Probabilistic Approach to Analysis of L^p-operators

Probability Theory has strong connections with many areas in Analysis. In recent years, many classical results have been restudied by Probabilists (e.g. P.A. Meyer and N. Varopoulos) and alternative proofs have been introduced using powerful tools of Martingale Theory. In particular, one can use Brownian Motion, a continuous stochastic process, to define harmonic functions in classical sense. In this talk, we replace Brownian Motion with a more general process, namely a symmetric stable process. Stable processes are not continuous as Brownian Motion is. But they still enjoy many nice properties. Using this process we define what a "harmonic" function with respect to this process is and discuss operators obtained through this new "harmonic" functions. One of the main results is that a new Littlewood-Paley operator is introduced. We show that this new operator is bounded on $L^p(\mathbb{R}^d)$ for $p > 1$. Moreover, this allows us to generalise some classical results from Littlewood-Paley Theory.

In this talk, we discuss how a bridge between Analysis and Probability can be formed, how we use it to define new operators on $L^p(\mathbb{R}^d)$ and discuss our recent results using these techniques.