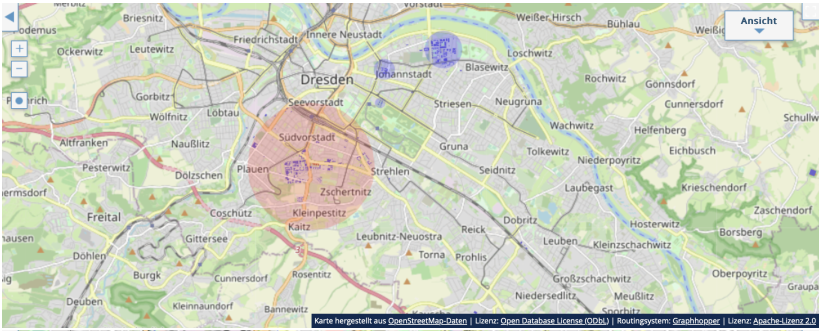
Rainer Turns 80 in Freiberg @ Dresden

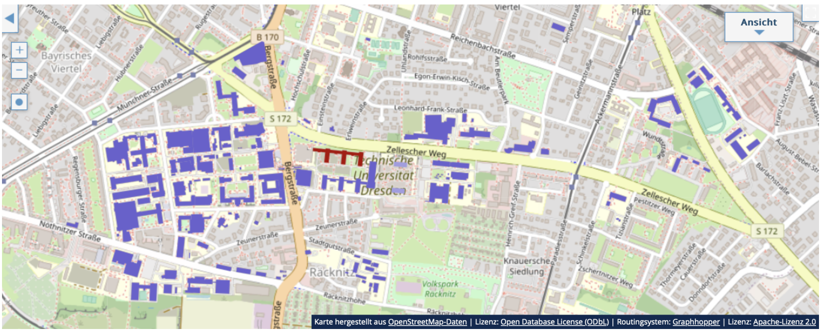
A conference on honouring the scientific work of Rainer Picard

27th of July and 28th of July 2026

Venue I

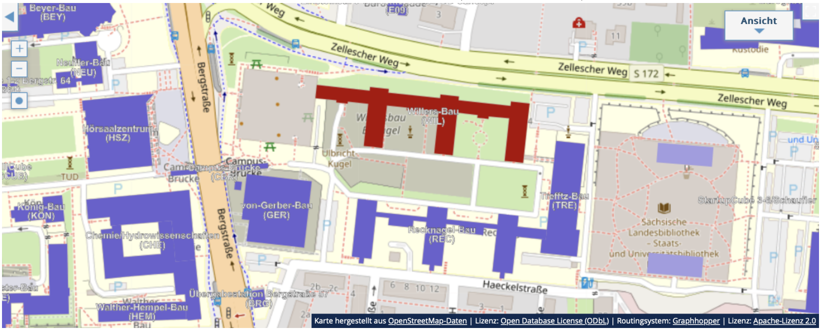
TU Dresden / WIL Willers-Bau / Zellescher Weg 12 – 14 / 01069 Dresden / Germany

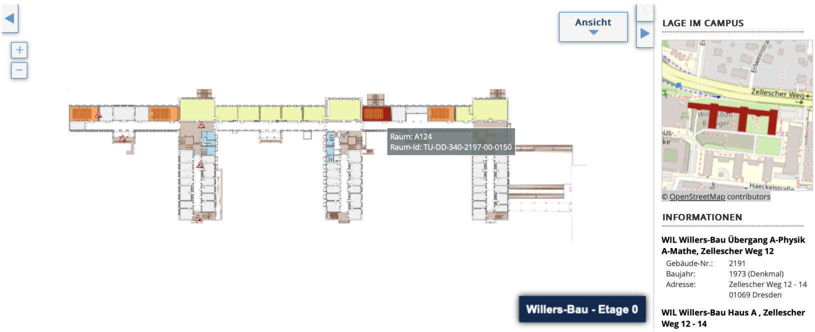




Venue II

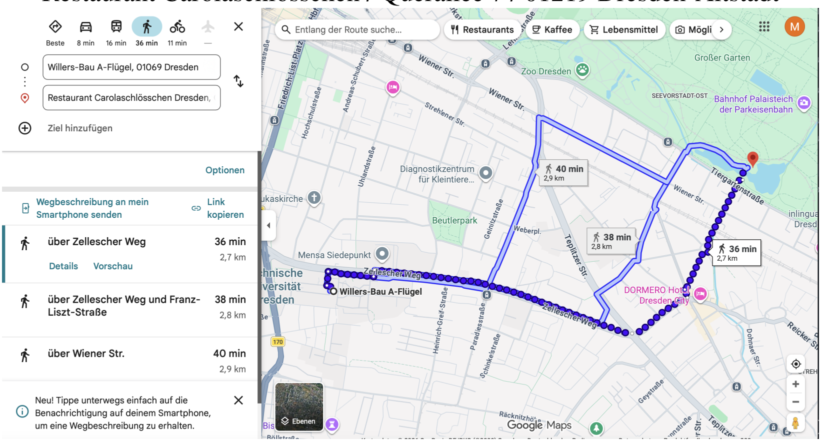
Room – WIL A 124 (Base Level)





Conference Dinner

Restaurant Carolaschlösschen / Querallee 7 / 01219 Dresden-Altstadt



Schedule

Time	Monday	Tuesday
09:00	*opening*	*opening*
09:05–09:50	Sascha Trostorff	Felix Schwenninger
10:00–10:45	Martin Berggren	Andreas Buchinger
10:45–11:15	*coffee break*	*coffee break*
11:15–12:00	Gabriel Barrenechea	Marcus Waurick
12:00–13:45	*lunch break*	*closing / lunch*
13:45–14:15	Wolfgang Ruess	
14:15–14:40	Sebastian Franz	
14:40–15:25	Christian Seifert	
15:25–15:55	*coffee break*	
15:55–16:40	Dirk Pauly	
from 17:30	*Carolaschlösschen*	

List of Speakers

Gabriel Barrenechea

University of Strathclyde

gabriel.barrenechea@strath.ac.uk

Martin Berggren

Umeå Universitet

martin.berggren@cs.umu.se

Andreas Buchinger

TU Hamburg

andreas.buchinger@tuhh.de

Sebastian Franz

TU Dresden

sebastian.franz@tu-dresden.de

Dirk Pauly

TU Dresden

dirk.pauly@tu-dresden.de

Wolfgang Ruess

Universität Duisburg–Essen

wolfgang.ruess@uni-due.de

Christian Seifert

TU Hamburg

christian.seifert@tuhh.de

Felix Schwenninger

University of Twente

f.l.schwenninger@utwente.nl

Sascha Trostorff

CAU Kiel

trostorff@math.uni-kiel.de

Marcus Waurick

TU Bergakademie Freiberg

marcus.waurick@math.tu-freiberg.de

Abstracts

Analysis and approximation of a two-dimensional induction heating problem

Gabriel Barrenechea

University of Strathclyde

I will present the analysis of existence of solutions and finite element approximation of a steady-state two-dimensional induction heating problem. One of the main difficulties of the problem is its right-hand side which, at a first sight, is only integrable. Using a priori regularity results for the PDEs involved it is shown that the natural weak formulation of the problem can be justified. Then, we study the finite element approximation and prove that the standard Galerkin FEM converges in convex domains and under suitable conditions on the mesh. We improve on this result by applying the recently-proposed bound-preserving method (BPM) to the heat equation, and show that this method converges to a solution of the problem under less stringent conditions on the domain and the mesh. As these analyses are carried out without any assumption on regularity of the solutions, then the convergence of the finite element method also proves existence of solutions. I will end the presentation by showing several numerical experiments confirming the theoretical results, and showcasing the improvement provided by the use of the bound-preserving method over the standard finite element method.

Shape optimization over domain paths: transformations vs. dilations

Martin Berggren

Umeå Universitet

For shape optimization, there is a need to describe the shape of a point set with a collection of numbers and to define derivatives that can be used by an optimization algorithm. A standard approach is to create smooth domain paths, parametrized by a scalar t, for which $t = 0$ corresponds to an initial or reference domain.

Domain paths are commonly defined by domain transformations, associated with a vector field that displaces each point in the domain. These transformations can be used to define directional derivatives for use in gradient-based shape optimization. However, transformations are also practically useful to deform the computational mesh in the inside of the domain when subjected to a modified boundary shape.

However, the use of domain transformations to create domain paths is not natural for so-called unfitted methods, that is, for methods in which the computational mesh is fixed and the domain boundary is allowed to cut the mesh at arbitrary locations. A recent development is a shape calculus for unfitted methods for which the domain boundary is defined by dilation of a level-set function. We have for many years carried out shape optimization using domain transformation to design devices such as acoustic horns. When repeating some of these investigations using unfitted methods and dilation of level-set functions, we obtain quite surprising shapes, not reachable with previous methods and with substantially better performance. In ongoing investigation, we consider the use of second-order numerical methods, such as Newton's method, for shape optimization. The shape calculus also here differs significantly depending on whether the domain paths are created through transformations or level-set dilations.

(Non-)Local Homogenization meets Evolutionary Equations

Andreas Buchinger

TU Hamburg

Based on results from the last few years and ongoing research, we will discuss (non-)local homogenization theory for evolutionary equations and an application of this theory to a classical time-dependent and fractional-in-space homogenization problem.

Lewis Carroll's Work on Logic

Sebastian Franz

TU Dresden

In this talk, we will leave the world of partial differential equations and analysis to explore the fascinating realm of logic puzzles created by Charles Lutwidge Dodgson, better known as Lewis Carroll. This project is close to Rainer's heart, and we will present our interpretation of the logic involved, as well as an algorithmic approach to solving Lewis Carroll's logic puzzles.

The Closed Range Property of the De Rham Complex in Unbounded Domains

Dirk Pauly

TU Dresden

The classical Friedrichs/Poincaré estimate establishes closedness of the range of the gradient in unweighted $\mathsf{L}^2(\Omega)$-spaces as long as $\Omega \subset \mathbb{R}^3$ is contained in a slab, that is, Ω is bounded in one direction. Here, as a main observation, we provide closed range results for the rot-operator, if (and only if) Ω is bounded in two directions. Along the way, we characterise closed range results for all the differential operators of the primal and dual de Rham complex in terms of directions of boundedness of the underlying domain.

As a main application, one obtains the existence of a spectral gap near the 0 of the Maxwell operator allowing for exponential stability results for solutions of Maxwell's equations with sufficient damping in the conductivity.

Our results are based on the validity of Gaffney's (in)equality and the transition of the same to unbounded (simple) domains as well as on the stability of closed range results under bi-Lipschitz regular transformations. The latter technique is well-known and detailed in the appendix; for the results concerning Gaffney's estimate, we shall provide accessible, simple proofs using mere standard results.

Moreover, we shall present non-trivial examples and a closed range result for rot with mixed boundary conditions on a set bounded in one direction only.

This is joint work with Marcus Waurick (TU Freiberg).

A Mathematical Miniature: the Weak Banach-Dieudonné Theorem

Wolfgang M. Ruess

Universität Duisburg–Essen

Everyone knows that, by the (proof of the) Banach-Dieudonné Theorem, compact subsets of Fréchet spaces are contained in closed convex hulls of nullsequences. But – what if weakly compact subsets are contained in closed convex hulls of weak nullsequences? Just about 75 years after the classical compact result, the authors of [1] dared to ask this question. And came up with the beautiful result that, for Banach spaces, this happens only in the trivial case that the Banach space has the Schur property, i.e., that weakly compact sets are compact. The proof is rather involved, but – alas! – doesn't carry over to Fréchet spaces – as in the classical compact case. As a mathematical miniature, I will present the three-lines proof of the result for general Fréchet spaces as achieved jointly with the late Charles Stegall [2], based on A. Grothendieck's early work of the nineteen fifties.

[1] P.N. Dowling, D. Freeman, C.J. Lennard, E. Odell, B. Randrianantoanina, B. Turett, A weak Grothendieck compactness principle, J. Funct. Anal. 263 (2012), 1378-1381

[2] W.M. Ruess and C.P. Stegall, Weak characterisations of the Schur property, Adv. Oper. Theory 10:63 (2025)

Controllability for Evolutionary Equations

Christian Seifert

TU Hamburg

We aim to study notions of null-controllability for evolutionary equations, i.e. we ask whether we can steer the solution of an evolutionary equation to zero in finite time by a suitable choice of inhomogeneities. As the general theory of evolutionary equations only provides L_2-regularity in time, the usual pointwise description of null-controllability needs to be rephrased. Moreover, we will exploit duality results which are one of the key tools to study null-controllability.

The talk is based on joint work with Andreas Buchinger (TU Hamburg).

The reproducing kernel thesis induced by Foguel–Hankel operators

Felix Schwenninger

University of Twente

Reproducing kernel spaces such as the Hardy space H^2, are central objects at the intersection of complex analysis and operator theory. For instance, boundedness of Hankel operators can be characterized by only showing (uniform) bounds on the reproducing kernels. Such phenomenon, called a reproducing kernel thesis (RKT), can be abstractly defined for a fixed power bounded operator T on a Hilbert space X and the class of operators

$$\Lambda_c : H^2 \to X, f \mapsto f(T)c,$$

with $c \in X$. A result by Harper, based on earlier variants by Jacob–Partingtion, states that the collection of all Λ_c's satisfies a RKT provided that T is (similar to) a contraction. We prove a corresponding results for Foguel–Hankel operators, a class of polynomially bounded operators which in general are not similar to a contraction.

This is joint work with Eskil Rydhe (Lund).

M-accretive realisations of skew-symmetric operators

Sascha Trostorff

CAU Kiel

We consider skew-symmetric operators on a Hilbert space and provide a characterisation of all m-accretive extensions (linear and non-linear). The extensions are formulated within the framework of boundary systems, a natural generalisation of classical boundary values for differential operators. The talk is based on a joint work with Rainer, where we proved the result for a concrete boundary system. Later, I was able to generalise the result to arbitrary boundary systems, which allows for a more natural treatment of differential operators.

Operator Blocks and Stability

Marcus Waurick

TU Bergakademie Freiberg

We analyse asymptotic stability properties of wave-type phenomena with partial damping; the prototypical example being Maxwell's equations with non-negative conductivity. This set-up results in a damped electric field. We shall demonstrate that outside trivial static solutions, this damping suffices to yield stability results for the whole electro-magnetic field. In fact, depending on the set where the conductivity is strictly positive, we provide results for strongly/semi-uniformly/exponentially stable solution operator, generalising already available results in the literature in that more general domains, structure and regularity conditions are admitted.

The main idea of the proof is to reduce the general variable coefficient case to almost all coefficients being identically one and to make extensive use of block operator matrices allowing for an elementary calculus and a transparent rationale simplyfying the equations considered.

The results can be found in

[1] M. Waurick, Block operator matrix techniques for stability properties of hyperbolic equations, arXiv:2603.12005 [math.AP], 2026.

[2] M. Waurick, Exponential Stability for Maxwell-type Systems Revisited, arXiv:2603.11999 [math.AP], 2026.