Math 581: PDEs on non-smooth domains

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In this course we will study partial differential equations on non-smooth domains. In particular we will be interested in the relationship between the boundary regularity of the solutions to elliptic second order divergence form partial differential equations and the geometry of the boundary. While in the smooth setting this question uses tools from classical PDEs, in the non-smooth setting tools from harmonic analysis are needed to tackle the problem. We will first review classical results ,mostly, to put the work in context. Then we will focus our attention on non-smooth domains such as Lipschiz, Chord Arc, Reifenberg and Non-Tangentially Accessible domains.

To the extent that it is possible the material will be self contained. Most of the course will be based on papers dating from the 1980's to today.

Some references:

- D.Gilbarg & N. S. Trudinger, *Elliptic Partial Differentail Equations of Second Order*, Springer-Verlag, 1983.

- Q. Han & F.H. Lin, *Elliptic Partial Differential Equations*, Courant Lecture Notes, AMS, 2011.

- S. Hofmann, C. Kenig, S. Mayboroda & J. Pipher, Square function/Non-tangential maximal function estimates and the Dirichlet problem for non-symmetric elliptic operators, to appear in JAMS.

- S. Hofmann and J.M. Martell, Uniform Rectifiability and Harmonic Measure I: Uniform rectifiability implies Poisson kernels in L^p, to appear *Annales Scientifiques de L'ENS*.

- S. Hofmann, J.M. Martell and I. Uriarte-Tuero, Uniform rectifiability and harmonic measure II: Poisson kernels in L^p imply uniform rectifiability, to appear, *Duke Math. J.*

- D. Jerison & C. Kenig, Boundary behavior of harmonic functions in nontangentially accessible domains, *Adv. in Math.* **46** (1982), no. 1, 80–147.

- C. Kenig, *Harmonic analysis techniques for second order elliptic boundary value problems*, CBMS Regional Conf. Series in Math., **83**, Amer. Math. Soc., Providence, RI, 1994.

- C. Kenig, B. Kirchheim, J. Pipher & T. Toro, Square Functions and the A_∞ Property of Elliptic Measures, to appear in The Journal of Geometric Analysis, (DOI) 10.1007/s12220-015-9630-6

- E. Milakis, J. Pipher & T. Toro, Harmonic Analysis on Chord Arc Domains, J. Geom. Anal. **23** (2013), 2091–2157.

Prerequisites: Graduate analysis class. While some knowledge of Partial Differential Equations and Geometric Measure Theory would be useful is not absolutely crucial. If you have questions about whether this is the right course for you please come see me.