INTERNATIONAL CONFERENCE
ON GENERALIZED FUNCTIONS GF2026

BOOK OF ABSTRACTS

23–27 AUGUST 2026

OHRID, N. MACEDONIA

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Organized by

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Skopje, North Macedonia

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Preface

It is our great pleasure to welcome you to the *International Conference on Generalized Functions (GF2026)*, held from 23–27 August 2026 in Ohrid, North Macedonia. The conference continues the long-standing tradition of international scientific meetings promoted by the *International Association for Generalized Functions (IAGF)*, bringing together researchers working in generalized functions and their numerous applications.

GF2026 provides a forum for presenting recent developments, exchanging ideas, and fostering new scientific collaborations across a broad spectrum of topics. The conference covers, among others, distributions, ultradistributions, hyperfunctions and algebras of generalized functions; linear and nonlinear differential equations and stochastic analysis; pseudodifferential operators and microlocal analysis; geometric problems and nonlinear distributional geometry; harmonic analysis, time-frequency analysis and function spaces; functional analytic methods; and applications in mathematical modeling and mathematical physics.

This Book of Abstracts collects the contributions of the plenary and contributed speakers participating in GF2026. It reflects the diversity and vitality of current research in the theory of generalized functions and related areas. We hope that the presentations gathered here will stimulate fruitful discussions, inspire new ideas, and encourage further collaborations among researchers from different mathematical communities.

We are especially pleased to host GF2026 in Ohrid, a city renowned for its exceptional cultural heritage and natural beauty. Situated on the shores of Lake Ohrid, one of Europe's oldest and most remarkable lakes, Ohrid provides a unique setting in which scientific exchange and collaboration can be combined with an inspiring cultural and social experience.

We would like to express our sincere gratitude to all plenary speakers, contributing authors, participants, and members of the scientific and organizing committees for their valuable contributions to GF2026. We are also deeply grateful to the supporting institutions and organizations whose assistance has made this conference possible.

We hope that GF2026 will be a scientifically stimulating and memorable event for all participants and that the discussions initiated in Ohrid will lead to lasting collaborations and further developments in the field of generalized functions.

We wish you an inspiring, productive, and enjoyable conference.

The Organizing Committee of GF2026

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Plenary Lectures

Stability, structure, and operators in shift-invariant subspaces of Banach and Sobolev spaces

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We investigate the structural properties, stability, and operator dynamics of finitely generated shift-invariant (FSI) spaces within a broad class of translation-invariant Banach spaces E. Our framework focuses on spaces that satisfy the continuous dense embeddings $\mathcal{S}(\mathbb{R}^d) \hookrightarrow E \hookrightarrow \mathcal{S}'(\mathbb{R}^d)$. While we introduce sequence-space decompositions for these general Banach spaces, our central methodological tool for characterizing closed shift-invariant subspaces relies on restricting to their Hilbert counterparts. In these settings, we utilize isometric isomorphisms $\mathcal{T}_E : E \to L^2(X, \mathcal{H})$, which map E into spaces defined over a fundamental domain X with a corresponding fiber Hilbert space $\mathcal{H}$. This formulation enables the characterization of closed shift-invariant subspaces via measurable range functions. We establish conditions for E-stability and demonstrate that canonical dual generators preserve the topological regularity of their original frames.

Beyond general Banach spaces, we specialize our analysis to the Sobolev space setting, studying bounded shift-preserving operators through range operators. We discuss the s-diagonalization of normal shift-preserving operators and provide insights into the dynamical sampling problem, demonstrating conditions under which the iterations of these operators yield frame generators. Finally, we analyze the algebraic structures within these spaces, specifically addressing the convolution and product of distributions in FSI spaces, characterizing their Fourier multipliers, and determining the wave front sets for these operations.

Remark: This is a joint work with Stevan Pilipović and Aleksandar Aksentijević.

On the Cauchy problem for p-evolution equations

Alexandre Arias Junior

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We deal with a class of p-evolution equations with real characteristics, where $p \geq 2$ is an integer number. This class of PDEs includes, for instance, the Schrödinger and the linear part of the KdV equations. More precisely, we consider the initial value problem for the equation

$$Pu = 0, \qquad P = D_t + D_x^p + \sum_{j=1}^{p} a_{p-j}(t,x) D_x^{p-j}, \qquad t \in [0,T], \quad x \in \mathbb{R}, \qquad D_x = -i\partial_x, \quad (1)$$

with $a_{p-j} \in C([0,T]; \mathcal{B}^\infty(\mathbb{R}^n))$, where $\mathcal{B}^\infty(\mathbb{R}^n)$ stands for the space of all complex-valued functions bounded on $\mathbb{R}$ together with all their derivatives.

It is well known that, when lower-order coefficients a_{p-j} are real-valued, the Cauchy problem associated to (1) is well-posed in the functional settings L^2, H^m, H^∞ and suitable Gevrey-type spaces. The problem is more delicate when complex-valued coefficients are allowed.

In this talk, we discuss necessary and sufficient conditions on the lower-order coefficients a_{p-j} for the well-posedness of the Cauchy problem associated with (1) in the aforementioned spaces.

Remark: The results presented in this talk were obtained in collaboration with Alessia Ascanelli (University of Ferrara) and Marco Cappiello (University of Torino).

Sequence space representations of Gelfand-Shilov spaces and their multiplier spaces

Andreas Debrouwere

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We present an overview of known results and open problems concerning sequence space representations of Gelfand-Shilov spaces and their multiplier spaces. In particular, we explain how Pełczyński–Vogt decomposition results may be used to obtain such representations.

Remark: This is a joint work with Lenny Neyt.

Distributional curvature bounds in geometry

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In General Relativity the study of spaces with lower curvature bounds has led to many beautiful geometric insights, among them the Singularity Theorems of Hawking and Penrose and the Positive Mass Theorem. After a very gentle introduction to these classical global geometric results we will turn to reexamining them under reduced differentiability of the metric tensor where curvature inequalities can only hold distributionally. A central ingredient in establishing analogous results in this regularity is the construction of suitable smooth approximations. We will see that the standard approach of smoothing by convolution is already very powerful here, largely thanks to Friedrichs lemma type commutator estimates guaranteeing that curvature bounds are almost preserved, and can be further adapted to fit each setting.

Remark: This is based on joint works with M. Calisti, E. Hafemann, M. Kunzinger and R. Steinbauer as well as with E. Hafemann (in preparation).

Sharp Beurling-Hörmander-type uncertainty principles and the non-triviality of Gelfand-Shilov spaces

Lenny Neyt

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The uncertainty principle in harmonic analysis states that a function f and its Fourier transform $\widehat{f}$ cannot be simultaneously too well-localized. Famously, Beurling proved that if (v, w) are conjugate convex functions on $\mathbb{R}$ and if

$$\int_{-\infty}^{\infty} |f(x)|e^{v(x)}\,\mathrm{d}x < \infty \quad \text{and} \quad \int_{-\infty}^{\infty} |\widehat{f}(\xi)|e^{w(\xi)}\,\mathrm{d}\xi < \infty,$$

then necessarily $f = 0$.

In particular, this recovers the classical uncertainty principles of Hardy, with $v(t) = t^2$, and Morgan, with $v(t) = t^p$ for $p \in (1, \infty)$. In private conversations, Beurling remarked to Hörmander that examples could be constructed showing that this principle seems rather precise, although the exact details appear to have been lost.

In this talk, we establish sharp uncertainty principles for a broad class of weight functions and characterize when they coincide with those of Beurling, providing a more definitive answer to this question.

In addition, we will discuss how, equivalently, our results characterize the non-triviality of the Gelfand-Shilov spaces $\mathcal{S}_A^M(\mathbb{R}^d)$ and $\Sigma_A^M(\mathbb{R}^d)$. These spaces refine the classical Schwartz space $\mathcal{S}(\mathbb{R}^d)$ of rapidly decreasing smooth functions by imposing bounds on the differentiability and decay of the functions in terms of the weight sequences M and A. So far, no general characterization of the non-triviality of the Gelfand-Shilov spaces is known. As part of this talk, we will provide an exact condition for non-triviality in terms of the weight sequences M and A.

Generalized stochastic processes revisited

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Let E be a locally convex topological vector space. A linear random functional is a sequentially continuous map from E into $L^0(\Omega)$, the space of measurable functions on a probability space Ω (with the metric topology of convergence in probability). The question whether every linear random functional has a version in E', that is, can be realized as a measurable map from Ω to E', has been answered affirmatively by Kiyosi Itô for nuclear spaces E in 1982. However, the question of uniqueness has only been partially answered by Itô. The issue is important in the theory of stochastic processes with values in spaces of generalized functions.

Various aspects of this question have also been investigated by Stevan Pilipović and Dora Seleši. In this talk, I present a set-up in terms of inclusion mappings that allows one to consider the question from a more general viewpoint, showing that nuclearity is sufficient, but not necessary, proving uniqueness when E is sequentially separable, and producing various examples and counterexamples.

This is a follow-up to a talk I gave in Novi Sad in 2023, a more mature version of which was published in JMAA 545 (2025).

Complex Interpolation of Closed Subspaces of Maximal Banach Function Spaces

Yoshihiro Sawano

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In this talk, we introduce the concept of Calderón product level sets and use it to characterize the complex interpolation spaces of the closed subspaces with the lattice property for any couple of maximal Banach function spaces (Banach lattices). As applications, we obtain several new results on the complex interpolation of closed subspaces of both Morrey spaces and Lorentz spaces. Moreover, for smooth function spaces having no lattice property, we also study their various closed subspaces and obtain their corresponding complex interpolation results by using their real-variable characterizations.

Remark: This is a joint work with Dachun Yang, Wen Yuan and Mingdong Zhang at Beijing Normal University.

The Laguerre operator, its propagator, and related fractional transforms

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In this lecture, we present continuity properties of the Laguerre operator propagator and provide an overview of results concerning extensions of the well-known representation of the fractional Fourier transform as the harmonic oscillator propagator [3]. In particular, we show that the fractional power of the Hankel–Clifford transform can be identified with the propagator of the Laguerre operator.

The functional-analytic framework for our investigations is provided by (P)-spaces, introduced in [2] via suitable properties of the iterates of the Laguerre operator. These spaces extend the (G)-type spaces introduced by A. J. Duran in the 1990s as a natural counterpart of the global Gelfand–Shilov spaces on the half-line $(0, \infty)$ [1]. Recently, we showed that Duran's results can be extended to topological isomorphisms between (P)-spaces and Pilipović spaces [2].

This extension opens the way to comparing results on Pilipović spaces with their (P)-space counterparts. We refer to [4, 5, 6] for further details on Pilipović spaces and their applications.

Remark: This is a joint work with S. Jakšić, S. Pilipović, N. Teofanov, and Dj. Vučković.

Acknowledgement: This work was supported by the Science Fund of the Republic of Serbia, Grant No. 2727, Global and Local Analysis of Operators and Distributions – GOALS.

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Contributed Talks

Structural properties and stable sampling in FGSI subspaces of Sobolev spaces

Aleksandar Aksentijević

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This talk presents new structural results on finitely generated shift-invariant (FGSI) subspaces of Sobolev spaces $H^s(\mathbb{R}^d)$, $s \in \mathbb{R}$. The main focus is on convolution, pointwise multiplication, duality, and stable sampling. More precisely, we characterize the dual FGSI space and show that a certain class of equations with right-hand sides in FGSI spaces admits solutions that remain within FGSI spaces. We also describe the convolutors of FGSI spaces and determine the wave front sets of convolutions and products, yielding a detailed characterization of their microlocal structure.

Furthermore, we prove the stability of the dual generator in certain weighted Wiener amalgam spaces and establish a necessary Nyquist-type density condition for stable non-uniform sampling in $H^s(\mathbb{R}^d)$, $s > d/2$. These results provide a rigorous foundation for constructing stable and convergent Petrov–Galerkin schemes for elliptic PDEs and for stable image reconstruction in Magnetic Resonance Imaging (MRI). The talk concludes with an outline of possible extensions to this framework for generalized sampling with $s \leqslant d/2$.

Acknowledgement: This research was supported by the Science Fund of the Republic of Serbia, Grant No. 2727, *Global and local analysis of operators and distributions – GOALS*.

Remark: This is a joint work with Prof. Stevan Pilipović and Prof. Suzana Aleksić.

A Functional Analytic Approach to Stochastic Differential Equations with Hermite Noise

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We investigate the existence and uniqueness of almost automorphic mild solutions for a class of abstract stochastic differential equations driven by a cylindrical Brownian motion and a Hermite process of arbitrary order. The analysis is carried out in real separable Hilbert spaces, where the stochastic integrals are interpreted in the framework of Malliavin calculus. By combining estimates for the divergence integral with a Hardy–Littlewood–Sobolev inequality, sufficient conditions ensuring well-posedness are established. As an illustration of the theoretical results, a stochastic heat equation is presented.

Hausdorff Measure, Separation Conditions, and Dimension in Self-Conformal Sets

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We investigate measure-theoretic and dimensional properties of self-conformal sets and related classes of quasi self-similar sets. A central question is the relationship between Hausdorff measure, Hausdorff content, regularity, and fractal dimensions in the presence or absence of separation conditions.

For a broad class of quasi self-similar sets, including graph-directed and sub-self-conformal sets, we establish comparability between Hausdorff measure and Hausdorff content on measurable subsets. As a consequence, graph-directed and sub-self-conformal sets with positive Hausdorff measure are Ahlfors regular, irrespective of separation conditions.

We further consider self-conformal subsets of the real line with Hausdorff dimension strictly less than one. In this setting, the weak separation condition is shown to be equivalent to Ahlfors regularity. Moreover, failure of the weak separation condition leads to full Assouad dimension. These results provide a connection between separation properties, measure-theoretic regularity, and local dimensional behavior of self-conformal sets.

Remark: This is a joint work with Antti Käenmäki and Sascha Troscheit.

On Extremality of TMIB-Spaces of Quasi-Analytic Ultradistributions

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In this article, we construct explicit examples of translation-modulation invariant Banach spaces of ultradistributions. In the Beurling $(M_p) - (A_p)$ and the Roumieu $\{M_p\} - \{A_p\}$ setting, we introduce Hilbert-type spaces defined by weighted L^2-norms of derivatives, with weights determined by the associated functions of the defining sequences. We prove that these spaces are invariant under translations and modulations and show that their construction remains valid when the L^2-norm is replaced by an L^p-norm, $1 \leq p < \infty$. The short-time Fourier transform is then used to associate modulation spaces to these examples. By duality, we obtain translation-modulation invariant Banach spaces of ultradistributions lying arbitrarily close to the corresponding spaces of ultradistributions.

Remark: This is a joint work with Pavel Dimovski.

Orthogonality of finite-order distributions

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One of the original successes of H-measures was in relating the orthogonality of L^2 sequences and the measure-theoretic mutual singularity of corresponding H-measures [Gérard, Comm. Partial Diff. Eq. 1991]. Our goal is to extend this result to H-distributions [Antonić & Mitrović, Abs. Appl. Analysis 2011; Antonić, Erceg & Mišur, Anal. Appl. (Singap.) 2021], in order to treat products of pairs of weakly convergent sequences in L^p and L^q spaces, paving the way for numerous possible applications (e.g. in homogenisation of the Boltzmann equation).

The notion of mutual singularity for Radon measures, being equivalent to alieness, has to be rephrased in a form which can apply also to distributions of finite order (thus H-distributions as well). We propose several other characterisations for Radon measures, which can be carried on to distributions of finite order, and explore their applicability for proving the orthogonality result for pairs of $\mathrm{L}^p, \mathrm{L}^q$ converging sequences.

Remark: This is a joint work with *Marin Mišur, Darko Mitrović* and *Tomislav Perić*.

Gyrator potential operator and L^p-Sobolev spaces

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This presentation provides insight into the properties of the gyrator potential operator $\mathcal{G}_\mu^l$, a particular class of pseudo-differential operators defined via the gyrator transform with a certain symbol, and the related L^p-Sobolev spaces $H_\Delta^{m,p}(\mathbb{R}^2)$. A Schwartz-type space $S_\Delta(\mathbb{R}^2)$ is introduced, and several properties of the gyrator transform kernel are studied, including its continuity on $S_\Delta(\mathbb{R}^2)$. Furthermore, a pseudo-differential operator $\mathcal{A}_{\alpha,q}$ associated with the gyrator transform is defined, and its continuity on $S_\Delta(\mathbb{R}^2)$ is established. An alternative integral representation of $\mathcal{A}_{\alpha,q}$ is obtained, and its $L^p(\mathbb{R}^2)$-boundedness is analyzed. It is shown that the operator $\mathcal{G}_\mu^l$ acts as an isometry on $H_\Delta^{m,p}(\mathbb{R}^2)$, and an L^p-boundedness result for same is established. Finally, it is demonstrated that the analytical solutions of certain non-homogeneous partial differential equations belong to these spaces.

Remark: This is a joint work of Kanailal Mahato.

Microlocal analysis of distributions via fractional integral transforms

Sanja Atanasova

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In this talk, we present recent developments in the characterization of distributional wavefront sets through fractional integral transforms, including the fractional Fourier, fractional Stockwell, and fractional wavelet transforms. These transforms offer a flexible time-frequency representation that enables a refined analysis of the location, orientation, and propagation of singularities while extending classical Fourier-based techniques.

Pseudo-Differential Operators Involving the Fourier–Bessel Transform on $\mathbb{Z}_+^{n+1}$

Priyanka Balvant

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In this talk, I will introduce pseudo-differential operators on $\mathbb{Z}_+^{n+1}$ associated with the Fourier–Bessel transform and show that these operators preserve the Schwartz space $S_*(\mathbb{Z}_+^{n+1})$. I will further show boundedness results for the Friedrichs operators on the Sobolev space $\mathcal{H}_\alpha^{s,2}(\mathbb{Z}_+^{n+1})$ associated with $L_\alpha^2(\mathbb{T}_+^{n+1})$. As an application, I will discuss solutions of the heat equation on the frequency space $\mathbb{T}_+^{n+1}$.

Remark: This is a joint work with Mohd Sartaj and S. K. Upadhyay.

On multiplier and convolutor spaces between spaces of distributions

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We use techniques from the theory of vector-valued distributions to present characterisations of the multiplier and convolutor spaces between a number of spaces of smooth functions or distributions. In particular we use the representation of these multiplication and convolution mappings by distributional kernels. The spaces we are interested in are classical spaces of L. Schwartz' theory of distributions.

Remark: This is joint work with Norbert Ortner.

Optimal decay of semi-uniformly stable operator semigroups

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In this talk, we discuss new results concerning the decay of semi-uniformly stable semigroups. The existing literature already contains several results on the (optimality of the) decay of such semigroups based solely on spectral properties of the generator. We present new findings on the optimality of decay rates when only information about the location of the spectrum of the infinitesimal generator is available. We will focus on the limit case where the spectrum $\sigma(A)$ of the generator is empty.

Remark: This is a joint work with L. Neyt and J. Vindas.

Electromechanical Stability and T-Controllability Analysis of Hilfer Fractional Stochastic Switching Systems with Non-Instantaneous Impulses using Integral Contraction Framework

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This paper addresses the existence, uniqueness, and Hyers–Ulam stability (HUS) of a novel class of higher-order coupled stochastic non-instantaneous impulsive Hilfer fractional switched differential equations with deviated arguments and Poisson jumps in finite-dimensional spaces. The well-posedness of the proposed system is established through the method of integral contractors, combined with appropriate regularity hypotheses and a weakened Lipschitz-type condition imposed on the nonlinear operators governing the coupled stochastic dynamics. Under these assumptions, we rigorously derive existence and uniqueness results, followed by a comprehensive analysis of Hyers–Ulam stability in the simultaneous presence of impulsive effects and stochastic perturbations.

The principal contribution of this work lies in the formulation of a unified and structurally enriched class of coupled Hilfer fractional systems that coherently integrates mechanical and electrical dynamics within a stochastic switching framework. The model is designed to capture system evolution over non-instantaneous impulsive intervals as well as at discrete switching instants, while incorporating both Poisson jump processes and continuous stochastic disturbances. This integrated structure yields a mathematically robust and physically realistic modeling paradigm. Furthermore, the introduction of fractional integral-type initial conditions provides a flexible and nonstandard initialization scheme, substantially expanding the applicability and modeling versatility of the framework.

The theoretical development is carried out using a synthesis of sequencing techniques, fractional calculus, Laplace transform methods, stochastic analysis, and the theory of Mittag–Leffler functions. To demonstrate the practical relevance and effectiveness of the theoretical findings, a detailed numerical example is presented, followed by an application to electromechanical coupling and seeker stabilization problems. The proposed Hilfer fractional stochastic switching model thus offers a novel analytical foundation for the study and control of complex hybrid systems characterized by memory effects, impulses, switching mechanisms, and random perturbations.

Remark: This is a joint work with Luigi Rodino.

Microlocal analysis of a class of time-fractional partial differential equations

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We study regularity and decay properties of the solutions of the Cauchy problem for time-fractional partial differential equations, with tempered initial data, associated with a differential operator on space variables with polynomially bounded coefficients. We obtain a representation formula for the solution, modulo time-regular functions, smooth and rapidly decreasing with respect to the space variables.

By means of the representation formula, the (decay and smoothness) singularities of the solution of the homogeneous Cauchy problem can be controlled, in terms of (global) wavefront sets of the initial data.

Remark: This is joint work with Giovanni Girardi and Stevan Pilipović.

On sequence convergence in $(3, j)$-metric spaces, $j \in \{1, 2\}$

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In this article, we investigate the uniqueness of limits of convergent sequences in generalized metric-type spaces. We examine the role of the underlying generalized distance function in determining whether convergence implies uniqueness of the limit. We first show that every convergent sequence in a $(3, 2)$-metric space has a unique limit. We then provide several examples in $(3, 1, \rho)$-metric spaces and $(3, 1)$-metric spaces showing that a convergent sequence may have more than one limit. Finally, we establish sufficient conditions on the generalized distance structure that guarantee the uniqueness of limits in $(3, 1)$-metric spaces. These results illustrate how the properties of the generalized distance function influence the behavior of convergent sequences and provide a framework for understanding the uniqueness of limits in generalized metric-type spaces.

Remark: This is a joint work with Dončo Dimovski and Pavel Dimovski.

Inversions of unbounded linear operators

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We consider inversions of unbounded linear operators on Banach and Hilbert spaces. Results related to the ordinary inverse as well as to the various types of generalized inverses will be presented. Some applications to operator equations and spectral theory will be explined.

Reduction principle for potentials on metric spaces

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In this talk we will investigate potential convolution operators with nonnegative radially nonincreasing kernels. Consider a metric space (R, ρ), a convolution kernel K and the respective potential operator

$$Tf(x) = K * f(x) = \int_R f(y)K(\rho(x, y))\, d\mu(y).$$

Operators of this type include the classical Riesz potential. We will present here the reduction principle for these operators. In other words we will present the optimal conditions under which the convolution operator

$$T\colon X(R, \mu) \to Y(R, \nu)$$

is bounded as the operator between two general rearrangement-invariant function spaces X, Y defined on metric measure spaces with different measures.

Fractional Stockwell transform in the Lizorkin distribution framework

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We study the fractional Stockwell transform (FRST) within a Lizorkin-type distributional framework. In particular, we establish the continuity of the FRST and its adjoint on suitable Lizorkin-type spaces of test functions. These results enable the use of a duality approach, leading to a rigorous distributional setting for the FRST.

Within this framework, we derive a Parseval identity, often referred to as the desingularization formula, and characterize bounded subsets in the corresponding Lizorkin-type space of distributions.

The developed theory is employed to characterize the quasiasymptotic behavior of Lizorkin distributions at the origin and infinity via their FRST. This analysis is based on Abelian- and Tauberian-type results, which connect the quasiasymptotics with the boundary asymptotics of the FRST.

Remark: The talk is based on joint work with Katerina Hadzi-Velkova Saneva.

The fractional Zener wave equation with random density

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We study the fractional Zener wave equation for viscoelastic, non-homogeneous media with possible random density variations. To model unpredictable fluctuations of the material density ϱ we treat ϱ as a stochastic process, enabling description of random environmental effects arising from physical uncertainty or incomplete information.

Our framework uses the Gaussian white-noise probability space and analyses the equation within the Kondratiev class of generalized stochastic processes. To give meaning to otherwise ill-defined products of generalized processes we employ the Wick product.

Remark: This is a joint work with Ljubica Oparnica.

Modeling of point charges with distributions, regularizations, and generalized functions

Günther Hörmann

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We apply regularization and generalized function techniques to the classical electromagnetic field of a point-charge, following, extending and correcting a strategy by the physicist A. Gsponer in several articles (in Eur. Jour. Phys. and J. Math. Phys.) and preprints that appeared in 2007–2009. We show how the Liénard–Wiechert potential emerges essentially from the basic geometry of Minkowski space, namely by action of the d'Alembertian on a generating vector field, which is defined via a spacetime interval between an observer and the point-charge at retarded proper time.

Furthermore, for a charged particle in its rest frame, we discuss generalized functions aspects of the electric monopole, magnetic dipole, electron singularity, and self-energy, where infinitely large generalized numbers occur whose concrete representations can be applied in field renormalization.

Remark: This talk is based on joint work with Nathalie Tassotti.

The comparison of continuity results for pseudodifferential operators on Lebesgue and mixed-norm Lebesgue spaces

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In this talk, we compare continuity results for pseudodifferential operators on Lebesgue and mixed-norm Lebesgue spaces. We consider pseudodifferential operators with symbols belonging to the Hörmander classes $\mathrm{S}^m_{\rho,\delta}$ and some of their subclasses.

For $\rho = 1$, the continuity theory is well understood in both settings. In contrast, when $\rho < 1$, continuity results are available only for operators of sufficiently negative order, and the corresponding necessary conditions remain unknown in the mixed-norm setting. Moreover, for $\rho < 1$ and $m = 0$, continuity is known only on L^2 and for certain subclasses of symbols in the general Lebesgue-space setting, while the corresponding theory on mixed-norm Lebesgue spaces remains largely unexplored.

Remark: This is a joint work with Nenad Antonić and Ivana Vojnović.

Schrödinger-Type Equations: From the Hermite Operator to the Laguerre Operator

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We investigate the well-posedness of the Cauchy problem for Schrödinger-type equations associated with the general Laguerre operator and establish its relationship with the corresponding problem for the general Hermite operator. Our analysis is based on the even and radial subspaces of global Pilipović spaces, as well as on Pilipović spaces defined on positive orthants. We further employ the transposes and inverses of operators associated with radial symmetry to transfer results between the Hermite and Laguerre settings. Finally, we discuss the challenging problem of interpreting these results when the initial data are ultradistributions.

Remark: This is a joint work with N. Teofanov and Đ. Vučković.

Integrating STEAM Education with Sports for Interdisciplinary Learning

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This paper presents a pilot study examining the development, implementation, and preliminary evaluation of the STEAM and Sports interdisciplinary curriculum, developed as part of a research initiative on integrated teaching methodologies that link Science, Technology, Engineering, Arts, and Mathematics (STEAM) with sports-based learning. The study addresses three research questions:

1. Does the STEAM and Sports curriculum produce measurable learning gains compared to standard classroom instruction?
2. Is the curriculum effective across diverse school contexts, student populations, and national educational systems?
3. How do teachers and students perceive the curriculum in terms of clarity, engagement, and overall satisfaction?

The methodology provides educators with structured lesson plans, implementation frameworks, and assessment tools designed to make STEAM subjects more relevant, engaging, and accessible. A comprehensive teaching guide comprising 14 ready-to-use lesson plans was developed and piloted across three schools in three countries: Primary School Bakar in Croatia, Jan Amos Komenski School in North Macedonia, and Branko Radicevic School in Serbia, engaging 362 students in grades 3 to 9 and 18 teachers across diverse disciplines.

Using a controlled pre-test/post-test design with matched pilot and control groups, the curriculum demonstrated promising preliminary effectiveness: pilot groups achieved average learning gains of 22.0 to 54.5 percentage points, reaching post-test performance of 87.6% to 99.3%, while control groups showed minimal gains of 3.9 to 14.5 percentage points. Teacher and student feedback surveys further confirmed high levels of engagement, clarity, and satisfaction, with 96.4% of students reporting they enjoyed the lessons and 79% expressing enthusiasm for more similar learning experiences. While the pilot design precludes definitive causal conclusions, these results provide encouraging preliminary evidence for the cross-cultural applicability of STEAM-integrated sports education and establish a strong basis for larger-scale, controlled research.

Acknowledgement: The author wishes to thank all participating students, teachers, and school leaders at Primary School Bakar (Croatia), Jan Amos Komenski School (North Macedonia), and Branko Radicevic School (Serbia) for their enthusiastic engagement with the research.

Homogenisation of nonlocal linear diffusion problems with fractional operators

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Using the recently developed theory of fractional vector analysis, in which fractional differential operators are defined via the fractional Riesz potential, we extend the notion of weak fractional operators in the sense of distributions and analyse their properties and connections with fractional Sobolev spaces. In particular, we prove a fractional analog of a compensated compactness result.

We then consider fractional variants of linear diffusion problems in divergence form on bounded domains with highly oscillatory local coefficients. Exploiting the relationships between nonlocal (fractional) and local (classical) operators, together with the compactness of the fractional gradient on the complement of the domain, and applying compensated compactness result, we characterise the convergence of the diffusion coefficients in terms of the classical H-convergence and the weak-$*$ convergence.

Moreover, we study analogous problems involving fractional differential operators with a finite interaction horizon (the so-called finite-horizon or δ-horizon operators) and compare the results obtained for the homogenisation of finite-horizon and infinite-horizon fractional diffusion problems.

Remark: This is a joint work with K. Burazin, I. Crnjac, M. Erceg, A. Buchinger and M. Waurick.

On the convolution of (generalized) functions with supports contained in spiral domains in $\mathbb{R}^d$

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Classical results on the existence of the convolution $f * g$ of functions, Schwartz distributions or other generalized functions f and g concern usually one of the following cases: 1° the support of f or g is compact; 2° the supports of f and g are contained in suitable cones in $\mathbb{R}^d$. We deliver a quite new case of the existence of the convolution $f * g$: both supports of f and g may be unbounded in every direction in $\mathbb{R}^d$, but they have to be contained in a kind of spiral domains in $\mathbb{R}^d$.

On the commutant of the integration operator determined by a multipoint functional in the Banach space $C(\Delta)$, where Δ is a segment in $\mathbb{R}^d$

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Results of the paper [2] (see also [1], p. 16) are extended to the Banach space $C(\Delta)$ of continuous functions on the segment Δ in $\mathbb{R}^d$ containing the origin $0 = (0, \ldots, 0)$, where $\Delta = (a, b)$, $\Delta = [a, b)$, $\Delta = (a, b]$ or $\Delta = [a, b]$ with

$$a = (\alpha_1, \ldots, \alpha_d), \qquad b = (\beta_1, \ldots, \beta_d) \in \mathbb{R}^d$$

and $a < b$. One of the results is the following:

Theorem 1. *Let L be the generalized integration operator, i.e. the right inverse operator of the differentiation $\frac{d}{dt}$ in $C(\Delta)$, determined as the solution $y = Lf$ of the boundary value problem*

$$y' = f, \qquad \Phi(y) = 0,$$

where

$$\Phi f = \sum_{k=0}^{n} p_k f(a_k), \qquad n \in \mathbb{N}_0 = \mathbb{N} \cup \{0\},$$

p_k $(0 \le k \le n)$ are nonzero constants such that

$$\sum_{k=0}^{n} p_k = 1,$$

and $a_k \in \Delta$ $(0 \le k \le n)$.

An arbitrary linear continuous operator

$$M : C(\Delta) \longrightarrow C(\Delta)$$

commutes with the operator L if and only if it admits the following convolutional representation:

$$Mf = \frac{d}{dt}(m * f),$$

where $m := M\{1\}$ (the symbol $\{1\}$ means the constant function equal to 1). Moreover, m is a continuous function of bounded variation in Δ.

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Forced Frequency Locking for Semilinear Dissipative Hyperbolic PDEs

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This talk concerns the behavior of time-periodic solutions to 1D dissipative autonomous semilinear hyperbolic PDEs under the influence of small time-periodic forcing. We show that the phenomenon of forced frequency locking happens similarly to the analogous phenomena known for ODEs or parabolic PDEs. However, the proofs are essentially more difficult than for ODEs or parabolic PDEs. In particular, non-resonance conditions are needed, which do not have counterparts in the cases of ODEs or parabolic PDEs. We derive a scalar equation which answers the main question of forced frequency locking: Which time shifts $u(t+\varphi)$ of the solution $u(t)$ to the unforced equation do survive under which forcing?

Remark: This is a joint work with Lutz Recke.

Abstract Volterra integro-differential inclusions with multiple variables

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The theory of abstract Volterra integro-differential inclusions is still a rapidly growing field of research of many authors. In this talk, we will briefly present several recent results concerning abstract partial fractional differential inclusions and abstract Volterra integro-differential inclusions with multiple variables. We will also present some applications of multidimensional vector-valued Laplace transform.

Singularity structures for nonsmooth spaces

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Singularity structures for Fréchet modules are a categorical approach to distribution theory that gives an operator-theoretic description of microlocal analysis based on the action of smooth functions (via evaluation) and pseudodifferential operators on distributions.

Extending previous work of Shantanu Dave and the speaker, we describe a recent generalization from compact to complete Riemannian manifolds. Our construction is based entirely on the functional calculus of the Laplacian, with the aim of generalizing microlocal analysis beyond the manifold-setting to (infinitesimally Hilbertian) metric measure spaces.

Remark: This is ongoing joint work with Darius Erös and Günther Hörmann.

The Distributional Laguerre Transform

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In this presentation, a new class of test function spaces $\mathfrak{L}_\alpha$, $\mathfrak{G}_\alpha$, $\mathfrak{l}_\alpha$ are defined and it is shown that the Laguerre transform is a continuous injective map from $\mathfrak{L}_\alpha$ to $\mathfrak{l}_\alpha$ and the inverse Laguerre transform is an injective map from $\mathfrak{l}_\alpha$ to $\mathfrak{G}_\alpha$. Exploiting the above results, the Laguerre transform to corresponding distribution spaces are defined and it is shown that the distributional Laguerre transform is a monomorphism from $\mathfrak{L}'_\alpha$ into $\mathfrak{l}'_\alpha$. Furthermore, the inverse Laguerre transform is a monomorphism from $\mathfrak{l}'_\alpha$ into $\mathfrak{G}'_\alpha$. Moreover, the continuity and boundedness of the the continuous Laguerre wavelet transform of distributions in the space $\widetilde{\mathfrak{L}_\alpha}([0,\infty)\times[0,\infty))$ are discussed.

Remark: This is a joint work with Dr. Santosh Kumar Upadhyay, Professor (HAG), Indian Institute of Technology (BHU) Varanasi, Varanasi, Uttar Pradesh, India.

Generalization of a class of Chaterjea-type mappings with sequentially convergent mappings

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In this paper, well known results are generalized using sequentially convergent mappings, relating to mappings $T : X \to X$, defined on a complete metric space (X, d) for which for each $x, y \in X$ holds the inequality

$$d^2(Tx, Ty) \leq \lambda\big(d^2(x, Ty) + d^2(y, Tx)\big), \qquad 0 \leq \lambda < \frac{1}{4}.$$

Quasiasymptotic Results for Fractional Transforms of Generalized Functions

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Fractional transforms have emerged as powerful analytical tools that bridge the time, frequency, and scale domains by introducing a fractional-order parameter into the kernel of classical transforms. This talk provides an overview of the mathematical foundations and distributional frameworks of several key fractional transforms, with emphasis on their formulation within appropriate spaces of generalized functions. Particular attention is devoted to the quasiasymptotic behavior of distributions in relation to the asymptotic properties of their corresponding fractional transforms.

Remark: This is a joint work with Sanja Atanasova, Slavica Gajić, Smiljana Jakšić and Stevan Pilipović.

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Robust Inventory Optimization under Semi–Markov Environmental Dynamics and Budgeted Cost Uncertainty

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This paper presents a robust optimization framework for deteriorating inventory systems operating under stochastic environmental dynamics and uncertain economic costs. The inventory environment is modeled by a semi–Markov process with general sojourn–time distributions, allowing both customer demand and product deterioration to evolve according to long–run environmental conditions. To account for incomplete knowledge of economic parameters, ordering, purchasing, holding, deterioration, disposal, and preservation costs are represented using a budgeted interval uncertainty set based on the Bertsimas–Sim methodology. The resulting robust optimization model determines the optimal markdown time and replenishment cycle that maximize the worst–case expected average profit while satisfying no–shortage and terminal inventory constraints. Numerical experiments demonstrate the influence of environmental dynamics, uncertainty budgets, and preservation policies on the optimal inventory strategy and economic performance. The results show that integrating semi–Markov environmental modeling with robust optimization provides computationally tractable inventory policies that remain effective under both stochastic environmental variability and bounded cost uncertainty.

Inverse problem for the geodesic subpath number

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Inverse Wiener problem is the problem of determining which positive integers can be realized as Wiener index of a graph.

For a given graph G, its geodesic subpath number, denoted by $\mathrm{gpn}(G)$, is defined as the total number of geodesic subpaths in G, [1, 2]. In this talk we show that, up to eight exceptions, 2, 4, 5, 7, 8, 9, 13 and 14, for every positive integer t there is a connected graph G such that $\mathrm{gpn}(G) = t$. Furthermore, we show that almost all such a graph can be chosen to be even unicyclic. Namely, for positive integers except for 36 there is an even unicyclic graph G such that $\mathrm{gpn}(G) = t$, and except for 30 there is an unicyclic graph G such that $\mathrm{gpn}(G) = t$, [3].

Remark: This is a joint work with Riste Skrekovski and Martin Knor.

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C-chain connectedness

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In this talk, we study the notion of a c-chain connected set in topological spaces. Given a topological space X and $C \subseteq X$, C is defined to be c-chain connected in X if for every clopen covering $\mathcal{U}$ of X and every pair $x, y \in C$, there exists a chain in $\mathcal{U}$ that connects x and y. We establish that c-chain connectedness is equivalent to classical chain connectedness [1], providing a new criterion that allows known results to be re-examined and reproven. However, several new results are also obtained. Specifically, we establish a chain-based criterion for the star of a set with respect to a covering. Furthermore, we generalize standard theorems regarding unions and Cartesian products by formulating them for (c-)chain connected components rather than for closures of (c-)chain connected sets as in [1, 2]. We also present an extension of Theorem 3.5 from [1], analogous theorems at the level of a single covering are given in [3], and present new concrete examples.

Remark: This is a joint work with Zoran Misajleski.

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Hypocoercivity and the hypocoercivity index for linear and nonlinear ODEs

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Hypocoercivity is a structural property of semi-dissipative linear evolution equations which is weaker than coercivity, but still yields asymptotic stability. I will introduce this concept and related properties in the finite-dimensional linear case. Then, I discuss the hypocoercivity index, how it characterizes the short-time decay behaviour of solutions and how these results can then be transferred to discrete-time systems via the Cayley transform. Finally, we give an outlook on current work extending these notions to nonlinear ODEs.

Remark: This is joint work with A. Arnold, S. Egger (TU Wien) and V. Mehrmann (TU Berlin).

Generalized Holomorphic Functions as Generalized Complex Analytic Functions

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We study the equivalence between generalized holomorphic functions (GHF) and complex analytic functions in the framework of Robinson-Colombeau generalized numbers. In every non-Archimedean ring, the use of ordinary series is severely restricted by the topological property that a series converges (in a topology of infinitesimal neighborhoods) if and only if its general term is infinitesimal. Consequently, classical Taylor series representations for generalized functions are limited to infinitesimal neighborhoods. To overcome this drawback, we introduce and develop the theory of hyperpower series, defined by summation over the set of hyperfinite natural numbers. We establish the foundational algebraic and topological properties of hyperpower series, including their radii of convergence and sets of convergence. Building on this, we define generalized complex analytic functions and extend several fundamental theorems of complex analysis to the GHF setting, specifically, providing generalizations of Goursat's theorem, Liouville's theorem, the identity theorem, and a Paley-Wiener type theorem.

Remark: This is a joint work with Paolo Giordano, University of Vienna, Austria.

The stochastic fractional Zener wave equation with singular density

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We investigate the stochastic fractional Zener wave equation as a model for wave propagation in viscoelastic, non-homogeneous media that can feature singularities and random density fluctuations. In this talk we concentrate on the singular density regime, allowing the material density ϱ to be extremely irregular – including highly oscillatory functions and distributions. The analysis is carried out on the Gaussian white-noise probability space and framed in the Kondratiev class of generalized stochastic processes. Our main tools are the chaos-expansion techniques of white-noise analysis, combined with existence and uniqueness results for (very) weak solutions of the associated deterministic fractional Zener wave equations.

Remark: This is a joint work with Snežana Gordić.

Taylor Wavelet Solutions of a Nonlinear Differential System Modeling Computer Virus Spread

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This study focuses on a nonlinear system of ordinary differential equations modeling the spread of a computer virus, known as the C-SEIRA model. The dynamics of the malware propagation through the computer network are analyzed using the mathematical model that consists of five compartments: Controlled Susceptible, Exposed, Infectious, Removed and Antidotal computers. In order to solve the model, a numerical approach based on the use of Taylor wavelets is suggested. This method converts the nonlinear differential equation system into a nonlinear algebraic system and achieves high accuracy while using low-degree polynomial approximation. We compare our results with the fourth-order Runge-Kutta method and Mathematica's default solver and we assess the accuracy through the residual error analysis. We also include parameter analysis to understand how the changes in the parameters affect the way the virus spreads.

Characterizing Wavefront Sets of Solutions to the Time-Dependent Schrödinger Equation Using the Stockwell Transform

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In this talk, we characterize the usual and Sobolev wavefront sets and propose a novel representation of the Schrödinger equation with sub-quadratic perturbation using the Stockwell transform. Additionally, we discuss its application in determining the wavefront set of solutions to the Schrödinger equation with sub-quadratic perturbation.

Remark: This is a joint work with Dr. Ashwani Rao.

Homogenisation of heterogenous Boltzmann equation in the L^p setting

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We consider a heterogeneous linear Boltzmann equation in which the opacity oscillates rapidly and periodically with respect to the spatial variable, while the drift may depend on both position and velocity. The aim is to study homogenisation in the L^p setting, $1 < p < 2$, and to understand when microscopic oscillations average out in the weak limit.

The method is based on H-distributions, which describe the microlocal defect of weakly convergent sequences. Here we can approximate the H-distribution by a sequence of H-measures. Then, by combining the localisation principle with an orthogonality argument of H-measures, we obtain a nonresonance condition ensuring that no additional oscillatory defect survives in the limit. Under this condition, the homogenised equation has the same structure as the original one, with the periodic opacity replaced by its cell average.

Remark: This is a joint work with Nenad Antonić and Darko Mitrović.

The wave packet analysis of ΨDOs

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Let f be an element of a Gelfand Shilov type space and $\sigma(x,D)$ be a pseudodifferential operator with the exponential growth of its symbol $\sigma(x,\xi)$ and certain additional properties. Then

$$f=\sum_{\lambda\in\Lambda} f_\lambda\psi_\lambda, \qquad f_\lambda=\langle f,\phi_\lambda\rangle, \qquad \sigma(x,D)f=\sum_{\lambda\in\Lambda} f_\lambda\sigma(x,D)\psi_\lambda,$$

where Λ is the set of lattice points in $\mathbb{N}^{2d}$ and ϕ_λ and ψ_λ, $\lambda\in\Lambda$, are frame and its dual frame.

Let

$$\sigma(x,D)\psi_\lambda=\sum_{\lambda'\in\Lambda}\langle\sigma(x,D)\psi_\lambda,\phi_{\lambda'}\rangle\psi_{\lambda'}.$$

Denote by A the matrix with elements $A_{(\lambda,\lambda')}$:

$$A=\left(A_{(\lambda,\lambda')}\right) \quad \text{where} \quad A_{(\lambda,\lambda')}=\langle\sigma(x,D)\psi_\lambda,\phi_{\lambda'}\rangle.$$

With this,

$$\sigma(x,D)f=\sum_{\lambda'}\sum_{\lambda} f_\lambda A_{(\lambda,\lambda')}\phi_{\lambda'}.$$

Our aim is to analyze Gelfand Shilov type spaces and corresponding ΨDOs through

$$\langle\sigma(x,D)\psi_\lambda,\phi_{\lambda'}\rangle.$$

Moreover sampling type results will be presented in relation to corresponding series expansions.

Remark: This is a joint work with my students...

On the Moving Load Problem with Time Delay and General Fractional Derivative

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We consider a moving load problem of an elastic rod with a non-local action. The resulting fractional Winkler-type equation is investigated. With respect to the time variable t, the solution and its first derivative are continuous and exponentially bounded, whereas the second derivative is not. From the viewpoint of physical modeling, the concentrated moving load $\delta(x - vt)$ is approximated by a sequence $\delta_n(x - vt)$. This approximation yields solutions possessing classical derivatives of all orders with respect to x and a classical first derivative with respect to t.

Remark: This is a joint work with Marko Janev (Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, Serbia), Teodor Atanacković (Faculty of Technical Sciences, University of Novi Sad, Serbia; Serbian Academy of Sciences and Arts, Belgrade, Serbia), and Stevan Pilipović (Department of Mathematics and Informatics, Faculty of Sciences, University of Novi Sad, Serbia; Serbian Academy of Sciences and Arts, Branch in Novi Sad, Serbia).

Ridgelet transform on Gelfand–Shilov-type spaces

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In this talk, we construct Gelfand-Shilov spaces of type $\mathfrak{S}$ and discuss the continuity and boundedness of the Ridgelet transform. We then extend the analysis to generalized functions and explore its application to the space of tempered ultradistributions. Finally, we extend our findings to Gevrey functions of compact support. We also discuss an application of the Ridgelet transform in image processing.

Remark: This is a joint work with Dr. Ashish Pathak.

Double Almost Statistical Convergence of order α with respect to seminorm

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Let $\lambda = (\lambda_m)$ and $\mu = (\mu_n)$ be two non-decreasing sequences of positive real numbers both of which tends to ∞ as m and n approach ∞, respectively. Also let $\lambda_{m+1} \leq \lambda_m + 1$, $\lambda_1 = 1$ and $\mu_{n+1} \leq \mu_n + 1$, $\mu_1 = 1$. We write the generalized double de la Valèe-Poussin mean by

$$t_{mn}(x) = \frac{1}{\lambda_m \mu_n} \sum_{i \in I_m,\, j \in I_n} x_{ij}.$$

In this paper we define and study λ-double almost statistical convergence of order α with respect to seminorm. Furthermore, some inclusion relations have been considered. We further introduce a new sequence space by taking double almost statistical convergence and Orlicz function in seminorm.

Metaplectic time-frequency representations: characterization and uncertainty principles

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We prove that the sesquilinear forms which satisfy a general phase space covariance property are metaplectic time-frequency representations, i.e., generalized Wigner distributions as introduced by Cordero and Rodino. We discuss a method for the transfer of an uncertainty principle for the short-time Fourier transform or a Fourier pair to an uncertainty principle for a sesquilinear or quadratic metaplectic time-frequency representation. In particular, we derive Beurling-type and Hardy-type uncertainty principles for metaplectic time-frequency representations.

Remark: This is a joint work with Karlheinz Gröchenig (University of Vienna).

Rigged Hilbert Space for Matrix Quantum Mechanics

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We construct two infinite-dimensional inner vector spaces, $\mathbb{C}^{\mathbb{N}}_Q$ and $\mathbb{C}^{\mathbb{N}}_P$, none of which is a Hilbert space. Each of these spaces is isomorphic to $\mathbb{C}^{\mathbb{N}}$ and at the same time each of them is a proper subspace of $\mathbb{C}^{\mathbb{N}}$. Our spaces accommodate two Hermitian operators $\widehat{Q} \in \mathcal{L}(\mathbb{C}^{\mathbb{N}}_Q)$ and $\widehat{P} \in \mathcal{L}(\mathbb{C}^{\mathbb{N}}_P)$ – extensions of Heisenberg matrices Q and P, respectively – both with spectrum $\mathbb{R}$, satisfying $[\widehat{P}^t, \widehat{Q}] = iI$. The latter allow us to calculate the spectrum of the harmonic oscillator, hydrogen atom, etc. – as in classical matrix quantum mechanics. In addition (and here is the novelty), $\mathbb{C}^{\mathbb{N}}_Q$ and $\mathbb{C}^{\mathbb{N}}_P$ possess orthonormal algebraic (Hamel) bases of eigenvectors of $\widehat{Q}$ and $\widehat{P}$, respectively. Consequently, each of the vectors taken from these bases determines an eigenstate of $\widehat{Q}$ and $\widehat{P}$, respectively. Recall that Heisenberg matrices Q and P do not have eigenvectors in Hilbert space l^2. Neither the family of Dirac-delta functions $\delta(x - \lambda)$, $\lambda \in \mathbb{R}$, present an orthonormal basis of Gelfand's rigged Hilbert space extending $\mathcal{L}^2(\mathbb{R})$.

Remark: A Joint Work with Günther Hörmann, Universität Vienna.

Wavelets beyond classical Gevrey spaces

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Extended Gevrey classes of locally smooth functions contain the union of all classical Gevrey classes and thus capture a level of regularity between Gevrey and C^∞. Their structure is governed by the two-parameter sequence $M_p^{\tau,\sigma} = p^{\tau p^\sigma}$, which fails to satisfy Komatsu's $(M.2)$ condition for any $\tau > 0$ and $\sigma > 1$. Recently, these classes have been recognized as an important example within the framework of weight matrix spaces, offering a flexible setting for various applications.

In this talk, we combine techniques from multiresolution analysis (MRA) and invariant cycles to present a general method for constructing smooth orthonormal wavelets ψ such that both ψ and its Fourier transform $\widehat{\psi}$ belong to the extended Gevrey class $\mathcal{E}_\sigma(\mathbb{R})$, for $\sigma > 1$. The decay properties of ψ and $\widehat{\psi}$ are characterized in terms of the Lambert W function, which plays a central role in the construction. This approach yields explicit examples that lie beyond all classical Gevrey classes. Both bandlimited and non-bandlimited cases are discussed.

Remark: This is a joint work with N. Teofanov, M. Žigić and S. Tutić.

On certain applications of Grunsky coefficients in the theory of univalent functions

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In this paper a survey is given of application of a method based on Grunsky coefficients for obtaining different estimates (some sharp) for the general class of univalent functions where no analytical characterisation exists. More precisely, estimates are given for the modulus of the third and the fourth logarithmic coefficients, for the modulus of the second and the third Hankel determinant for the general class of univalent functions, and for the modulus of some coefficients of the inverse function, and some coefficient differences.

Remark: Joint work with Prof. Milutin Obradović.

The product of distributions in the Sobolev sense

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We consider the space

$$\mathscr{H}^{s,r}_L(O) := \{u \in H^s_{\mathrm{loc}}(O) \mid WF^r(u) \subseteq L\} = H^s_{\mathrm{loc}}(O) \cap \mathcal{D}'^{,r}_L(O)$$

consisting of all local Sobolev distributions of order s on an open set O whose Sobolev wave front set of order r is contained in the closed conic set $L \subseteq O \times (\mathbb{R}^m \backslash \{0\})$. We introduce a locally convex topology on $\mathscr{H}^{s,r}_L(O)$ and show that the ordinary product of smooth functions uniquely extends to a continuous bilinear mapping

$$\mathscr{H}^{r_1,r'}_{L_1}(O) \times \mathscr{H}^{r_2,r''}_{L_2}(O) \longrightarrow \mathscr{H}^{s,r}_L(O),$$

for appropriate s and r when L_1 and L_2 are in a favorable position. The key ingredient in our proof is to employ Hörmander's idea of considering the pullback by the diagonal map $x \mapsto (x, x)$ of the tensor product of two distributions.

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Dynamic Portfolio Optimisation Using Global and Local Dependence Functions

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Financial asset dependence changes over time, making static portfolio optimisation models less effective under varying market conditions. This study proposes a dynamic portfolio optimisation framework that incorporates time-varying dependence information into a linear optimisation model through adaptive diversification constraints. Dependence matrices are re-estimated using rolling windows of asset returns, and the strongest dependence relationships are converted into pairwise concentration constraints. Portfolio allocation is formulated as a Conditional Value-at-Risk (CVaR) constrained linear programming problem with long-only, budget, and turnover constraints. Four dependence measures are compared within the same optimisation framework: Pearson correlation, Spearman correlation, Local Gaussian Correlation, and the Bairamov–Kotz Local Dependence Function. Daily experiments on a subset of Borsa Istanbul (BIST) stocks demonstrate that the proposed framework remains computationally feasible while dynamically adapting portfolio weights to evolving dependence structures. The local dependence measures generate different diversification patterns from classical correlation-based approaches, illustrating their ability to capture state-dependent relationships. The results indicate that incorporating dynamic local dependence into portfolio optimisation provides a flexible and interpretable framework for adaptive portfolio construction and offers a promising alternative to traditional static correlation-based models.

Discrete Weinstein Pseudo-differential Operators

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Pseudo-differential operators are useful integral representations and play an important role in various problems of Partial differential equations. In this talk, various properties of the pseudo-differential operators associated with the discrete Weinstein transform are discussed, and their applications in Sobolev-type spaces are established.

Solvability of the Cauchy-Riemann equation in weighted spaces of smooth functions

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In this talk, I will present my work on the solvability of the inhomogenuous Cauchy-Riemann equation in spaces of smooth functions that decay fast at infinity on strip-like domains in the complex plane. My first main result is a complete characterization of the solvability of this equation in terms of the weights that model the decay at infinity. Secondly, I will discuss parameter dependence problems related to this equation: If the data of the equation decay fast on a strip-like domain in the complex plane and depend on a couple of parameters in some "nice" (real analytic, smooth,...) way, can we then always find a solution that decays as fast as the data and that depends on these parameters in the same "nice" way? I will present a characterization of this phenomenon in terms of the linear topological invariant (A). As an application, we will see that real-analytic parameter dependence of the solution cannot always be guaranteed. Throughout this talk, I intend to give a taste of the main functional analytic methods we used: the abstract Mittag-Leffler method and the splitting theory for Fréchet spaces.

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Asymptotic relations for some generalized integral transforms and frames

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Asymptotic analysis of distributions is a very attractive research field that took the attention of different authors. In the recent years it has become common to analyze the asymptotic behavior of distributions through the asymptotic behavior of some generalized integral transforms and frames.

Some Abelian- and Tauberian-type results for the quasiasymptotics of tempered distributions through the asymptotic behavior of generalized directional short-time Fourier transform and localized frames are presented. Also, several Abelian- and Tauberian-type results for the quasiasymptotics of Lizorkin distributions, polynomial multiplication of Lizorkin distributions and m-th derivative Lizorkin distributions in terms of their generalized Stockwell and wavelet transforms are given.

Some asymptotic results for both transforms of the m-th derivative of Dirac delta distribution are given. The talk is based on papers [1, 2, 3, 4, 5, 6].

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Rotation Invariant P-type Ultradistributions

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In our recent work, we defined and characterized ultradifferentiable functions and the corresponding ultradistributions on positive orthants by means of iterates of the Laguerre operator. The characterization is based on decay and growth conditions for the coefficients in the corresponding Laguerre series expansions. These results were then applied to establish an isomorphism between certain subspaces of Pilipović spaces on $\mathbb{R}^d$ and the associated spaces of ultradifferentiable functions.

In the present work, we study rotation invariant ultradifferentiable functions and ultradistributions of P-type. More precisely, we show that the space of rotation invariant functions in the Pilipović space is isomorphic to the space of even one-dimensional functions in the corresponding Pilipović space. We also obtain the analogous result for the corresponding ultradistribution spaces.

Moreover, these investigations establish the relation between a Cauchy problem involving the Laguerre operator and Schrödinger type equations associated with the harmonic oscillator with rotation invariant initial value.

Remark: This is a joint work with Nenad Teofanov and Smiljana Jakšić.

The filter of singularities in global anisotropic microlocal analysis

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We define a filter of time-frequency anisotropic global singularities of phase space for tempered distributions. The filter contains information from the corresponding anisotropic Gabor wave front set and admits propagation results for the Cauchy problem for certain linear evolution equations of Schrödinger type that generalize the harmonic oscillator.

Remark: This is a joint work with Luigi Rodino.

Recent developments in the quasiasymptotic theory of fractional integral transforms

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Quasiasymptotic analysis provides a fundamental framework for studying the local and global asymptotic behavior of generalized functions through integral transforms. In this survey, we review recent results concerning the quasiasymptotic properties of a broad class of fractional integral transforms, including the fractional Fourier, Hankel, Stockwell, and wavelet transforms. The talk emphasizes unified approaches for deriving Abelian and Tauberian theorems in distribution spaces, the role of transform kernels, and extensions to Lizorkin distributions.

Remark: This is a joint work with Sanja Atanasova.

Interpolation problem in extended Gevrey classes

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We consider spaces of smooth functions defined by relaxing Gevrey-type regularity and decay conditions. We show that these classes fit naturally into the framework of the weighted matrix approach to ultradifferentiable functions. We further prove that controlling the derivatives of a function f only at orders d_n, by bounds characteristic of extended Gevrey classes, where $(d_n)_n$ is a divergent sequence of positive integers satisfying $d_{n+1} \leq Ld_n$, $n \in \mathbb{N}$, for some $L > 1$, already implies control of derivatives of all orders. Consequently, f belongs to the corresponding extended Gevrey class.

Remark: This is a joint work with Dj. Vučković and J. Dimitrić.