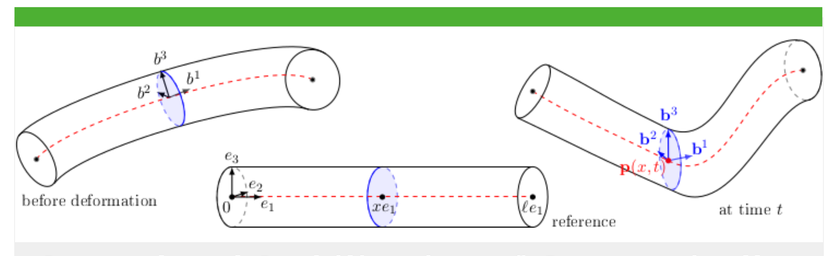
Borjan Geshkovski, Enrique Zuazua



Inverse design for Conservation Laws and Hamilton-Jacobi equations

For Scalar Conservation Laws and Hamilton-Jacobi equations, backward uniqueness is eventually lost due to shock formation, making the dynamics time-irreversible. We present a method to construct all the possible initial conditions which are compatible with a given observation.

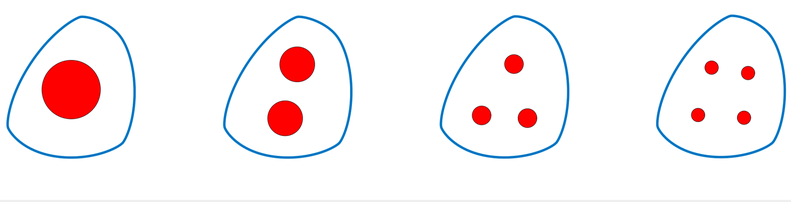
Carlos Esteve, Enrique Zuazua



Control and Stabilization of Geometrically Exact Beams

To model highly flexible structures, we use geometrically nonlinear beam models on networks, and then tackle problems of stabilization and control of nodal profiles -- a 'weaker' notion of controllability allowing us to deal with loops.

Charlotte Rodríguez, Günter Leugering, Yue Wang



Optimal shape design of sensors via a geometric approach

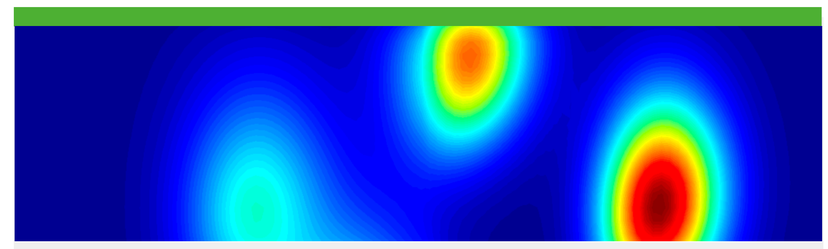
The optimal shape and placement of sensors frequently arises in industrial applications such as urban planning and temperature and pressure control in gas networks. We consider a simple and natural geometric criterion of performance, based on distance functions.

Ilias Ftouhi, Enrique Zuazua

Long Time Control

We demonstrate the need for long times in control dynamics, for a constrained diffusion model. The validity of the turnpike property is shown for a prototypical optimal control problem.

Dario Pighin, Enrique Zuazua



Sparse Initial Source Identification for a Diffusion – Advection Equation

The identification of moving pollution sources in fluids that can be described by diffusion-advection systems and can be mathematically modeled by initial source identification problems of diffusion-advection systems, where the initial source is assumed to be sparse.

Umberto Biccari, Yongcun Song, Yuan Xiaoming, Enrique Zuazua