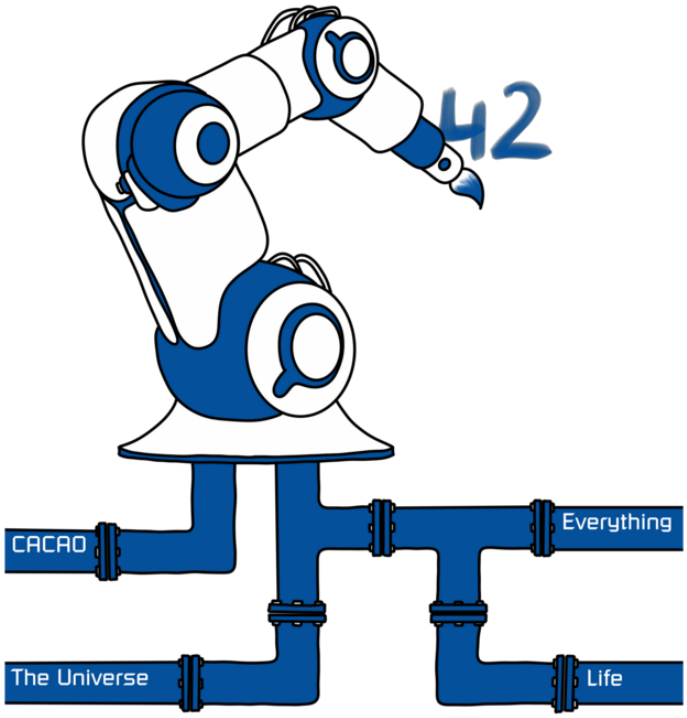
Conference on Applied, Computational and Algorithmic Optimization

September 25-26, 2023

dedicated to Marc C. Steinbach

Conference Booklet



Welcome Message

It's a great pleasure to welcome you to the

"**C**onference on **A**pplied, **C**omputational and **A**lgorithmic **O**ptimization"

in honor of the 60th birthday of

Marc C. Steinbach (Leibniz Universität Hannover).

The mission of the "Conference on Applied, Computational and Algorithmic Optimization", which will be held during September 25 - September 26, 2023, is to bring together academic fellows and companions of Marc, whose (research-) interests engage with the various works of Marc C. Steinbach. We want to celebrate Marc's various contributions to the international academic community as well as industry and business. For almost two decades Marc has been a teacher, supervisor, and an ongoing driving force behind the development of optimization and applied mathematics in Hannover.

Dear colleagues and friends, welcome and thank you for participating at the CACAO 2023. It is a great pleasure for us to enjoy our conference together with Marc and you.

The organizers:

Sven Beuchler
Christian Günther
Denis Khimin
Natascha Krienen
Senta Lange
Jenny Schubert
Anne-Kathrin Wenske
Thomas Wick

Marc C. Steinbach

Marc Christian Steinbach was born on August 28, 1963 in Mainz, Germany. He received his diploma in mathematics from the University of Bonn in 1987, his Ph.D. in mathematics from the University of Heidelberg in 1995, and his Habilitation in mathematics from the Technical University of Berlin in 2002. In 2006, he was a visiting research professor at the Vorarlberg University of Applied Sciences in Dornbirn, Austria. Since August 2006, Marc C. Steinbach has been working as professor and head of the Algorithmic Optimization Group at the Institute of Applied Mathematics of the Leibniz University Hannover.

Figure 1: Marc C. Steinbach

Marc C. Steinbach has made numerous contributions to the international academic community, industry and business. In particular, his research focuses on the following topics:

- Operations research, mathematical programming,
- Numerical analysis and optimization,
- Calculus of variations and optimal control,
- Mechanics of deformable solids, particles and systems,
- Gas and water networks.

In addition to his great achievements in Algorithmic Optimization and his well-developed and exciting lectures in Numerics and Optimization, Marc is well-known for combining his lectures with historical aspects of mathematics. In Marc's lecture "Numerical Mathematics 1" one learns, for example, about the following great personalities

Joseph-Louis Lagrange; Brook Taylor; Michel Rolle; Charles Hermite; Pafnuti Lwowitsch Tschebyschow; Augustin Louis Cauchy; Wiktor Jakowlewitsch Bunjakowski; Hermann Amandus Schwarz; Sir Isaac Newton; Roger Cotes; Georg Friedrich Bernhard Riemann; Thomas Simpson; Johannes Kepler; Evangelista Torricelli; Edward Arthur Milne; Thomas Weddle; Johann Carl Friedrich Gauß; Adrien-Marie Legendre; Henri Leon Lebesgue; Euklid von Alexandria; Charles William Clenshaw; A. R. Curtis; Jean Baptiste Joseph Fourier; Ferdinand Georg Frobenius; David Hilbert; William George Horner; Gabriel Cramer; Andre-Louis Cholesky; Alexandre-Theophile Vandermonde; Svante August Arrhenius; Carl Gustav Jacob Jacobi; Philipp Ludwig von Seidel; Marie Ennemond Camille Jordan; John William Strutt (Lord Rayleigh); Magnus Rudolph

Hestenes; Eduard L. Stiefel; Konrad Zuse; General Alexei Nikolajewitsch Krylow; Stefan Banach; Rudolf Otto Sigismund Lipschitz; Leonid Witaljewitsch Kantorowitsch

while in his lecture "Numerical Mathematics 2" one learns about

Jørgen Pedersen Gram; Erhard Schmidt; Alston Scott Householder; James Wallace Givens, Jr; Eliakim Hastings Moore; Sir Roger Penrose; William Karush; Harold William Kuhn; Albert William Tucker; Ludwig Otto Hesse; Friedrich Ludwig Bauer; Charles Theodore Fike; John William Strutt (Lord Rayleigh); Richard Courant; Ernst Sigismund Fischer; Issai Schur; Karl Adolf Hessenberg; John G. F. Francis; Vera Nikolaevna Kublanovskaya; Mark Kac; Gene Howard Golub; Jean Baptiste Joseph Fourier; Jean-Luc Picard; Charles Emile Picard; Ernst Leonard Lindelöf; Alexander Michailowitsch Ljapunow; Leonhard Euler; Carl David Tolme Runge; Karl Heun; Martin Wilhelm Kutta; Erwin Fehlberg; Balthasar van der Pol; Rehuel Lobatto; Sergei Lwowitsch Sobolew; Cesare Arzela; Giulio Ascoli; Boris Grigorjewitsch Galerkin; Paul Adrien Maurice Dirac.

In the following we would like to present you some facts about Marc's professional experience and education as well as some other important facts about Marc C. Steinbach.

Professional experience

- 08/2006 - today
  Professor of Algorithmic Optimization, Leibniz Universität Hannover
- 01/2006 – 08/2006
  Visiting Research Professor, Vorarlberg University of Applied Sciences in Dornbirn, Austria
- 01/2003 - 12/2005
  Private lecturer, Technische Universität Berlin
- 01/1997 – 12/2005
  Postdoctoral research scientist in the group of Professor M. Grötschel, Department Optimization, Konrad-Zuse-Zentrum für Informationstechnik Berlin
- 11/1991 – 12/1996
  Research scientist in the group of Professor H.G. Bock, Interdisciplinary Center for Scientific Computing (IWR), Ruprecht Karls Universität Heidelberg
- 11/1991 – 12/1996
  Research scientist in the group of Professor H.G. Bock, Interdisciplinary Center for Scientific Computing (IWR), Ruprecht Karls Universität Heidelberg
- 07/1990 – 07/1991
  Research scientist in the group of Professor G. Sachs, Chair of Flight Mechanics and Flight Control, Technische Universität München
- 10/1989 – 07/1990, 07/1991 – 10/1991
  Research associate in the group of Professor H.G. Bock, Institute of Mathematics, Universität Augsburg

Education

- 02/2002
  Habilitation in Mathematics, Technische Universität Berlin, Professor M. Grötschel, Professor R. Schultz, Professor M. Heinkenschloss, Professor W. Römisch,
  Title: "*Numerical Algorithms for Deterministic and Stochastic Dynamic Optimization*"

- 06/1995
  Dr. rer. nat. in Mathematics, Universität Heidelberg, Professor H.G. Bock, Professor G. Reinelt,
  Title: "*Fast Recursive SQP Methods for Large-Scale Optimal Control Problems*"

- 02/1987
  Diploma in Mathematics, Universität Bonn, Professor J. Frehse, Professor G. Dziuk,
  Title: "*Numerische Berechnung optimaler Steuerungen für Industrieroboter*"

- 10/1981–02/1987
  Mathematics and physics studies, Universität Bonn

Further key facts

- **Functions and responsibilities in Hannover:**
  Faculty advisor for mathematics studies (2023-); Managing director, Institute of Applied Mathematics (2009–2011, 2014-2017); Head of mathematics admissions committee (2008–2012); Head of mathematics audit committee (2008–2009); Member of faculty council, Faculty of Mathematics and Physics (04/2007–04/2009, 04/2011–04/2013, 04/2015–04/2019)

- **Other functions and responsibilities:**
  Chair, Special Interest Group Optimization, German Mathematical Society, DMV (2011–2016); Junior Chair, Special Interest Group Optimization, German Mathematical Society, DMV (2006–2011); Reviewer services for international journals, research organizations, book publishers; Editor of international journals

- **Scientific work:**
  75 publications (Journal articles, Book chapters, Proceedings articles, Theses, Miscellaneous)

- **Funded projects in Hannover:**

  01/2021 – 01/2024
  PI, Collaborative Research Centre 1463 (DFG): *Integrated design and operation methodology for offshore megastructures*, subproject *Efficient simulation and model reduction for offshore wind turbines*

  04/2019 – 03/2023
  Member, Exchange Program Leibniz Universität Hannover with IIT Indore, India (DAAD)
  A new passage to India

  12/2016–11/2017
  EXIST-Gründerstipendium (BMWi, founder scholarship): *DressLife*

03/2013 - 02/2015
PI, Bottom-up Project (NTH: Niedersächsische Technische Hochschule), *Enwicklung von Optimierungsverfahren für den Verdichtereinsatz in der Erdgasinfrastruktur zum Speichern regenerativer Energien*, Cooperation: TU Clausthal

10/2008 – 12/2013
PI, Industry Project (OpenGrid Europe GmbH, Essen) Forschungskooperation *Netzoptimierung*, Cooperation: Humboldt-Universität zu Berlin, WIAS Berlin, ZIB Berlin (coordination), TU Darmstadt, Universität Duisburg-Essen, Universität Erlangen-Nürnberg

07/2009 – 06/2012
PI, Collaborative Project (BMWi: Federal Ministry for Economic Affairs and Energy) Technische Kapazitäten von Gasnetzen, subproject *Monotonie, Konvexität und Sensitivität der Kapazität in stationären Gas-Netz-Modellen*, Cooperation: Open Grid Europe GmbH, Essen, Bundesnetzagentur, Humboldt-Universität zu Berlin, WIAS Berlin, ZIB Berlin (coordination), TU Darmstadt, Universität Duisburg-Essen, Universität Erlangen-Nürnberg

05/2007 – 04/2010
PI, Industry Project (PANalytical B.V., Almelo, The Netherlands), *Optimization for advanced materials analysis by X-Ray Diffraction*

04/2006 – 03/2007
PI, Industry Project (Berliner Wasserbetriebe, Veolia Water), *Umsetzung eines Entscheidungshilfesystems zur Verbundsteuerung von Abwasserpumpwerken und Analyse weitergehender Steuerungsvarianten*, Cooperation: Berliner Wasserbetriebe, KompetenzZentrum Wasser Berlin gGmbH (coordination), ZIB Berlin

- **Supervisor of PhD students (finished):**
  Lisa C. Hegerhorst-Schultchen (2020), Daniel Rose (2017), Jan Thiedau (2017), Jens Hübner (2016), Bernhard M. Willert (2014), Martin Schmidt (2013), Klaas Eggert (2012)

- **Supervisor of PhD students (ongoing):**
  Denis Khimin (2020-), Senta Lange (2020-), Jenny Schubert (2021-), Anne-Kathrin Wenske (2023-)

- **Member or External Referee in PhD Committees:**
  Timo Kreimeier (2023), Olga Weiß (2021), Sabrina Fiege (2017), Dai Pham Duc (2015), Astrid Intas (2010), Sebastian Kuhn (2008)

- **47 co-authors (according to MathSciNet):** Martin Schmidt, Bernhard Willert, Hans Georg Bock, Lisa C. Hegerhorst-Schultchen, Christian Kirches, Thomas Wick, Cristian Guillermo Gebhardt, Richard W. Longman, Raimund Rolfes, Jens Burgschweiger, Bernd Gnädig, Dominik Schillinger, Jens Hübner, Denis Khimin, René Henrion, Rüdiger Schultz, Ralf Gollmer, Georgii V. Kostin, Alexander Martin, Gottfried Sachs, Volker H. Schulz, K. Lesch, Thorsten Koch, Marc E. Pfetsch, Pu Li, Izaskun Garrido, Andris Möller, Moritz Wendt, Günter Wozny, Benjamin Hiller, Lars Schewe, Armin R. Fügenschuh, Stefan Vigerske, Kapil Ahuja, Antonio Morsi, Björn Geißler, Robert Schwarz, Jonas Schweiger, Thomas Lehmann, Claudia Stangl, Jesco Humpola, Jessica Rövekamp, Nina Geißler, Daniel Rose, Imke Joormann, Bernhard Endtmayer, Jenny Schubert

- **Lectures at the Leibniz University Hannover:**
  Numerische Mathematik 1 und 2, Konvexe Optimierung, Numerik für Informatik und Computergestützte Ingenieurwissenschaften, Mathematik 1 und 2 für Studierende der Wirtschaftswissenschaften, Numerik der nichtlinearen Optimierung 1 und 2, Optimierung bei Differentialgleichungen, Lineare Optimierung, Mathematische Modellbildung, Algorithmisches Programmieren, Dynamische Optimierung, Nichtglatte Optimierung

We all know Marc C. Steinbach as a great human being, a wonderful friend, and an excellent mentor of more than 11 (finished, ongoing) PhD students. On the occasion of his 60th birthday, we wish him good health, many productive years to come, and all the best in his life.

General Information

Local organizers

Prof. Dr. Sven Beuchler
Prof. Dr. Thomas Wick
Dr. Christian Günther
M.Sc. Denis Khimin
M.Ed./ M.Sc. Senta Lange
M.Sc. Jenny Schubert
M.Sc. Anne-Kathrin Wenske
Natascha Krienen

Contact

If you have any questions, please do not hesitate to contact us:

`cacao@conference.uni-hannover.de`

Information for participants

Information about this event will be posted here:

`https://www.ifam.uni-hannover.de/de/cacao`.

The conference will take place at the

Leibniz Universität Hannover,
Institut für Angewandte Mathematik,
Welfengarten 1,
30167 Hannover,

Lecture room: **B305**
Registration and coffee breaks: in front of the room **F335**
Conference Dinner: **Al-Dar**, Königsstraße 3, 30175 Hannover, `https://aldar.de/hannover`

Information for speakers

All invited speakers (denoted with (*) behind the time in the program) will have 45 minutes per talk while all other speakers will have 20 minutes per talk. Please note that the lecture times as given in the program already include some minutes for discussion. Session chairs will make sure that speakers do not exceed their allocated time.

1st CACAO Day: Monday, September 25, 2023

Time	Activity information
09:00 - 09:45	**Registration** (Room F335)
09:45 - 10:00	**Laudations** (Room B305)
	Session 1 (Room B305, Chair: Christian Günther)
10:00 - 10:45 (*)	**Hans Georg Bock**: *Inverse Optimal Control Problems and Applications to Modeling the Gait of Cerebral Palsy Patients*
10:45 - 11:30 (*)	**Cristian Gebhardt**: *Some methods and applications in computational mechanics*
11:30 - 11:50	**Sebastian Probst**: *Studying and handling the varieties of dynamical systems in natural sciences and industry*
11:50 - 13:00	Lunch break
	Session 2 (Room B305, Chair: Denis Khimin)
13:00 - 13:45 (*)	**Martin Schmidt**: *15 years of gas network optimization*
13:45 - 14:05	**Jan Thiedau**: *Numerical studies for applications in the field of supply and disposal*
14:05 - 14:25	**Bernhard Michael Willert**: *Digitalization shapes the future of logistics*
14:25 - 15:00	Coffee break
	Session 3 (Room B305, Chair: Senta Lange)
15:00 - 15:20	**Volker Schulz**: *Algorithmic Optimization - Now and Then*
15:20 - 15:40	**Djamal Oucherif**: *Demonstrating the potential impact of climbing Mount Stupid in many different areas of life: a case study*
15:40 - 16:00	**Lisa Hegerhorst-Schultchen**: *From university to today*
16:00 - 16:30	Small break
	Marc Session (Room C311, Chair: IfAM)
16:30 - 17:30	**Marc C. Steinbach**
18:00 -	Conference Dinner (Restaurant Al-Dar)

2nd CACAO Day: Tuesday, September 26, 2023

Time	Activity information
	Session 1 (Room B305, Chair: Jenny Schubert)
9:00 - 9:45 (*)	**Andreas Potschka**: *Parallel Preconditioners for Tree-Sparse Optimization Problems*
9:45 - 10:05	**Fleurianne Bertrand**: *Stress-based finite element methods for phase-field fracture optimal control problems*
10:05 - 10:25	**Denis Khimin**: *A more general approach to phase-field fracture optimal control problems*
10:25 - 11:00	Coffee break
	Session 2 (Room B305, Chair: Anne-Kathrin Wenske)
11:00 - 11:45 (*)	**Christian Kirches**: *Block structures from optimal control in quadratic programming*
11:45 - 12:05	**Senta Lange**: *Optimization models of contact problems in hybrid Data-Driven Computational Mechanics*
12:05 - 12:25	**Jenny Schubert**: *Antificial Intelligence*
12:25 - 12:45	**Anastasija Kartamysheva**: *My path to mathematical optimization*
12:45 - 13:00	**Final words** (Martin Steinbach, Thomas Wick)

Abstracts of the Speakers

Hans Georg Bock (Monday, 10:00 - 10:45)

Universität Heidelberg, Interdisciplinary Center for Scientific Computing (IWR)

▷ Inverse Optimal Control Problems and Applications to Modeling the Gait of Cerebral Palsy Patients

The presentation discusses numerical approaches for solving inverse optimal control problems as complex bi-level dynamic optimization problems: a nonlinear approximation problem on the upper level and a nonlinear optimal control problem (OCP) with jumps and switching conditions and mixed path-control constraints on the lower level. The OCP solution can be considered as a model that describes autonomous optimal processes in nature such as human gait. However, the optimal control model includes unknown parameters that need to be determined by fitting its solution to measurements in the upper level optimization. We develop a direct mathematical all-at-once approach for solving this relatively new class of problems, and apply this to identify biomechanical optimal control models for the gait of cerebral palsy patients from real-world motion capture data obtained by the Motion Lab of the Orthopedic University Hospital Heidelberg.

Cristian Gebhardt (Monday, 10:45 - 11:30)

University of Bergen, Geophysical Institute (GFI) and Bergen Offshore Wind Centre (BOW)

▷ Some methods and applications in computational mechanics

Computational mechanics can be regarded as a sub-discipline of theoretical and applied mechanics concerned with the use of computational methods and devices to study events governed by the principles of mechanics. However, such can be seen as well as a sub-discipline of predictive computational science. In few words, this exciting field deals with the formulation, calibration, numerical solution, verification and validation of mathematical models targeting at predicting the behavior of mechanical systems. In addition, this can also be associated to the presence of uncertainties. Regardless of its many flavors or associated perspectives, computational mechanics has been proven to be a fundamental tool in many dissimilar fields.

In this invited talk, I will present some of the work that I carried out in the last decade and a half within the field of computational mechanics, specifically rigid and flexible solids as well as fluid-structure interaction. The first part is concerned to numerical methods, which within that scope are designed to preserve some invariance laws that are essential to produce meaningful physical pictures. The second part deals with the systematic application of these numerical methods to approximately investigate the mechanical behavior of systems that are relevant in engineering, ranging, for instance, from bio-inspired micro-swimmers to wind turbines.

Sebastian Probst (Monday, 11:30 - 11:50)

IAV GmbH

▷ Studying and handling the varieties of dynamical systems in natural sciences and industry

Although, as the conference logo already reveals, the final answer is 42, the variety of ways to reach that insight can be very versatile, but mostly comprises studying, processing, and application of dynamical systems; be it energy distribution systems, population genetics, power trains or microcontroller compounds. An applied mathematician with hands-on mentality can contribute substantially to any of those fields - especially, if you are able to use computational support to automate recurring tasks or hard calculations, and to write your code as CLEAN as possible.
The latter attitude, then, also predestines for quality assurance purposes of software development. Enjoying finding errors and corner cases, curiosity and accuracy, professional pessimism and a critical view are prerequisites for being a good software tester. And those become more relevant in a more and more connected world with growing software systems controlling machines that could harm life and limb - and do not have the only purpose of answering the "Ultimate Question of Life, the Universe, and Everything".

Martin Schmidt (Monday, 13:00 - 13:45)

Universität Trier, Mathematik

▷ 15 years of gas network optimization

15 years ago, in 2008, I started my PhD under the supervision of Marc. Within a large industrial project (ForNe), we studied the modeling and optimization of gas networks. What started with "simple" nonlinear but purely continuous optimization for stationary regimes later lead to a large branch of research including mathematical programming with complementarity constraints, mixed-integer nonlinear optimization, or mixed-integer optimization with PDE constraints. Besides theses advancements in the field of gas network optimization, the joint research with Marc also influenced general-purpose methods such as the penalty alternating direction method for mixed-integer nonlinear problems or novel techniques in the area of domain decomposition for problems constrained with differential equations.

This talk will try to give an overview of the research within the last 15 years.

Jan Thiedau (Monday, 13:45 - 14:05)

Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) im GEOZENTRUM, Hannover

▷ **Numerical studies for applications in the field of supply and disposal**

Supply and disposal structures in times of changing requirements are not only a central aspect of infrastructure planning, but also the motivation for many scientifically interesting questions. During my time at IfAM, the focus was on different applications in supply and disposal networks for natural gas and wastewater with numerical optimization. Since then I have been working on numerical simulations in the context of nuclear waste disposal.

The latter, located at the interface between engineering and geosciences, involves a number of interesting and challenging issues. The long assessment periods and as well as the mutual coupling of different processes can only be assessed bases on numerical simulations. This requires validated and verified computational models as well as efficient numerical methods and workflows to handle the complex geological and engineering systems. The limited capacity to characterize the geological barrier leads to the challenge to assess the impact of the induced uncertainties. In addition, the special public interest in the subject area places further demands on the repository system analysis.

This talk will give a short overview of my past and current work in the area of supply and disposal.

Bernhard Michael Willert (Monday, 14:05 - 14:25)

▷ **Digitalization shapes the future of logistics**

The world of logistics has drastically sped up in recent years.
On-demand ordering, next-day delivery and just-in-time supply are taken for granted, while trends like lean warehousing, supply chain agility, supply chain transparency and real-time information put additional pressure on logistics.
To keep up with the growing demands from society and economy, it is crucial to optimize and re-invent transportation processes and to streamline decision making with digitalization and automation.
This talk will put a spotlight on aspects of modern railway transportation and intralogistics. Involved mathematical problems will be described and the impacts on an adaptable software architecture will be discussed.

Volker Schulz (Monday, 15:00 - 15:20)

Universität Trier, Institut für Mathematik

▷ **Algorithmic Optimization - Now and Then**

Algorithmic Optimization plays an ever more important role in the scientific communities of mathematics and data science. In this talk, we explore historic roots as well as current developments. Of particular importance will be events in the early days of algorithmic optimization before the Hannover phase and their relations to current events in Trier.

Djamal Oucherif (Monday, 15:20 - 15:40)

▷ **Demonstrating the potential impact of climbing Mount Stupid in many different areas of life: a case study**

Mount Stupid is a phenomenon closely related to the Dunning-Kruger effect. We present an instructive example that illustrates the possible effects that systematically climbing Mount Stupid can have on a person in very different areas.

Lisa Hegerhorst-Schultchen (Monday, 15:40 - 16:00)

▷ **From university to today**

I will take you on a journey and we will see which mathematical and computational problems have been on my way until now. We will start at my time as a Phd student in Marc's group where I did research on optimality conditions for abs-normal NLPs. Then, I left university to work in a start-up on solving the travelling salesman and the vehicle routing problem. In February, I started to work in the Analytics team of an insurance company and will give a short overview what I am doing there.

Andreas Potschka (Tuesday, 9:00 - 9:45)

Technische Universität Clausthal, Institut für Mathematik

▷ **Parallel Preconditioners for Tree-Sparse Optimization Problems**

Tree-sparse optimization problems (see, e.g., [1]) originate in a number of important application problems, including stochastic programming, distributed control, and domain decomposition techniques for optimal control problems. A recently developed optimization method [2] results in a sequence of large-scale structured linear systems, whose condition number can be controlled and which only need to be solved approximately. We show recent advances for the application of iterative linear algebra and the design of structure-exploiting preconditioners. These preconditioners are are based on Schur complements and allow for a high level of parallelism.

[1] Steinbach, M. Tree-sparse convex programs. Mathematical Methods of OR 56, 347–376 (2003).

[2] Potschka, A., Bock, H.G. A sequential homotopy method for mathematical programming problems. Mathematical Programming 187, 459–486 (2021).

Fleurianne Bertrand (Tuesday, 9:45 - 10:05)

Technische Universität Chemnitz, Fakultät für Mathematik

▷ Stress-based finite element methods for phase-field fracture optimal control problems

Since large stress components may cause plastic behavior or even damage, their accurate resolution associated with numerical simulations is of paramount importance in the phase-field optimal control problems introduced in [1] and [2]. In particular, the finite element spaces must allow the evaluation of boundary traces. However, for standard displacement- based approaches, the normal component of the boundary traces of the associated stresses are not defined. To overcome this problem, this talk highlights variational principles which involve stresses in H(div)-like saddle point formulations of Hellinger-Reissner-type and first-order system least squares approaches.

[1] I. Neitzel, T. Wick, and W. Wollner. An optimal control problem governed by a regularized phase-field fracture propagation model. SIAM Journal on Control and Optimization, 55(4):2271–2288, 2017.

[2] D. Khimin, M. C. Steinbach, and T. Wick. Optimal control for phase-field fracture: Algorithmic concepts and computations. In F. Aldakheel, B. Hudobivnik, M. Soleimani, H. Wessels, C. Weißenfels, and M. Marino, editors, Current Trends and Open Problems in Computational Mechanics. Springer, 2022.

Denis Khimin (Tuesday, 10:05 - 10:25)

Leibniz Universität Hannover, Institut für Angewandte Mathematik

▷ A more general approach to phase-field fracture optimal control problems

In this work we consider a space-time continuous phase-field fracture model as an abstract energy minimization problem in a Banach space. The goal is to derive the optimality conditions for such formulation, where special emphasis is on the concrete choice of the function spaces to ensure the required regularity. Afterwards we formulate a higher level optimal control problem, where the constraits are given by the previously derived optimality conditions of phase-field fracture.

Christian Kirches (Tuesday, 11:00 - 11:45)

Technische Universität Braunschweig, Institut für Mathematische Optimierung

▷ Block structures from optimal control in quadratic programming

Time discretizations of optimization problems constrained by differential equations induce partial separability properties of objective and constraints. This is known to result in intricate block structures of gradient, Jacobians, and Hessians. Exploitation of such block structures in nonlinear programming bears significant potential for speeding up the solution process. We review structure exploitation ideas for the Quadratic Programming problems that arise in the Sequential Quadratic Programming approach and the Interior Point approach to solving nonlinear programming problems.

Senta Lange (Tuesday, 11:45 - 12:05)

Leibniz Universität Hannover, Institut für Angewandte Mathematik

▷ **Optimization models of contact problems in hybrid Data-Driven Computational Mechanics**

The Data-Driven Computational Mechanics (DDCM) approach replaces the empirical strain-stress equation with the requirement that strain-stress pairs computed in the overall model are closest to a given data set. A recent hybrid DDCM approach requires that a material model has to be reconstructed from the data in an offline step. This reconstruction by a smooth constitutive manifold is then followed by solving a NLP in a second step.
This talk addresses different perspectives of the online step, where in particular the presence or absence of inequality constraints makes a significant difference. In our work, we study various contact problems by introducing geometric inequalitiy constraints. Under consideration of acting constraint forces, the NLP generalizes to a MPCC. Our new "quick shot" approach drops complementarity in MPCC and can yield to physically reasonable solutions by solving up to four NLPs.

Jenny Schubert (Tuesday, 12:05 - 12:25)

Leibniz Universität Hannover, Institut für Angewandte Mathematik

▷ **Antificial Intelligence**

With the rapid development of artificial intelligence in recent years, there is one type of intelligence that has been largely overlooked: The swarm intelligence of ant colonies. Not only can it be used to solve routing problems like the traveling salesman problem, but also for scheduling problems and image processing.

Ants, or more precisely Ant Colony Optimization, have been in my life since I held a talk about the Traveling Salesman Problem in 7th grade. I will take you and my artificial ants on a (hopefully fun) journey through a few hours of not too serious work on this particular swarm intelligence algorithm.

Anastasija Kartamysheva (Tuesday, 12:25 - 12:45)

Leibniz Universität Hannover, Institut für Angewandte Mathematik

▷ **My path to mathematical optimization**

In my master's thesis I analyzed an NLP modeling a single bifurcation of blood vessels under Marc's supervision. This problem is the simplest form of the NLP used in a framework for generating synthetic vascular trees. The goal was to determine if Murray's law holds without prescribing it, which is a special relationship between the radii of the blood vessels. I will talk about how I acquired the tools I used for that analysis and give an overview of the problem and the results.

Notes

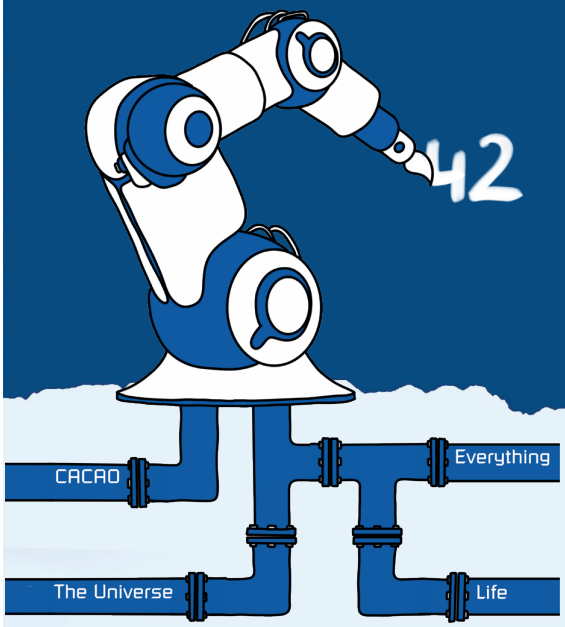
Notes

September 25 – September 26, 2023

Leibniz Universität Hannover

CACAO – Conference on Applied, Computational and Algorithmic Optimization

Conference in Honor of the 60th Birthday of Marc C. Steinbach



Leibniz Universität Hannover
Welfengarten1
B305

Invited Speakers

Hans Georg Bock
Interdisciplinary Center for Scientific Computing,
University of Heidelberg

Cristian C. Gebhardt
Bergen Offshore Wind Centre,
University of Bergen

Christian Kirches
Institute for Mathematical Optimization,
Technical University of Braunschweig

Andreas Potschka
Institute of Mathematics,
Clausthal University of Technology

Martin Schmidt
Department of Mathematics,
Trier University

Organizing Committee

Sven Beuchler, Christian Günther,
Denis Khimin, Natascha Krienen,
Senta Lange, Jenny Schubert, Thomas Wick

www.ifam.uni-hannover.de/de/cacao