

Research plan

Degenerate functionals of calculus of variations and PDEs

The project “Degenerate functionals of calculus of variations and PDEs” revolves around several properties of minima of degenerate functionals and PDEs which are currently object of investigation in our research group, coherently with the themes of research of the project PRIN 2022_CITTI, “Regularity problems in sub-Riemannian structures” 2022F4F2LH - CUP J53D23003760006.

We are mainly interested in different type of degeneracy:

- 1- ***Regularity properties of vectorial local minimizers of widely degenerate convex integral functionals of the calculus of variations under general growth conditions or anisotropic growth conditions.*** Such functionals naturally arise in a large number of optimal transport problems with congestion effects in which the total cost of the transport may be described through a functional whose energy density is a convex function superlinear at infinity. The degeneracy of the convexity of the functional that represents the cost comes from the fact that the congestion effects are negligible when the traffic volume is small.
- 2- ***Geometric analysis of sub-Riemannian Spaces and first order degenerate PDEs:*** sub-Riemannian structures are regular manifolds with a sub-bundle of the tangent bundle, called horizontal space, and a metric on it. Regular surfaces in this setting can be represented as intrinsic graphs whose gradient is a non-linear first order differential operator.
- 3- ***Elliptic, sub-Elliptic and parabolic PDEs*** We are interested in elliptic, subelliptic or parabolic type PDEs. In particular nonlinear fractional equation, geometric PDEs, and PDEs with critical exponent, which naturally arise while studying Yamabe problem.

The candidates are expected to have a proven previous exposure, and possibly research experience, in at least one of the previous mentioned research areas.

Activity plan:

The activity will take place at the Department of Mathematics, University of Bologna, within the funded project PRIN_CITTI 2022 “Regularity problems in sub-Riemannian structures” - 2022F4F2LH - CUP J53D23003760006. Toward the end of this research period the scholarship's holder will deliver one seminar on the results achieved. At the end of the work he/she will provide a research report written with the findings of the research work, which is expected to lead to an article on a research journal.