FNRS Group

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Functional Analysis

Book of Abstracts

3 - 4 July 2025 – University of Mons

Welcome and Practical Information

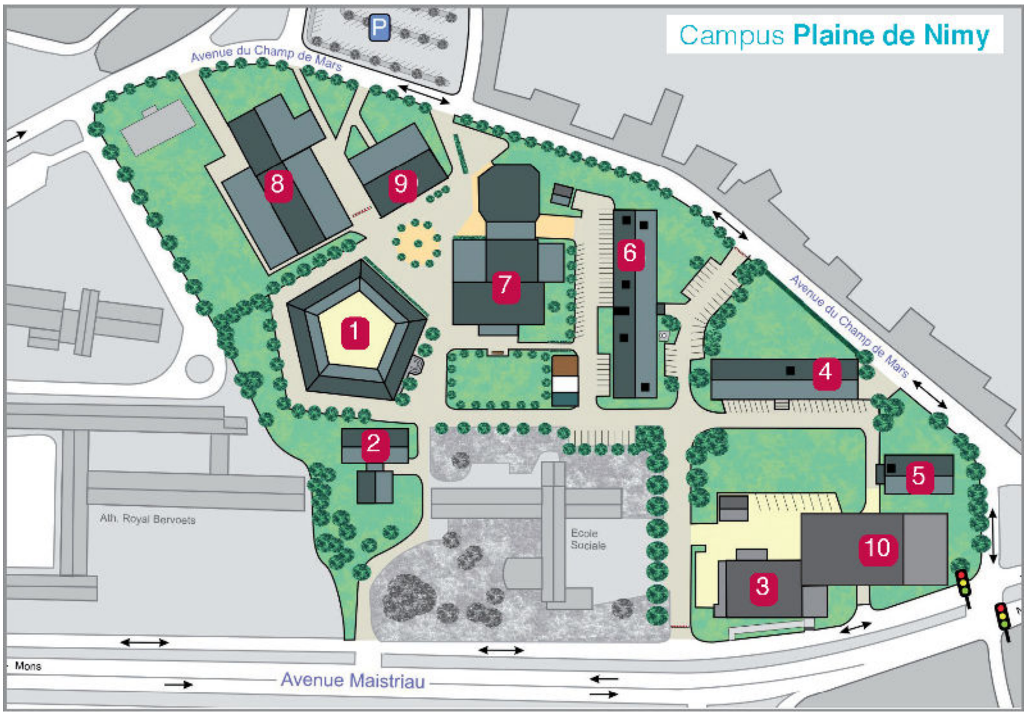
Thanks for joining us at this edition of the annual meetings of the FNRS group - Functional Analysis.

The reception and the coffee breaks will be held in the room "Vésale 030". The talks will take place in the room "La Fontaine". These two rooms are located in the Vésale building (Number 8 on the map below).

If you arrive by train, take a few moments to admire the brand new Mons station that was inaugurated this year (with only a 10-year delay).

If you pass through the "Grand-Place", take a few minutes to touch the head of the monkey of Mons with your **left** hand. This brings good luck for a year (you will then need to plan a return to Mons).

Looking forward to seeing you in Mons.



Program

Thursday, July 3, 2025

- 12:00 : Reception of participants (with sandwiches)
- 13:15 – 13:30 : Opening
- 13:30 – 14:20 : *Alfred Peris*
  Generalized hyperbolicity and shadowing properties for operators on locally convex spaces
- 14:20 – 15:10 : *Susana D. Moura*
  Generalised Morrey spaces and related smoothness spaces
- 15:10 – 15:50 : coffee break
- 15:50 – 16:40 : *Stéphane Charpentier*
  Approximation in the complex plane by incomplete polynomials and applications
- 16:40 – 17:30 : *Martina Maiuriello*
  Orbits and unpredictability: chaotic, linear phenomena in Operator Theory
- 19:30 : Restaurant "L'Excelsior", Grand Place 29, 7000 Mons

Friday, July 4, 2025

- 09:00 – 09:50 : *Javier Sanz*
  Borel-Ritt results in classes with uniform asymptotics defined by sequences with shifted moments
- 09:50 – 10:40 : *Edouard Daviaud*
  Dynamical approximation by ergodic systems
- 10:40 – 11:20 : coffee break
- 11:20 – 12:10 : *Frederik Broucke*
  The asymmetric Beurling-Selberg extremal problem
- 12:15 : closing (with sandwiches)

Abstracts

July 3, 13:30 – 14:20

Generalized hyperbolicity and shadowing properties for operators on locally convex spaces

Alfred Peris (Universitat Politècnica de València, Spain)
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In this talk we will present the notion of generalized hyperbolicity for operators on locally convex spaces, and we will show that every generalized hyperbolic operator on a locally convex space has the finite shadowing property. Under the assumption of sequential completeness, we will prove that generalized hyperbolicity implies the strict periodic shadowing property. This is a very strong dynamical property, since operators with the periodic shadowing property on topological vector spaces can be shown to be topologically mixing and Devaney chaotic when restricted to its chain recurrent set.

This is part of a joint work with Nilson Bernardes, Blas Caraballo, Udayan Darji and Vinicius Favaro.

References

[1] Bernardes, N.C., Caraballo, B.M., Darji, U.B., Fávaro, V.V., and Peris, A. Generalized hyperbolicity, stability and expansivity for operators on locally convex spaces. *J. Funct. Anal.*, 288(2), art. n. 110696, 2025.

July 3, 14:20 – 15:10

Generalised Morrey spaces and related smoothness spaces

Susana D. Moura (Universidade de Coimbra, Portugal)
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Over the past few decades, several scales of function spaces built upon Morrey spaces $\mathcal{M}_{u,p}(\mathbb{R}^d)$, $0 < p \leq u < \infty$, have been introduced and intensively studied. Commonly referred to in the literature as smoothness Morrey spaces, these spaces have attracted a lot of interest, primarily due to their potential applications in PDEs.

In this talk we consider generalised Morrey spaces $\mathcal{M}_{\varphi,p}(\mathbb{R}^d)$, where the parameter u is replaced by a general function parameter φ, and related smoothness spaces. We will explore unboundedness properties of functions belonging to these spaces in terms of their growth envelopes. This concept has already been successfully studied and applied to a variety of smoothness spaces. We also present some recent results on embeddings, such as Sobolev-type embeddings, between some generalised Morrey smoothness spaces.

This talk is based on joint work with Dorothee Haroske (Jena), Zhen Liu (Beijing), and Leszek Skrzypczak (Poznan).

July 3, 15:50 – 16:40

Approximation in the complex plane by incomplete polynomials and applications

Stéphane Charpentier (Aix-Marseille Université, France) stephane.charpentier.1@univ-amu.fr

Let K be a compact set in the complex plane, with connected complement. Runge's theorem asserts that every function holomorphic in some neighborhood of K can be approximated uniformly on K by polynomials. A quantitative version is known as Benrstein-Walsh's theorem. In this talk, we will discuss some results of this kind when we impose on the polynomial approximants some conditions on their valuation and degree. An application to the construction of frequently universal Taylor series will be given.

Joint works with Normal Levenberg and Franck Wielonsky, and with Konstantinos Maronikolakis.

July 3, 16:40 – 17:30

Orbits and unpredictability: chaotic, linear phenomena in Operator Theory

Martina Maiuriello (Link Campus University Rome, Italy)
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The dynamical study of linear operators has revealed a surprisingly intricate and chaotic landscape, even within the seemingly rigid framework of linearity. At the core of this rich theory lies hypercyclicity, one of the most striking manifestations of linear chaos, and, as extensively documented in the literature, its variants – such as frequent hypercyclicity, supercyclicity, and others – offer deeper insights into how simple linear settings can produce remarkably complex and unpredictable behaviors. This talk aims to present recent characterizations of the above mentioned notions in the context of composition operators on $L^p(X)$, $1 \leq p < \infty$, and to highlight the vastness of these chaotic phenomena, with further implications for the versatile class of weighted shifts.

July 4, 09:00 – 09:50

Borel-Ritt results in classes with uniform asymptotics defined by sequences with shifted moments

Javier Sanz (Universidad de Valladolid, Spain)
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We will present several new versions of Borel-Ritt theorem, stating the surjectivity of the asymptotic Borel mapping in classes of functions with $\mathbf{M}$-uniform asymptotic expansion on an unbounded sector of the Riemann surface of the logarithm. While in previous results the weight sequence $\mathbf{M} = (M_p)_{p\geq 0}$ of positive numbers is supposed to be derivation closed, the much weaker condition of having shifted moments, namely

$$\exists C_0 > 0,\ H > 1\colon \forall p \in \mathbb{N}_0,\ \log(m_{p+1}/m_p) \leq C_0 H^{p+1}, \quad (m_p := M_{p+1}/M_p)$$

is shown to be sufficient to obtain the result in the case of Roumieu classes. Moreover, the solution comes with explicit extension operators, right inverses for the Borel mapping.

Regarding Beurling classes and right inverses for the Borel mapping, we are able to slightly improve a classical result of J. Schmets and M. Valdivia and reprove a result of A. Debrouwere, both under derivation closedness. Our new condition also allows us to obtain surjectivity results for Beurling classes in suitably narrow sectors, but the technique is now adapted from a classical procedure already appearing in the work of V. Thilliez, in its turn inspired by that of J. Chaumat and A.-M. Chollet.

Joint work with J. Jiménez-Garrido, I. Miguel-Cantero and G. Schindl

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July 4, 09:50 – 10:40

Dynamical approximation by ergodic systems

Edouard Daviaud (Université de Liège, Belgium)
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The metric number theory is the field of mathematics which aims at describing finely the size (in terms of Hausdorff dimension or measure) of sets of points approximable at a "certain speed" by a sequence of points of particular interest. The original motivation for such study lies in understanding finely the approximation of real numbers by rationals. The problem formalizes itself in the following fashion: Let $\psi : \mathbb{N} \to \mathbb{R}_+$ be a mapping and define

$$E_\psi := \left\{ x \in \mathbb{R} \text{ s.t. } |x - \frac{p}{q}| \leq \psi(q) \text{ i.o. } p, q, p \wedge q = 1 \right\},$$

where *i.o.* means that the inequality holds for infinitely many pairs $(p, q) \in \mathbb{Z} \times \mathbb{N}$. The definitive answer regarding the dimension of these sets was obtained in 2021 by combining the results obtained in [1, 7] (which establishes the so-called Duffin-Schaeffer conjecture) and approximation theorems, such as the ubiquity theorem of Jaffard [5] or the mass transference principle, established in [1]. More precisely, the following result holds true:

$$\dim_H E_\psi \cap [0, 1] = \min \{1, s_\psi\},$$

where

$$s_\psi = \sup \left\{ s : \sum_{q \geq 1} \phi(q)\psi(q)^s = +\infty \right\},$$

and $\phi(q) := \# \{0 \leq p \leq q,\ q \wedge p = 1\}$ denotes the Euler mapping.

Although developed in the context of number theory, these approximation results play an important role in various area of mathematics. For instance, given a signal f, the regularity of f around a point t sometimes depends on how well the number t is approximable by certain points naturally connected with the definition of the signal f. As an illustration, if f is a random signal defined using uniform i.i.d sequences, then the multifractal analysis of f should rely on (almost sure) approximation results of numbers or vectors by uniform i.i.d. sequences of random variable. For such reasons (and also because the question is very natural), the approximation theory with respect to random sequences (see [4, 9, 6, 2]) and dynamical sequences (see [3, 8] for instance) has known many developments in the past 20 years.

Very recently, it was proved by Järvenpää, Järvenpää, Myllyoja and Stenflo that for every i.i.d. sequence $(X_n)_{n \in \mathbb{N}}$ of common law μ and every $t \geq \frac{1}{\dim_H \mu}$, almost surely it holds that

$$\dim_H \left\{ y \in \mathbb{R}^d : ||y - X_n||_\infty \leq \frac{1}{n^t} \text{ i.o. } \right\} = \frac{1}{t}.$$

On the other hand, sometimes, in multifractal analysis, to estimate the regularity of a random mapping at a given point, it is sometimes convenient to consider sequences of random variables that are not quite independent. This raises the natural question to understand how much one can weaken the independency assumption on the sequence $(X_n)_{n \in \mathbb{N}}$ in the above result. A natural problem one can consider in order to provide some insight about theses considerations is to consider the dynamical Diophantine approximation by orbits, i.e., the dynamical analog of the random approximation. In this talk, we will show that, under suitable mixing assumption on an ergodic system (T, μ), one still has, for μ-almost every $x \in \mathbb{R}^d$,

$$\dim_H \{ y : \ ||y - T^n(x)||_\infty \text{ i.o. } \} = \frac{1}{t}.$$

In addition, I will present an example of polynomially mixing ergodic system for which the above conclusion does not hold, justifying that the mixing assumption required for the above inequality to hold is optimal in a satisfying sense.

References

[1] V. Beresnevitch and S. Velani. A mass transference principle and the Duffin-Schaeffer conjecture for Hausdorff measures. *Ann. Math.*, 164(3), 2006.

[2] F. Ekström and T. Persson. Hausdorff dimension of random limsup sets. *Journal of the London Mathematical Society*, 98:661–686, 2018.

[3] A.-H. Fan, J. Schmeling, and S. Troubetzkoy. A multifractal mass transference principle for Gibbs measures with applications to dynamical diophantine approximation. *Proc. London Math. Soc.*, 107 (5):1173–1219, 2013.

[4] A.-H. Feng, E. Jarvenpäa, M. Jarvenpäa, and V. Suomala. Dimensions of random covering sets in Riemann manifolds. *J. London Math. Soc.*, 6:229–244.

[5] S. Jaffard. Construction de fonctions multifractales ayant un spectre de singularitâžes prescrit. *C.R.A.S.*, 315(1):19–24, 1992.

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[7] D. Koukoulopoulos and J. Maynard. On the Duffin-Shaeffer conjecture. *to appear in Annals of Mathematics*, 2020.

[8] L. Liao and S. Seuret. Diophantine approximation by orbits of expanding Markov maps. *Ergod. Th. Dyn. Syst.*, 33:585–608, 2013.

[9] S. Seuret. Inhomogeneous random coverings of topological markov shifts. *Math. Proc. Cambridge Philos. Soc.*, 2020.

July 4,
11:20 – 12:10

The asymmetric Beurling-Selberg extremal problem

Frederik Broucke (Ghent University, Belgium)
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Let $s(x)$ be a real-valued locally integrable function. A classical well-studied problem in Fourier analysis is to find, among all entire functions of exponential type at most 2π, the best approximation F to s, in the sense that

$$\int_{-\infty}^{\infty} |s(x) - F(x)| \mathrm{d}x$$

is minimized. Additionally one may ask that $F(x) \geq s(x)$ for all real x, when the problem is to find the best *majorant* of s, and which is sometimes also referred to as the Beurling-Selberg problem. A notable example is the case $s(x) = \operatorname{sgn} x$, for which the solution, found by Beurling, has numerous applications in Fourier analysis, number theory, and Tauberian theory.

In this talk, we propose the following more general problem, where one instead minimizes

$$(1-\eta)\int_{-\infty}^{\infty}(s(x)-F(x))_{+}\,\mathrm{d}x+\eta\int_{-\infty}^{\infty}(s(x)-F(x))_{-}\,\mathrm{d}x, \quad \text{for some fixed } \eta\in(0,1).$$

(Here $f_+ = \max\{f, 0\}$, $f_- = \max\{-f, 0\}$.) We construct the unique solution for $s(x) = x^n \operatorname{sgn} x/n!$ ($n \in \mathbb{N}$), and provide as an application sharp asymmetric finite forms of the Ingham-Karamata Tauberian theorem.

Joint work with Gregory Debruyne and Jasson Vindas.
