New Trends in Nonlocal and Nonhomogeneous PDEs

Organized in honor of Professor Patrizia Pucci

Sousse, Tunisia
April 24–27, 2026

PROGRAM AND ABSTRACTS

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2. Plenary Talks

Boumediene Abdellaoui
University of Tlemcen
Algeria

Title: Optimal Regularity Results for the Fractional Heat Equation and Applications to a Nonlocal KPZ Problem

Abstract: The main purpose of this talk is to present new regularity results for solutions to the fractional heat equation with Dirichlet boundary conditions, depending on the regularity of the data. More precisely, we consider the problem

$$(FHE) \qquad \begin{cases} u_t + (-\Delta)^s u = h(x,t) & \text{in } \Omega_T = \Omega \times (0,T), \\ u(x,t) = 0 & \text{in } (\mathbb{R}^N \setminus \Omega) \times (0,T), \\ u(x,0) = u_0(x) & \text{in } \Omega, \end{cases}$$

where h and u_0 are measurable functions satisfying suitable integrability assumptions. We assume that $0 < s < 1$ and that Ω is a bounded open subset of $\mathbb{R}^N$ with regular boundary.
The operator $(-\Delta)^s$ denotes the classical fractional Laplacian, defined by

$$(-\Delta)^s \phi(x) := a_{N,s}\, \text{P.V.} \int_{\mathbb{R}^N} \frac{\phi(x) - \phi(y)}{|x-y|^{N+2s}}\, dy, \qquad s \in (0,1), \tag{1}$$

for $\phi \in \mathscr{S}(\mathbb{R}^N)$.
According to the regularity of the data, we establish optimal regularity properties of the solution u in suitable functional spaces.
As an application of these results, we derive existence and regularity results for a class of Kardar–Parisi–Zhang (KPZ) equations involving fractional diffusion and a nonlocal gradient term.

This talk is based on joint works including the following papers:

1. B. Abdellaoui, S. Atmani, K. Biroud, E.-H. Laamri, *Global regularity results for the fractional heat equation and applications to a class of nonlinear KPZ problems*, submitted (2025).

2. B. Abdellaoui, A. Primo, I. Peral, F. Soria, *On the KPZ equation with fractional diffusion: Global regularity and existence results*, Journal of Differential Equations, Volume 312 (2022), 65–147.
We illustrate how fractional-order models can be effectively applied to selected health-related problems, where classical integer-order models may fail to accurately capture long-term memory effects. Examples from epidemiology and biological systems are considered to demonstrate the relevance of the fractional framework. These results illustrate the potential of fractional dynamical systems for improving the mathematical description of health processes and provide perspectives for future research at the interface between applied mathematics and health sciences.

José Carmona Tapia
University of Almería
Spain

Title: Multiplicity and global behavior of solutions to elliptic problems with nonlinearities having zeros

Abstract: We will present several recent results concerning the existence and multiplicity of solutions for boundary value problems in which an elliptic operator is confronted with a nonlinear term containing multiple zeros and different boundary conditions.

References

[1] D. Arcoya, J. Carmona Tapia and P. J. Martínez-Aparicio, *Multiplicity of solutions for an elliptic Kirchhoff equation*, Milan J. Math. **90** (2022), no. 2, 679–689.

[2] J. Carmona Tapia and R. Fiñana Aránega, *Existence, nonexistence and multiplicity of bounded solutions to a nonlinear BVP associated to the fractional Laplacian*, Fract. Calc. Appl. Anal. **28** (2025), no. 3, 1134–1154.

[3] J. Carmona Tapia, P. Malanchini, A. J. Martínez Aparicio and P. J. Martínez-Aparicio, *Regularizing effect of the natural growth term in quasilinear problems with sign-changing nonlinearities*. Submitted.

[4] J. Carmona Tapia, A. J. Martínez Aparicio and P. J. Martínez-Aparicio, *Intervals of bifurcation points for semilinear elliptic problems*, Adv. Nonlinear Anal. **14** (2025), no. 1, Paper No. 20240061, 25 pp.

[5] J. Carmona Tapia, A. J. Martínez Aparicio and P. J. Martínez-Aparicio, *Multiplicity of nonnegative solutions for semilinear Robin problems involving sign-changing nonlinearities*. Submitted.

Hichem Chtioui
University of Sfax
Tunisia

Title: Perturbation results for critical problems involving the spectral fractional laplacian with mixed boundary conditions

Abstract: We consider critical nonlinear problems on bounded domains of $\mathbb{R}^n$, $n \geq 2$, involving the fractional Laplacian operator defined by the spectrum of the Laplacian $(-\Delta)$ under mixed Dirichlet-Neumann boundary conditions. Fractional critical problems with various boundary conditions are a well-known topic in the field of nonlinear partial differential equations. Due to the critical nonlinearity, the associated Euler-Lagrange functional does not satisfy the Palais-Smale condition. This prevents the direct use of classical variational techniques to study the problem of the existence of solutions.
In the present work, we study the lack of compactness of the associated variational problems for all dimensions $n \geq 2$. We analyze the asymptotic behavior of diverging flow lines of the associated gradient flow which concentrate at the least possible energy level and identify the points at which these flow lines can blow-up. Our study in the lower dimensional cases; $n = 2$ and 3 does not impose any conditions on the critical points of the prescribed Morse function. Determining the index of the associated energy functional at each blow-up point, we prove a general perturbation theorem through an Euler-Hopf type criterion.

Iwona Chlebicka
University of Warsaw
Poland

Title: Lavrentiev's phenomenon and density of regular functions

Abstract: Modelling materials that differ from place to place require the use of unconventional, inhomogeneous space setting. One of the key structural challenge might be the lack of density of regular functions that entails irregularity or even non-existence of solutions. I will discuss what for do we need the density, how to ensure it and examples when it is not possible.

Andrea Cianchi
University of Florence
Italy

Title: Integrability and continuity properties of functions from Musielak-Orlicz-Sobolev spaces

Abstract: Embedding theorems for Sobolev spaces built upon general Musielak-Orlicz norms are offered. These norms are defined in terms of generalized Young functions, which also depend on the x-variable. A Sobolev conjugate

is associated with any function of this type, and plays a role in an embedding into a Musielak-Orlicz target space. Such a conjugate is sharp, in the sense that, for each fixed x, it agrees with the sharp Sobolev conjugate in classical Orlicz spaces. In the supercritical regime where the target space is contained in L^∞, embeddings into spaces of uniformly continuous functions are also derived. This talk is based on collaborations with Lars Diening and with Michal Borowski.

Youssef EL Hadfi
Sultan Moulay Slimane University
Morocco

Title: Modern Approaches to Partial Differential Equations: From Artificial Intelligence-Based Methods to Physics-Informed Neural Networks

Abstract: Partial differential equations occupy a fundamental place in the mathematical modeling of many phenomena in science and engineering. In recent years, artificial intelligence-based methods have opened new perspectives for the analysis and approximation of PDEs, especially in complex settings where classical approaches may be difficult to implement. Among these emerging tools, Physics-Informed Neural Networks have attracted significant attention by combining learning techniques with the intrinsic structure of the underlying physical models.
This talk offers a concise overview of these modern approaches, highlighting their main principles, their relevance for PDE problems, and some of the theoretical and computational challenges they raise.

Filomena De Filippis
University of Salzburg
Germany

Title: Intrinsic Schauder estimates at nearly linear growth

Abstract: Variational integrals at nearly linear growth appear in the theory of plasticity with logarithmic hardening, that is the borderline configuration between plasticity with power hardening and perfect plasticity. The related (very challenging) regularity theory for minima has been intensively developed over the last 25 years, see e.g. the work of Frehse & Seregin '99, Fuchs & Mingione '00, Bildhauer '03, Beck & Bulíček & Gmeineder '20, Di Marco & Marcellini '20, Gmeineder & Kristensen '22, De Filippis & Mingione '23.
In this talk, we will discuss a nonlinear potential theoretic framework for Schauder estimates for vector valued solutions of a broad class of nonautonomous variational problems at nearly linear growth. Our approach naturally embraces the variable exponent as well as the Double and Multi phase setting, yielding new regularity results in basic models and recovering optimal regularity recently established in specific cases. From recent, joint work with Cristiana De Filippis (Parma) and Peter Hästö (Helsinki).

Alessio Fiscella
UNICAMP
Brazil

Title: On critical double phase equations with logarithmic perturbations

Abstract: In this talk, we discuss about recent results for double phase equations in $\mathbb{R}^N$, involving critical Sobolev nonlinearities and logarithmic perturbations. More precisely, our equations are driven by the so-called double phase operator given by

$$\operatorname{div}\left(|\nabla u|^{p-2}u + \mu(x)|\nabla u|^{q-2}u\right) \qquad \text{for } u \in W^{1,\mathcal{H}}(\mathbb{R}^N),$$

set on a Musielak-Orlicz Sobolev space $W^{1,\mathcal{H}}(\mathbb{R}^N)$, where $\mathcal{H}(x,t) = t^p + \mu(x)t^q$ with $1 < p < q < \infty$ and $\mu \in L^\infty(\mathbb{R}^N)$ such that $\mu(x) \geq 0$ a.e. in $\mathbb{R}^N$. The main difficulties arise from the presence of the logarithmic perturbation, which is sign-changing, combined with a double lack of compactness, due to the free action of translation group in $\mathbb{R}^N$ and the critical Sobolev nonlinearity. Furthermore, we have to deal with the Luxemburg type norm of $W^{1,\mathcal{H}}(\mathbb{R}^N)$, which complicates even the study of geometry for the energy functional. For this, we introduce two different strategies to

get existence results for our equations, and we compare the pros and cons. Our results, contained in [1, 2], are new even in the classical p-Laplacian case.

References

[1] A. Bahrouni, A. Fiscella and P. Winkert, *Critical logarithmic double phase equations with sign-changing potentials in* $\mathbb{R}^N$, J. Math. Anal. Appl. **547**, no. 2 (2025) Paper No. 129311.

[2] A. Bahrouni, A. Fiscella and P. Winkert, *Gain and loss on critical logarithmic double phase equations*, Nonlinear Differ. Equ. Appl. 33 (2026) Paper No. 27.

Olivier Goubet
University of Lille
France

Title: Nonlinear eigenvalue problem involving Lipschitzian nonlinearities with non-positive primitive and applications

Abstract: Consider Ω a connected smooth bounded domain of $\mathbb{R}^D$. Consider (for instance) the nonlinear eigenvalue problem $\Delta u = \lambda \sin(u)$ in Ω, $\lambda > 0$, $u = 0$ on $\partial\Omega$. We discuss the existence of non-zero solutions for a general class of equations containing the example above. We provide some applications to the global attractor of damped sine-Gordon equations.

Hatem Hajlaoui
University of Kairouan
Tunisia

Title: Classification of stable and asymptotically homogeneous solutions to the Lane-Emden system

Abstract: For the Lane–Emden system

$$-\Delta u = |v|^{p-1}v, \qquad -\Delta v = |u|^{q-1}u \quad \text{in } \mathbb{R}^d, \tag{2}$$

with $p \geq q \geq 1$, it is known that there exists a positive radial stable solution if and only if $d \geq 11$ and (p, q) lies on or above the so-called Joseph–Lundgren curve introduced in [1].
This talk is devoted to presenting an optimal improvement of this result: In the case $d \leq 10$, there exists no positive solution of (2) which is stable, or merely stable outside a compact set, with

$$\frac{1}{p+1} + \frac{1}{q+1} \neq 1 - \frac{2}{d}. \tag{3}$$

In dimension $d \geq 11$, our results are sharp for a restricted class of solutions: the Joseph–Lundgren curve precisely characterizes existence, provided the solutions are stable (resp. stable outside a compact set and (3) holds) and asymptotically homogeneous.
This is joint work with Louis Dupaigne and Marius Ghergu.

References

[1] Chen, W., Dupaigne, L., Ghergu, M. *A new critical curve for the Lane–Emden system*, Discrete Contin. Dyn. Syst., **34** (2014), 2469–2479.

Patrizia Pucci
University of Perugia
Italy

Title: Uniqueness of radial solutions for m-Laplacian equations in low dimensions

Abstract: In this talk we present new uniqueness results which extend those of Serrin and Tang [Indiana Univ. Math. J., 49 (2000), pp. 897–923] to the low-dimensional case $1 \leq N \leq m$, with $m > 1$. Moreover, we also completely resolve

an open problem posed by Pucci and Serrin [Indiana Univ. Math. J., 47 (1998), pp. 501–528], which had been settled for N ¿ m in the earlier work of Serrin and Tang.

Ariel Salort
Universidad CEU San Pablo
Spain

Title: Asymptotic behavior for anisotropic fractional energies

Abstract: We investigate the asymptotic behavior of anisotropic fractional energies as the fractional parameter $s \in (0,1)$ approaches the critical limits $s \uparrow 1$ and $s \uparrow 0$, in the spirit of the seminal works by Bourgain-Brezis-Mironescu and Maz'ya-Shaposhnikova. Focusing on the limit $s \uparrow 1$, we analyze the stability and convergence of solutions to the corresponding minimization problems. Finally, we examine the interplay between homogenization effects and the localization phenomena that arise as the operator recovers its local structure in the limit $s \uparrow 1$. This is a joint work with J. F. Bonder.

Jean Vélin
Université des Antilles
France

Title: On a nonlinear nonlocal parabolic equation under Neumann boundary conditions

Abstract: This paper deals with the existence of a unique classical solution for a parabolic quasi-linear problem involving the fractional p-Laplacian with Neumann boundary conditions, where the nonlinear source term depends on the solution. The approach used is based on Rothe's discretisation method under certain assumptions. Besides, we demonstrate that this solution converges to a weak solution of the associated elliptic problem at a finite time. The existence of this solution in an appropriate fractional Sobolev space is also proven. Finally, we establish some additional properties, such as mass conservation and the extremum principle, for the solution of the parabolic problem. We also prove the boundedness of the solution of the associated elliptic problem using a De Giorgi iteration argument.

Michael Winkler
University of Paderborn
Germany

Title: Facets of complexity in chemotactic aggregation

Abstract: Keller-Segel type cross-diffusion systems have been playing an outstanding role in the understanding of various patterning phenomena in biology. Concentrating on issues of predominant application relevance, the description of taxis-driven explosions has been among the most challenging topics in their analysis, and a natural focus of the literature in this regard is on the characterization of solution behavior near collapse. The presentation aims at reporting both on classical and on some recent developments, with a particular focus on the identification of circumstances under which solutions either must blow up at single points only, or alternatively may form singularities throughout larger regions in space.

3. Contributed Talks

Mustapha Ait Hamou
Sidi Mohamed Ibn Abdellah university, Morocco

Title: Nonlinear Fractional Integro-Differential Equation by Topological Degree
Abstract: The purpose of this paper is to obtain an existence result for a class of boundary value nonlinear integro-differential equations with fractional derivative of the type

$$D^{\alpha}y(x) = \int_0^x K(x,s)y(s)\,ds + F(x,y(x)); \quad \alpha > 0, x \in [0,1],$$

where D^α is the Caputo fractional-order derivative of order α, F and K are appropriate continuous functions satisfying some special growth conditions. The main idea is to transform the integral equation into a fixed point problem for a condensing map $\mathcal{L}$ and use the degree defined for σ-condensing perturbations of the identity.

Mustafa Ait Khellou
University of Sultan Moulay Slimane , Morocco

Title: Renormalized Solution to Nonlinear Elliptic Equations with Measure Data in Musielak Spaces

Sabri Bahrouni
University of Monastir, Tunisia

Title: Eigenvalue estimates and maximum principle for Lane-Emden systems, and applications to poly-Laplacian equations

Abstract: The talk is based on our recent paper that deals with explicit upper and lower bounds for principal eigenvalues and the maximum principle associated to generalized Lane-Emden systems (GLE systems). Regarding the bounds, we generalize a well-known upper estimate for the first eigenvalue of linear scalar problems on general domains to the case of strongly coupled GLE systems with $m \geq 2$ equations on smooth domains. The explicit lower estimate we obtain is also used to derive a maximum principle to GLE systems relying in terms of quantitative ingredients. Furthermore, as applications of the previous results, upper and lower estimates for the first eigenvalue of weighted poly-Laplacian eigenvalue problems with Lp weights ($p > n$) and Navier boundary condition are obtained. Moreover, a strong maximum principle depending on the domain and the weight function for scalar problems involving the poly-Laplacian operator is also established.

Ala Eddine Bahrouni
University of Monastir, Tunisia

Title: A New Anisotropic Double Phase Problem with Exponents Depending on the Gradient of the Solution

Abstract: In this talk, we investigate a new class of quasilinear elliptic equations driven by a double phase operator with variable exponents depending on the gradient of the solution.

References

A.E. Bahrouni, A. Bahrouni, H. Missaoui, A New Anisotropic Double Phase Problem with Exponents Depending on the Gradient of the Solution, Nonlinear Analysis, in press.

Abdelkrim Barbara
Sidi Mohamed Ibn Abdellah university, Morocco

Title: Study of a weighted elliptic problem with a measure right-hand side

Mounir Bedhiafi
University of Kairouan, Tunisia

Title: Enhanced Structures and Differential Equations for Time-Changed Rough Paths

Abstract: We investigate the effect of a discontinuous time change φ on continuous paths and develop a rough path framework for the transformed path $x \circ \varphi$.
Our method is illustrated on Lévy processes, such as the variance gamma and normal inverse Gaussian models, highlighting its relevance for stochastic modeling.

Abdelkrim Brahim
University of Souk-Ahras, Algeria

Title: ON THE NONLINEAR ELLIPTIC SYSTEMS INVOLVING $(p(x);q(x))-$LAPLACIAN OPERATOR.
Abstract: This work deals with a nonlinear elliptic system of the form

$$\begin{cases} -\Delta_{p(x)}u = |u|^{p(x)-2}u & \text{in } \Omega, \\ -\Delta_{q(x)}v = |v|^{q(x)-2}v & \text{in } \Omega, \end{cases} \tag{4}$$

with nonlinear coupling at the boundary given by

$$\begin{cases} |\nabla u|^{p(x)-2}\dfrac{\partial u}{\partial \nu} = F_u(x,u,v) & \text{on } \partial\Omega, \\ |\nabla v|^{q(x)-2}\dfrac{\partial v}{\partial \nu} = F_v(x,u,v) & \text{on } \partial\Omega. \end{cases} \tag{5}$$

Here, Ω is a bounded domain in $\mathbb{R}^N$ $(N \geq 1)$ with smooth boundary $\partial\Omega$, and $p, q \in C(\overline{\Omega})$ satisfy

$$1 < p^- \leq p(x) \leq p^+ < \infty, \quad 1 < q^- \leq q(x) \leq q^+ < \infty.$$

We employ the symmetric mountain pass theorem to establish the existence and multiplicity of nontrivial solutions.

Debajyoti Choudhuri
National Institute of Technology Rourkela, India

Title: Abstract Critical Point Theorem and elliptic problems
Abstract: This work deals with a nonuniform elliptic operator (a combination of pand a q Laplacians) driven by a critical and a singular nonliearity. An application of the abstract critical point theorem (using the Alexander-Spanier index) established the existence of m solutions, where the choice of m is made sufficiently large for a special reason.

S.M. Douiri
1Moulay Ismaïl University, Morocco

Title: An Enhanced Perona-Malik Model Based on a Leray-Lions Operator for Image Denoising
Abstract: In this talk, we propose an extended framework for image denoising based on a nonlinear diffusion model that combines the classical Perona-Malik approach with an operator of type Leray-Lions. The proposed formulation is designed to ensure effective noise reduction while preserving significant image features such as edges and fine structures. We first conduct a rigorous mathematical analysis of the model, addressing the issues of existence and uniqueness of solutions. Subsequently, we illustrate its practical relevance to image denoising through a series of numerical simulations that highlight its performance and effectiveness.

Mohamed Gaidi
University of Kairouan, Tunisia

Title: Strichartz Estimates and L^p Boundedness for the Dunkl–Klein–Gordon Equation with Energy Analysis
Abstract: In Dunkl theory, which generalizes classical Fourier analysis, we study the solution of the Klein–Gordon equation
We obtain an integral representation of the solution and derive several of its properties. As a main result, we study the energies associated with the Dunkl–Klein–Gordon equation.

Zied Garbouj
University of Kairouan, Tunisia

Title: On the Polar Decomposition of A Linear Relation

Abstract: It is well known that every bounded operator T can be decomposed as

$$T = U|T|,$$

where U is a partial isometry and

$$|T| = (T^*T)^{\frac{1}{2}}.$$

The operator U is uniquely determined by the kernel condition $N(U) = N(T)$. This decomposition is called the polar decomposition and is one of the most important results in operator theory.
The main goal of this presentation is to extend the polar decomposition to the case of closed linear relations that are everywhere defined in Hilbert spaces.

Mohamed Karim Hamdani
Académie militaire de Fondouk Jedid, Tunisia

Title: Existence Results for a Higher-Order Kirchhoff-Type Problem Without Control of the Nonlinearity Near 0 and Without the (AR) Condition

Abstract: Consider the following $m-$polyharmonic Kirchhoff problem:

$$M\left(\int_{\emptyset} |D_r u|^m + a|u|^m\right)[\Delta_m^r u + a|u|^{m-2}u] = K(x)f(u) \quad \text{in} \quad \Omega, \tag{6}$$

where $r \in \mathbb{N}^*$, $m > 1$, $N \geq rm + 1$, $a \geq 0$, either $\Omega = \mathbb{R}^N$ or Ω is an unbounded smooth domain. We suppose that $K \in L^\infty(\Omega)$ is a positive weight function, $M \in C([0, \infty))$ and $f \in C(\mathbb{R})$ which will be specified later. Using variational methods, especially the symmetric mountain pass theorem due to Rabinowitz (American Mathematical Soc., 1986), we establish the existence of infinitely many solutions of (6) when f is odd, having quasicritical growth at infinity and satisfies a condition which is weaker than the analogue of the Ambrosetti-Rabinowitz (AR) condition. A new feature of our approach is the use of a Schauder basis of $W_0^{r,m}(\Omega)$ (respectively of $D^{r,m}(\mathbb{R}^N)$) to verify the geometric hypotheses of the symmetric mountain pass theorem under minimal assumptions at zero, sufficient only to establish the variational framework. We also extend these results to the corresponding m-polyharmonic Kirchhoff problem with variable exponent under standard regularity and boundedness assumptions on the exponent.

Rached Jaidane
University of Tunis EL Manar, Tunisia

Title: Ground State Solutions For A Kirchhoff Type Equation Involving P- Biharmonic Operator With Exponential Growth non linearity

Abstract: In this article, we study the following non local weighted problem

$$g\Big(\int_B (w(x)|\Delta u|^{\frac{N}{2}})dx\Big)\Delta(w(x)|\Delta u|^{\frac{N}{2}-2}\Delta u) = |u|^{q-2}u + \ f(x,u) \quad \text{in} \quad B, \quad u = \frac{\partial u}{\partial n} = 0 \quad \text{on} \quad \partial B,$$

where B is the unit ball in $\mathbb{R}^N$ and $w(x)$ is a singular weight of logarithm type. The non-linearity is a combination of a reaction source $f(x,u)$ which is critical in view of exponential inequality of Adams' type and a polynomial function. The Kirchhoff function g is positive and continuous. The energy function loses compactness in the critical case. To remedy this, we introduce a new asymptotic condition for non-linearity and go through an intermediate problem. Using the Nehari manifold method, the quantitative deformation lemma and results from degree theory, we establish the existence of a ground-state solution.

[1] Rached Jaidane, *Ground State Solutions For A Kirchhoff Type Equation Involving P- Biharmonic Operator With Exponential Growth nonlinearity*, Annals of the University of Craiova, Mathematics and Computer Science Series, Volume 52(1), 2025, DOI: 10.52846/ami.v52i1.1937, pages Pages 150-169.

Wided Kechiche

University of Sousse, Tunisia

Title: Long-time dynamics of a semi-discrete weakly damped nonlinear Schrödinger equation with concentrated nonlinearity
Abstract: We consider a Crank–Nicolson approximation to discretize the damped forced nonlinear Schrödinger equation with point nonlinearity,

$$u_t + iu_{xx} + i\delta_0|u|^2u + \gamma u = f, \quad f \in L^2(\mathbb{R}),$$

where $\delta_0 = \delta_0(x)$ is the Dirac delta function supported at the origin. This provides us with a discrete infinite-dimensional dynamical system. We prove the existence of a global attractor of finite fractal dimension, without imposing any weighted condition on the forcing term.

Anis Kroumi
University of Kairouan, Tunisia

Title: Weierstrass Transform Associated with the Kontorovich–Lebedev Transform and the Extremal Function
Abstract: Using the best approximations and the theory of reproducing kernels, we give real inversion formulas for the Weierstrass transform associated with the Kontorovich–Lebedev transform, and we establish estimates for extremal functions.

Lamine Mbarki
University of Tunis El Manar, Tunisia

Title: The Markov sequence problem for the Jacobi polynomials and on the simplex
Abstract: The Markov sequence problem aims at the description of possible eigenvalues of symmetric Markov operators with some given orthonormal basis as eigenvector decomposition. A fundamental tool for their description is the hypergroup property. We first present the general Markov sequence problem and provide the classical examples, most of them associated with the classical families of orthogonal polynomials. We then concentrate on the hypergroup property, and provide a general method to obtain it, inspired by a fundamental work of Carlen, Geronimo and Loss. Using this technique and a few properties of diffusion operators having polynomial eigenvectors, we then provide a simplified proof of the hypergroup property for the Jacobi polynomials (Gasper's theorem) on the unit interval. We finally investigate various generalizations of this property for the family of Dirichlet laws on the simplex.

Souad Maarir
University of Sultan Moulay Slimane , Morocco

Title: Classical and modern forms of the Gagliardo Nirnberg inequalities

Mahfoudh Mechergui
University of Tunis El Manar , Tunisia

Title: Combined effects in nonlinear elliptic equations involving fractional operators
Abstract: In this talk, we use variational tools in order to study the existence and the multiplicity of solutions for a nonlinear elliptic problem involving fractional operators. Precisely, we use the Mountain pass theorem to prove the existence of a nontrivial solution. Also, the existence of infinitely many solutions is proved by using the $\mathbb{Z}2$-symmetric version for even functionals of the Mountain pass Theorem. To illustrate the usefulness of the main results an illustrative example is presented.

Chaima Sidia
University of Monastir, Tunisia

Title: Finite Dimensional Global Attractor for a Damped Ginzburg–Landau Model
Abstract: In this talk, we present a qualitative study of a coupled system of two dissipative nonlinear Ginzburg–Landau type equations.
We analyze the asymptotic behavior of the solutions and we prove that this coupled system generates a dissipative dynamical system characterized by the existence of a compact global attractor $\mathcal{A}$ in the phase space.

Abdelhakim Sahbani
University of Tunisa El Manar, Tunisia

Title: Existence of solutions to a fluid fow model involving a Hardy-type potential
Abstract: In this talk, we present a mathematical model related to fluid flow in a heterogeneous porous medium, specifcally focusing on groundwater flow. Our model involves a singular double-phase equation with a variable exponent and a Hardy-type potential. By utilizing the Nehari manifold approach, we demonstrate the existence of two positive solutions for our mathematical model.

Anouar Saidani
University of Monastir, Tunisia

Title: NONLOCAL AND NONHOMOGENEOUS INTEGRODIFFERENTIAL PROBLEMS: MAXIMUM PRINCIPLES, LIOUVILLE THEOREMS, AND SYMMETRY RESULTS
Abstract: In this work, we establish a maximum principle and a Liouville-type theorem for a nonlocal and nonhomogeneous integrodifferential problems, along with deriving other essential components needed for implementing the method of moving planes, including a crucial boundary estimate lemma. Building on this, we prove radial symmetry and monotonicity for positive solutions of nonlinear equations involving the new general fractional Laplacian with variable-order, both within a unit ball and in the entire space. The techniques introduced here can likely be applied to a wide range of problems involving nonlinear nonlocal and nonhomogeneous operators.

Sameh Tamrabet
University of Souk-Ahras, Algeria

Title: ON THE NONLINEAR ELLIPTIC TRANSMISSION SYSTEMS
Abstract: This paper is devoted to the study of the existence of solutions for a class of elliptic transmission system with nonlocal term: Using the ade- quate variational approach, more precisely, the Mountain Pass Theorem, we obtain at least one nontrivial weak solution.

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Title: Turing patterns in a predator-prey model with cross-diffusion.

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