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A useful black box: the theory of weighted Sobolev spaces

lundi 3 avril 2017 15:15 (45 minutes)

The smoothness of a function f is described by the rate of convergence of the smoothings of f to f. Another way to measure smoothness is given by the decay properties of the derivatives of these smoothings: this is encoded by the theory of weighted Sobolev spaces, developed in the 60s.
In the first part of the lecture, we will recall some striking results of this theory, with focus on Sobolev and Besov spaces.
We will next explain how this can be used as a starting point for deriving standard properties of function spaces, such as the Gagliardo-Nirenberg inequalities or the functional calculus.
The final part will be devoted to the role of the theory of weighted Sobolev spaces in the study of geometric quantities like the degree or the Jacobian. In this part, we will show how a combination of analytic and geometric arguments leads to estimates for topological invariants. We will also explain the factorization of unimodular maps, whose proof is based in part on such arguments.
The global flavor is that weighted spaces and elementary additional ingredients, possibly as simple as integration by parts, can be very effective.
The lecture will be elementary and hopefully at a master level. It is based on a series of results of Uspenski'i, Maz'ya, Bourgain, Brezis, Nguyen, Russ, and the lecturer.

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