The Neumann problem for the Laplacian on rough domains with data in Herz-type Hardy spaces

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Ordinary Euclidian Hardy spaces are defined by requiring the membership of the Fefferman–Stein grand maximal function to Lebesgue spaces. By replacing the latter scale with the class of Herz spaces gives rise to a new brand of Hardy spaces, which we introduce and study in the setting of Ahlfors–David regular sets. Most significantly, we develop a Calderón–Zygmund theory for singular integral operators acting on (and from) this scale of Herz-type Hardy spaces defined on uniformly rectifiable sets, and, by employing the method of boundary layer potentials, we prove a solvability result for the Neumann problem for the Laplacian, when the data is prescribed in Herz-type Hardy spaces. This is joint work with Marius Mitrea.

Extremizers for the Strichartz inequality for a fourth-order Schrödinger equation

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We consider the Strichartz inequality for a fourth-order Schrödinger equation on $\mathbb{R}^3$. We show that extremizers exist using a linear profile decomposition. Based on the existence of extremizers, we use the associated Euler–Lagrange equation to show that the extremizers have exponential decay and consequently must be analytic. Furthermore, we also prove that extremizers must have the even property $|\widehat{f}(\xi)| = |\widehat{f}(-\xi)|$ almost everywhere.

L^2 holomorphic Lefschetz fixed point theorem on stratified spaces

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We present a generalization of the holomorphic Lefschetz fixed point theorem of Atiyah and Bott to stratified pseudomanifolds with wedge metrics. We introduce new local cohomology groups which allows for the computation of local Lefschetz numbers. We also extend Witten's holomorphic Morse inequalities to the singular setting using these new structures and showcase a few applications.

The Dirichlet problem on rough domains with boundary data in weighted Morrey spaces

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We present recent progress in the direction of employing boundary layer potential operators in proving the unique solvability of weakly elliptic boundary value problems in general rough settings, best described in the language of geometric measure theory. Using a blend of techniques from Harmonic Analysis, Functional Analysis, and Calderón–Zygmund Theory, we succeed in proving a well-posedness result in the case when the boundary data is arbitrarily prescribed in Muckenhoupt weighted Morrey spaces. This work is part of my Ph.D. thesis, carried out under the guidance of Professor Marius Mitrea.

Improved upper bounds for the Hot Spots constant

Hugo Panzo
Saint Louis University

The Hot Spots constant was recently introduced by Steinerberger as a means to control the global extrema of the first nontrivial eigenfunction of the Neumann Laplacian by its boundary extrema. We use a probabilistic technique to derive a general formula for a dimension-dependent upper bound that can be tailored to any specific class of bounded Lipschitz domains. This formula is then used to compute upper bounds for the Hot Spots constant of the class of all bounded Lipschitz domains in $\mathbb{R}^d$ for both small d and for asymptotically large d that significantly improve upon the existing results. Joint work with Phanuel Mariano and Jing Wang.

Unified definition of determining wavenumber for the 3D Naiver–Stokes Equations

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We introduce a wavenumber for the solution of the 3D Navier-Stokes equation (NSE). This wavenumber is shown to be a determining wavenumber for the 3D NSE. Furthermore, we establish an upper bound for this determining wavenumber in terms of Kolmogorov's dissipation number; the upper bound is optimal for any intermittency dimension.

Optimal control in fluid flows through deformable porous media

Sarah Strikwerda
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We consider an optimal control problem subject to a poro-visco-elastic model with applications to fluid flows through biological tissues. Our goal is to optimize the fluid pressure and solid displacement using distributed or boundary control. We discuss an application of this problem to a tissue in the human eye. Previous literature on well-posedness of the poro-visco-elastic model are reviewed. Results on the existence and uniqueness of an optimal control as well the associated necessary optimality conditions are presented.