GOR Gesellschaft für Operations Research e.V.

Kackertstr. 7 52072 Aachen Tel.: +49 (0) 241 80 23830 Fax: +49 (0) 241 6 80 23830

GOR-AG: Praxis der Mathematischen Optimierung
Dr. Jens Schulz

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We invite you to the 110th meeting of the GOR working group "Practice of Mathematical Optimization". This meeting is planned to be held in person with the topic

High Performance Computing

The workshop will take place at the physics center in Bad Honnef (DPG – Deutsche Physikalische Gesellschaft) on Thursday and **Friday, March 12 & 13, 2026**.
The working language will be English.

Participation in the workshop is free for all GOR members, speakers, and hosts. Otherwise, the participation charge is 50€ for bachelor's and master's students, and 100€ for everyone else.
For accommodation, food, and drinks, a service charge needs to be paid at the Physics Center. We strongly advise you to book your stay and travel, acknowledging that the on-site event may be canceled on short notice. In this case, the organizers will waive the registration fee but will not refund any other costs.

Please, enter your selected stay during registration:

- Thursday to Friday (1 night at DPG): 190 Euro (incl 1 breakfast on Friday)
- Thursday to Friday (stay at hotel nearby; 1 breakfast at DPG): 117 Euro (incl 1 breakfast on Friday)
- Thursday to Friday (stay at hotel nearby; no breakfast): 107 Euro

All options include conference dinner, 2 lunches and coffee breaks

Please, register via www.redseat.de/pmo110

The latest information on the meeting is available on the homepage of the GOR (http://www.gor-ev.de/arbeitsgruppen/praxis-der-mathematischen-optimierung/real-world-optimization).

Yours sincerely,

Jens Schulz, Julia Kallrath, Josef Kallrath (GOR AG)

Thorsten Koch (Zuse Institut Berlin)

High Performance Computing

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Specific aims

This workshop aims to bring together researchers, practitioners, and students from applied mathematics, computer science, engineering, and related disciplines to explore the intersection of **advanced optimization techniques** and **cutting-edge computational methods on modern hardware**.

Key Topics Include:

- Large-scale optimization algorithms
- Parallel and distributed computing
- Real-world applications in science, engineering, and industry
- Recent developments in HPC architectures and their use in optimization
- Advances in GPU-accelerated computing for optimization
- Quantum computing approaches to combinatorial and continuous optimization
- Software tools and frameworks for optimization on HPC systems

We especially welcome presentations on the practical aspects of modeling and solving related problems on modern hardware. If you have conducted a study comparing different computational methods, ideally on real-world mathematical optimization problems as they occur in practice, and want to share your insights, this is the right forum.
Application areas of high interest range from energy, transportation, logistics, supply chain, chemical engineering, e-commerce and finance. We similarly value contributions from other fields.

The core of this 2-day workshop will feature an engaging schedule of talks covering a broad range of mathematical techniques, theoretical considerations, and real-world applications. As usual, we will reserve plenty of time for informal exchange and networking.
In talks of **35 + 10 min** duration, experts from practice and research will address problems and solutions.

If you would like to contribute a talk, please feel free to contact the organizer.

Jens Schulz (schulz-gor ‘at’ gmx.net)

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The venue & accommodation

Venue

Deutsche Physikalische Gesellschaft (DPG)
https://www.dpg-physik.de/ueber-uns/physikzentrum-bad-honnef/kontakt-anfahrt
Physikzentrum Bad Honnef
Hauptstraße 5
53604 Bad Honnef

How to get there?
Bad Honnef has good train connections from Cologne, and a 15 minutes walk from the train station to the venue.

Accommodation

The physics center offers accommodation for up to 50 participants starting on Thursday. You can choose to stay in a hotel nearby all nights as well. Please select the appropriate option during registration.

Recommended hotels nearby:

- (PREFERRED) Hotel The Yard; *7min walking distance;* https://hotel-badhonnef.com/
  use "GOR-PMO" when requesting a room via info@hotel-badhonnef.com
  Special rates:
  7 Standard rooms at 72€/night incl breakfast
  13 Comfort rooms at 82€/night incl breakfast

- Seminaris Hotel (96€/night incl breakfast if booked before March 1), 10min walking distance: https://bookings.seminaris.de/

Pre-conference get-together

For arrivals on Wednesday, we will arrange a table at a nearby restaurant.
Please inform the organizers if you plan to attend. Everyone pays their bill themselves.

Conference dinner

The conference dinner will take place at the Physics Center on Thursday evening at 7 pm in the nice wine cellar of Physikzentrum Bad Honnef.

Excursion

To be announced. In past years, we did a walking tour to the Konrad Adenauer House.

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Talks

In alphabetical order of author's last name

- **Tba (*GAMS and cuOpt*)**
  Michael Bussieck (GAMS)

- **Tba *(Tutorial GPU)***
  Akif Coerduek

- **Aspects of modelling and solving binary linear problems in a hybrid quantum-classical setup**
  András Czégel

- **Quantum Optimization for combinatorial optimization problems: Amplitude Amplification based approaches.**
  Laurien Demmler (Infineon)

- **GPU-accelerated heuristics for production planning and scheduling**
  Ambros Gleixner & Alexander Hoen (HTW Berlin)

- **From Large Scale Industrial Optimization to Quantum-Ready Models: Hybrid Solver Pipelines and Practical Benchmarks**
  Thomas Hußlein (OptWare GmbH)

- **GPU-Accelerated Heuristics for General-Purpose Mixed-Integer Programs.**
  Nils Christian Kempke (Zuse Institute Berlin)

- **Experiences in Super Computers, GPUs, and Quantum Computing**
  Thorsten Koch (Zuse Institute Berlin)

- **Computational Insights into Solving Optimization Instance Sets with MIP Solvers on Multi-Core Hardware**
  Willi Leinen (Helmut Schmidt University Hamburg)

- **Energy system modeling with PIPS-IPM++ on HPCs**
  Manuel Wetzel

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Abstracts

Aspects of modelling and solving binary linear problems in a hybrid quantum-classical setup
András Cégel

How to exploit the structure of linear programs in quantum optimization? What are practically relevant aspects of the physical encodings? After answering these questions, I show classically integrated hybrid quantum optimization algorithms that utilize these aspects in two different ways: a constraint generation routine, which aims to provide good-quality solutions fast, and a complete branch-and-bound scheme that decomposes the original problem with respect to the physical structure and is measurable by metrics like the primal-dual integral.

Quantum Optimization for combinatorial optimization problems: Amplitude Amplification based approaches.
Laurien Demmler (Infineon)

Amplitude amplification offers quadratic speedups for unstructured search but turning that into a practical advantage for combinatorial optimization depends on how we prepare and manipulate quantum states. This talk examines amplitude-amplification-based approaches through the lens of knapsack problems. After a concise introduction to quantum computing, Grover's algorithm, and amplitude amplification, the focus shifts to the central challenge: efficient, constraint-aware state preparation. Using "Quantum Tree Generator" style circuits (motivated by classical feasible states sampling), we coherently build superpositions that contain only feasible solutions by pruning branches that would violate capacity and accumulating weights and profits with unitary arithmetic. We then show how to convert feasibility search into optimization via Grover Adaptive Search, including oracle construction for profit comparisons and practical iteration schedules that handle unknown numbers of marked states. Finally, we discuss one possible extension, namely a nested version of Amplitude Amplification, along with resource estimates and regimes where these methods are likely to outperform classical baselines.

Laurin Demmler is a Quantum computing researcher with a physics background from the Technical University of Munich, where he specialized in tensor-network simulations of 1D Ising chains in the Heisenberg picture. Currently enrolled at the joint TUM-LMU Quantum Science & Technology program, collaborating with Infineon and Prof. Mendl on nested amplitude-amplification approaches to knapsack problems, he leads two funded projects on quantum algorithms for combinatorial optimization at Infineon. He furthermore has a background in software development focusing on efficient electromagnetic simulations for machine-learning models of walk-through security scanners.

GPU-accelerated heuristics for production planning and scheduling
Ambros Gleixner & Alexander Hoen (HTW Berlin)

Abstract tba

From Large Scale Industrial Optimization to Quantum-Ready Models: Hybrid Solver Pipelines and Practical Benchmarks
Thomas Hußlein (OptWare GmbH)

Industrial optimization in production and logistics increasingly requires solving large, tightly

coupled problems such as multi-site planning, sequencing, and capacity-constrained scheduling under real-world data volumes and operational constraints. In this talk, we share practical lessons learned from deploying optimization at scale and outline our roadmap towards HPC-first execution: GPU clusters, parallel decomposition, and hybrid solver pipelines that combine classical MIP/CP techniques with domain-specific heuristics and learning-based components. Building on these pipelines, we introduce a stepwise methodology to transform selected problem classes into “quantum-ready” formulations (e.g., QUBO), including structured pre-processing, constraint handling strategies, and quantum-computing simulations on HPC. We discuss how to benchmark classical versus hybrid (and quantum-inspired) approaches using transparent metrics such as time-to-solution, optimality gap, robustness, and cost/energy proxies—ultimately enabling evidence-based decisions on when advanced hardware and hybridization deliver measurable value.

Dr. Thomas Hußlein is a co-founder and Managing Director of OptWare GmbH, focusing on industrial optimization, AI-enabled planning, and quantum-readiness for real-world decision problems. He holds a Ph.D. in computer-based physics and conducted research at IBM Watson Research and the University of Pennsylvania, publishing in computer simulation and mathematical optimization.

GPU-Accelerated Heuristics for General-Purpose Mixed-Integer Programs.
Nils Christian Kempke (Zuse Institute Berlin)

We present a GPU-accelerated primal heuristic framework for generating feasible solutions to general mixed-integer programs (MIPs). The approach exploits massive parallelism by combining low-precision linear programming solves using first-order methods with large-scale neighborhood exploration and repair mechanisms executed on GPUs. We employ elements of local search and genetic programming to enables high-throughput exploration of the MIP search space. The proposed method is LP-algorithm agnostic and designed to integrate into existing branch-and-bound workflows as a fast primal solution generator. We present preliminary computational results on instances from MIPLIB to illustrate the behavior of the approach and discuss its potential for accelerating primal solution discovery in large-scale MIP solving.

Multicores, Manycores, GPUs, HPC, and Quantum: Wishes, hopes, and reality. An Overview of the state of affairs.
Thorsten Koch (Zuse Institute Berlin)
It seems obvious to say “big problems need big computers.” However, in practice, utilizing high-performance specialized computers to solve a particular problem can be challenging. We report on our experience over the last two decades to achieve “fast algorithms on fast computers”, the overall state of affairs, and how to benchmark digital and quantum computers.

Computational Insights into Solving Optimization Instance Sets with MIP Solvers on Multi-Core Hardware
Willi Leinen (Helmut Schmidt University Hamburg)

While high-performance computing (HPC) systems continue to advance, many combinatorial optimization methods and their software implementations exhibit limited scalability when parallel computing resources are used.
Mixed-integer programming (MIP) solvers are usually run on a single central processing unit (CPU) and rely primarily on modest shared-memory parallelism via multi-threading, which often provides only marginal improvements beyond a few cores.
At the same time, many decision-making applications require the efficient solution of large

collections of MIP instances, shifting the computational challenge from accelerating a single solve to exploiting available parallel computing resources effectively.
In this talk, we investigate strategies for handling such workloads using state-of-the-art software on multi-core hardware and provide practical guidelines for achieving high throughput and energy efficiency when solving large numbers of MIP problems.

Willi Leinen is since 2022 a researcher at the Chair of High Performance Computing at the Helmut Schmidt University in Hamburg and works in the dtec.bw project hpc.bw. His research focuses on high performance computing and optimization, in particular mixed-integer programming. He holds degrees from Trier University (B.Sc., Applied Mathematics, 2015; M.Sc., Applied Mathematics, 2017) and the Hamburg University of Technology (PhD, numerical linear algebra, 2024).

Using massively parallel solvers on HPCs to compute transformation pathways towards a climate-neutral European energy system
Manuel Wetzel (DLR)

The rapid and fundamental transformation of energy infrastructure towards climate neutrality presents major challenges for infrastructure planners and policymakers worldwide. Mathematical optimization, in the form of energy system optimization models, is fundamental to informing decisions and assessing infrastructure needs under a variety of alternative future development scenarios. However, the high spatial and temporal resolution can result in extremely large linear optimization problems, creating a significant computational burden in terms of solution time and possible memory limitations.

Various approaches have been developed to tackle this challenge and deal with the resulting complexity, including heuristics, mathematical decomposition and complexity reduction. One less-explored solution is to apply block structure-exploiting solvers on high-performance computers. Although this approach requires additional effort to identify the underlying block structures, its distributed nature mitigates limitations from shared memory systems while significantly speeding up the optimization process through massive parallelism.

This talk provides an overview of the BEAM-ME, UNSEEN and PEREGRINE research projects, in which the massively parallel solver PIPS-IPM++ was developed and successfully applied to REMix optimization models. Furthermore, the presented case study demonstrates how applying high-performance computers can effectively reduce the time taken to solve large-scale energy transformation pathway problems from multiple days to hours.

Manuel Wetzel completed his Master's degree in Sustainable Electric Power Supply at the University of Stuttgart in 2016. Since then, he has worked as an academic researcher in the Energy Systems Analysis department at the Institute for Networked Energy Systems at DLR. His ongoing PhD research focuses on acceleration methods for optimizing energy system models, stochastic optimization, and mathematical decomposition methods, as well as long-term transformation pathways towards high degrees of sector integration for combined electricity and gas infrastructures.