

Mid-year report on Joseph Feneuil's research activities.

From September 2021 to February 2022.

FUNDING PROJECT

ERC research grant VAREG "Variational approach to the regularity of the free boundaries" (ERC-2019-StG 853404 VAREG).

TALKS AND SEMINARS

Jan 31, 2022 : Talk at the workshop on *Geometric measure theory and Harmonic analysis*, Hausdorff Institute of Mathematics, Bonn, Germany.

Title: "Carleson estimates on solutions in domains with uniformly rectifiable boundaries".

Feb 25, 2022 : Analysis Seminar, Université de Lille, France.

Title: "The harmonic measure on large co-dimensional sets".

RESEARCH STAYS AND CONFERENCES ATTENDED

Sep 5-10, 2021 : Participation to the workshop "Regularity Theory for Free Boundary and Geometric Variational Problems" at Levico Terme, Italy.

Jan 16-Feb 12, 2022 : Participation to the research trimester entitled "Interactions between Geometric measure theory, Singular integrals, and PDE" at the Hausdorff Institute of Mathematics, Bonn, Germany.

NEW ARTICLES AND PREPRINTS

Accepted in Feb 2022 : Green function estimates on complements of low-dimensional uniformly rectifiable sets (with G. DAVID and S. MAYBORODA), *Mathematische Annalen*. Available at <https://arxiv.org/abs/2101.11646>

RESEARCH

- With Bozhidar Velichkov, we started to look at the compliance problem with length penalization on large Euclidean spaces. The classical compliance problem was solved in [CLLS], and a generalization to large Euclidean space using the p-Laplacian was done in [Bul]. We try to develop an alternative generalization of the compliance problem by using the degenerate elliptic operators, which were studied by my coauthors and me in a different context (see [DFM1]).
- Together with Zanbing Dai, Linhan Li, and Svitlana Mayboroda, I studied the regularity of the solutions of elliptic PDE with rough boundaries, which produced three papers ([DFM2, DFM3, FLM]) which are currently in their final phases before submission.
- During my stay in Bonn, I discussed with Guy David and Bruno Poggi on topics related to the regularity of solutions under a lack of connectedness of the domain, or when the boundary is beyond rectifiable.

References

[Bul] B. Bulanyi. *Partial regularity for the optimal p -compliance problem with length penalization*. Calc. Var. Partial Dif. 61 (2022).

[CLLS] A. Chambolle, J. Lamboley, A. Lemenant, E. Stepanov, *Regularity for the optimal compliance problem with length penalization*. SIAM J. Math. Anal. 49 (2017), no. 2, 1166-1224.

[DFM1] G. David, J. Feneuil, S. Mayboroda. *Elliptic theory for sets with higher co-dimensional boundaries*. Mem. Amer. Math. Soc. 274 (2021), no. 1346, vi+123 pp.

[DFM2] Z. Dai, J. Feneuil, S. Mayboroda. *Carleson perturbations for the regularity problem*. Manuscript under preparation.

[DFM3] Z. Dai, J. Feneuil, S. Mayboroda. *The regularity problem in domains with lower dimensional boundaries*. Manuscript under preparation.

[FLM] J. Feneuil, L. Li, S. Mayboroda. *Comparison between Green functions and smooth distances*. Manuscript under preparation.

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