Department of Mathematics

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WORKSHOP IN HARMONIC ANALYSIS

August 10, 2016 (Wednesday)
Room 220, Lady Shaw Building, CUHK

The Frobenius Theorem: From Geometry to Analysis

Dr. Brian Street
University of Wisconsin, Madison

11:00a.m. – 12:00noon

Abstract: We present a quantitative version of the classical Frobenius theorem from differential geometry. This theorem can be seen as providing scaling maps which can be used to study a range of problems in analysis. We present two such applications: a theory of singular Radon transforms (joint with E. M. Stein) and a theory of multi-parameter singular integrals which has applications to PDEs and several complex variables.

Hilbert transforms and maximal functions along variable curves

Dr. Joris Roos
University of Bonn

2:30p.m. – 3:30p.m.

Abstract: The talk will be about on work in progress with Shaoming Guo and Victor Lie. Consider the maximal operator along a variable curve in $\mathbb{R}^2$,

$$\mathcal{M}f(x) = \sup_{1\geq\varepsilon>0} \frac{1}{2\varepsilon}\int_{-\varepsilon}^{\varepsilon} |f(x-\Gamma_x(t))|dt$$

and the corresponding singular integral operator,

$$\mathcal{H}f(x) = p.v. \int_{\mathbb{R}} f(x-\Gamma_x(t))\frac{dt}{t}.$$

In the vector field case, $\Gamma_x(t) = (t, u(x)t)$, it is a long-standing open question to determine whether Lipschitz regularity of u suffices for these operators to satisfy weak L^2 bounds.
While we cannot answer that question, we can provide some answers for certain variants that feature curvature. Specifically, we prove L^p, $1 < p < \infty$ bounds for $\mathcal{H}$ in the one-variable case $\Gamma_x(t) = (t, u(x_1)|t|^\alpha)$ for *measurable* u and *real*, positive $\alpha \neq 1$. Also we can show L^p bounds for the maximal operator $\mathcal{M}$ in the two-variable case $\Gamma_x(t) = (t, u(x)|t|^\alpha)$ with u Lipschitz and $\alpha \neq 1$ real, positive.
In ongoing work we focus on recovering these results for the operators arising from replacing the monomial $|t|^\alpha$ by a more general curve.

(Multi-linear) Restriction Estimates and (Multi-linear) Decoupling Inequalities

Dr. Shaoming Guo
Indiana University, Bloomington

4:00p.m. – 5:00p.m.

Abstract: I will present the proof of the two dimensional restriction estimate (by Cordoba). This further implies the sharp l^2 L^p decoupling inequalities of the parabola for $2 \leq p \leq 4$ (by Bourgain). If time allows, I will show how to pass from $p = 4$ to the sharp exponent $p = 6$ by an iteration argument (by Bourgain and Demeter).

Workshop Banquet

6:00p.m. – 8:00p.m.