Description for the general public
Project: Norm estimates for Riesz trasnforms

The research proposed in the project will increase our knowledge in the field of mathematical analysis known as harmonic analysis. We also hope that the results of the project will find applications in partial differential equations.

Harmonic analysis (or Fourier analysis) is a branch of mathematics that grew out of the theory of Fourier series. Its main idea is a decomposition of the studied object onto a sum of simpler components. Methods of harmonic analysis find broad applications not only in mathematics but also in everyday technology: in computed tomography, data compression (MP3 and JPEG formats), or in signal processing (for instance in radio waves). Partial differential equations is a branch of mathematics that is one of the closest to real life application. They allow us the describe and model physical phenomena via mathematical equations.

The main object of our research will be the so called Riesz transforms. These are certain linear operators, which consist both of a differential part (e.g. partial derivative) and an integral part (e.g. Riesz potential). By an operator we mean here a function, for which both the domain and the codomain are subspaces of the functions of real variable. The world linear means that the operator of a sum of functions equals the sum of operators on each function. We are mostly interested in situations when an application of the Riesz transform to a p-integrable function returns a p-integrable function. Additionally, we are keen on concrete estimates for the Riesz transform in terms of the function being transformed. Such estimates are closely related with inequalities for differential operators. These inequalities are often an important step in showing existence and uniqueness of solutions for various partial differential equations.