Workshop – Conference

Vremensko-frekventna analiza sa primenama

Analysis and Acoustics Research – ANACRES

06 – 07 May, 2019
Novi Sad, Serbia

Book of Abstracts

Organized by
Serbian Academy of Sciences and Arts,
Novi Sad Branch of the Serbian Academy of Sciences and Arts
and
Department of Mathematics and Informatics,
Faculty of Sciences, University of Novi Sad

Organizing Committee

Academician Stevan Pilipović

Nenad Teofanov

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Metode vremensko-frekvencijske analize sa primjenama, Republika Srpska

Schedule

Novi Sad Branch of Serbian Academy of Sciences and Arts
Nikole Pašića 6, Novi Sad

Monday, 06 May

10:15-10:30		Opening
10:30-11:00	Hans Georg Feichtinger	*Two dimensional Gabor Analysis: Numerical Challenges and Applications*
11:00-11:30	Maurice deGosson	*The canonical group of transformations of a Gabor frame*
11:30-11:45		Coffee break
11:45-12:15	Luis Daniel Abreu	*TBA*
12:15-12:45	Tibor Pogany	*Second type Neumann series of generalized Nicholson's function*
12:45- 13:15	Djordje Vučković	*Ultradifferentiable functions and ultradistributions on the sphere*
13:15		Lunch break
after lunch		Discussions, plans for future visits

Tuesday, 07 May

09:00-9:30		Discussions
9:30-10:00	Stevan Pilipović	*Convolution in ultradistribution spaces*
10:00-10:30	Diana Stoeva	*Frame expansions in spaces of generalized functions*
10:30-11:00	Snježana Maksimović	*Sequential and algebric approaches to ultradistribution spaces*
11:00-11:30		Coffee break
11:30-12:00	Ivana Vojnović	*Defect distributions related to weakly convergent sequences in weighted Sobolev spaces*
12:00-12:30	Filip Tomić	*Extended Gevrey regularity: Paley-Wiener theorems and STFT*
12:30-13:00	Nenad Teofanov	*Bilinear multipliers for continuous frames*
13:00		Lunch break
after lunch		Discussions, plans for future visits

Abstracts of Talks

Bargmann-type transforms and function spaces of polyanalytic functions

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Starting from the classical transform of Bargmann we will talk about some related objects in spaces of polyanalytic functions and distributional analogues.

Two dimensional Gabor Analysis: Numerical Challenges and Applications

Hans G. Feichtinger
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The natural setting for time-frequency analysis and Gabor Analysis is the world of functions/signals or distributions over LCA (locally compact Abelian) groups G. A substantial part of the theory (the existence of a Janssen representation for the frame operator, etc.) has been developed in this context, making use of appropriate function spaces, in particular the Banach Gelfand Triple based on the Segal algebra $SO(G)$. In this setting only occasionally a distinction is made between the one-dimensional or the multidimensional (e.g. Euclidean) setting.

In contrast, when it comes to implementation the situation changes. Not because Gabor analysis wasn't interesting for the multi-dimensional setting. On the contrary, the first important papers in the field made the connection between Gabor expansions of images and the analogy with the visual system of humans. But, in terms of available code the situation is rather satisfactory for the case of 1D-signals: one can compute dual or tight Gabor atoms, construct Gabor multipliers, and has cheap algorithms for a cheap (and efficient) determination of approximate versions of these objects.

The talk will discuss the obstacles and additional problem which arise from the large dimensions (the number of pixels of the involved images), the computational costs and above all the huge storage requirements. One possible way out (or at least a special family of Gabor expansions and Gabor multipliers which can be realized) is the use of separable Gabor families. We will also try to explain the relevance of the double preconditioning approach in the 2D-setting.

The canonical group of transformations of a Gabor frame

Maurice de Gosson
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We reformulate some aspects of the theory of Gabor frames using the Weyl-Wigner formalism. This allows us to fully exploit properties of symplectic covariance. We show that every Gabor system has a canonical group of transformations which can be expressed using the metaplectic operators.

[1] M. de Gosson, *The Canonical Group of Transformations of a Weyl–Heisenberg Frame; Applications to Gaussian and Hermitian Frames*, J. Geom. Phys. **114**, 375–383 (2017)

[2] M. de Gosson, *Hamiltonian deformations of Gabor frames: First steps*, Appl. Comput. Harmon. Anal. **38**(2), 196–221 (2014)

Sequential and algebric approaches to ultradistribution spaces

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We introduce and analyze fundamental sequences of smooth functions partitioned into equivalence classes which we call s-ultradistributions. The spaces formed by these classes will be denoted as $\mathcal{U}'^{*}$. We prove the existence of an isomorphism between $\mathcal{U}'^{*}$ and the space of ultradistributions of Beurling type in case $* = (p!)^t$ and of Roumieu type in case $* = \{p!\}^t$, $t > 1$.

[1] P. Antosik, J. Mikusiński and R. Sikorski, *Theory of distributions. The sequential aproach*, Elsevier–PWN, Amsterdam–Warszawa, 1973.

[2] R. Carmichael, A. Kamiński and S. Pilipović, *Boundary Values and Convolution in Ultradistribution Spaces*, World Scientific, Singapore, 2007.

[3] G. Köthe, *Topological vector spaces II*, Vol. II, Springer-verlag, New York Inc., 1979.

[4] H. Komatsu, *Ultradistributions, I: Structure theorems and a characterization*, J. Fac. Sci. Univ. Tokyo Sect. IA Math. 20 (1973), 25–105.

[5] H. Komatsu, *Microlocal Analysis in Gevrey Classes and in Complex Domains*, Lecture Notes in Math. 1726, Springer, Berlin (1989), 426–493.

Convolution in ultradistribution spaces

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Convolution is among the most important tools in mathematical analysis. In the classical, distributional, setting this is much studied topic and most of the central problems have been solved more than half a century ago; however, there are still many interesting recent results.

One of the most important problems is extending the definition of convolution $S * T$ to the case when both S and T are not necessarily test functions. The key ingredient for the development of the theory was the study of the topological properties of basic spaces. The extension of the theory to the non-quasianalytic Roumieu ultradistributions was done only recently; the difficulty in the Roumieu case comes from the fact that the test spaces carry much more complicated topology than their Beurling (and distributional) counterparts.

In this talk we give an overview of our results. In the last part we present new results concerning the convolution with $e^{s|\cdot|^q}, q \in (1,2), s > 0$ in the quasi-analytic setting.

Second type Neumann series of generalized Nicholson's function

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The second type Neumann series are considered which building blocks are generalized Nicholson's functions $B_\nu^p(x) := J_\nu^p(x) + Y_\nu^p(x)$, $p \geq 2$ integer. Closed form definite integral expressions are obtained for such series with the aid of the associated Dirichlet series' Cahen's Laplace integral form.

Frame expansions in spaces of generalized functions

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In this talk, first we give a short introduction to Fréchet frames and localization of frames. Then we present results on expansions in certain classes of Fréchet spaces and their duals via several types of localized frames. In particular, we consider frame expansions of generalized functions. The talk is based on a joint work with Stevan Pilipović.

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Bilinear multipliers for continuous frames

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To warm up and give a broad context of the subject, we first recall some facts related to Fourier multipliers. An interpretation of multipliers in time-frequency plane is given by the means of time-frequency representations and it is known under the name localization operators or short-time Fourier transform multipliers. We give a selection of results on continuity and compactness properties of short-time Fourier transform multipliers and, more generally, of continuous frame multipliers. At the end we introduce their bilinear analogues.

Extended Gevrey regularity: Paley-Wiener theorems and STFT

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In this talk we present Paley-Wiener theorems for classes of extended Gevrey functions. The derivatives of such functions are controlled by sequences of the form $M_p = p^{\tau p^\sigma}$, $p \in \mathbf{N}$, $\tau > 0$, $\sigma > 1$. In particular, we show that such functions can be characterized through the decay properties of their short-time Fourier transforms (STFT). Moreover, we introduce the corresponding wave-front sets and recover them in the terms of the STFT.

Defect distributions related to weakly convergent sequences in weighted Sobolev spaces

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H-distributions (micro-local defect distributions) were introduced by Antonić and Mitrović (2011) for weakly convergent sequences in L^p spaces.

We consider defect distributions associated to weakly convergent sequences in weighted Sobolev spaces $H^{s,p}_{\Lambda}(\mathbb{R}^d)$. In our constructions we use weighted Shubin type classes of symbols and global pseudo-differential calculus.

Results are applied to linear differential equations. Let (u_n) be a weakly convergent sequence of approximate solutions of the given differential equation with bounded or unbounded coefficients. We obtain relation between associated defect distribution and possible (locally) strong convergence of the sequence (u_n).

The talk is based on a joint work with Stevan Pilipović.

Ultradifferentiable functions and ultradistributions on the sphere

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We will discuss a characterization of ultradifferentiable functions and ultradistributions on the unit sphere in terms of the growth of the norms of their projections onto spaces of spherical harmonics. After that, we will present a theory of ultradistributional boundary values of harmonic functions on the unit sphere $\mathbb{S}^{n-1}$ of $\mathbb{R}^n$.

Under suitable assumptions on a (not necessarily non-quasianalytic) weight sequence $\{M_p\}_{p\in\mathbb{N}}$, we shall show: A harmonic function U, defined on the Euclidean open unit ball, admits boundary values in $\mathcal{E}'^{\{M_p\}}(\mathbb{S}^{n-1})$, that is,

$$\lim_{r\to 1^-} U(r\omega) \text{ exits in } \mathcal{E}'^{\{M_p\}}(\mathbb{S}^{n-1}),$$

if and only if U satisfies the growth estimate

$$|U(x)| \leq C \exp\left(M^*\left(\frac{h}{1-|x|}\right)\right), \quad |x|<1,$$

for some constants $C, h > 0$, where M^* is the associate function of $M_p/p!$. A similar result holds in the Beurling case. Our considerations generalize results by Estrada and Kanwal obtained in the framework of distributions .