THE CALTECH DEPARTMENT OF MATHEMATICS PRESENTS

15th ANNUAL

Wolff Memorial Lecture

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RM 151 SLOAN

Lecture 1: Sets of Measure Zero and the Converse to Rademacher's Theorem: Part 1

Rademacher's Theorem states that a Lipschitz mapping from one Euclidean space to another is differentiable except on a set of (Lebesgue) measure zero. In this lecture and the next I will discuss joint work with Marianna Csornyei: Given a set E of measure zero, there is a map from Euclidean space to itself that is not differentiable on E. This is an old and easy result in dimension D = 1. In two dimensions this result was proven by G. Alberti, M. Csornyei, and D. Price. Their proof has two parts. First there is a combinatorial argument (special to dimension = 2), and a "covering argument", which works in any dimension. In this will explain some of the technical tools that go into the work of Csornyei and PJ. Critical here is the notion of the concept of "Tangent Cones" for sets of measure = 0. I will also review some basic machinery from harmonic analysis that is used in our proof.

Lecture 2: Sets of Measure Zero and the Converse to Rademacher's Theorem: Part 2

I will outline the proof that (in any dimension) a set measure zero has "Good Tangent Cones". The proof uses estimates from harmonic analysis, and does not use the combinatorial step used by Alberti, Csornyei, and Price mentioned in Lecture 1. I will also discuss the relations of these methods to some unsolved problems in combinatorics.

Lecture 3: New Results on Bounded, Complete Minimal Surfaces

The first example of a bounded, complete minimal surface was given in the 1970's (PJ). Since then several new types of such surfaces have been shown to exist. I will discuss recent research (PJ) showing that there exists a new type of example, namely a complete, bounded Legendrian disk in C^3. This means there are two bounded holomorphic functions (F, G) on the unit disk such that (F(z), G(z),z) is a complete, bounded minimal surface, with the property that, setting H'(z) = F(z)G'(z), H is also a bounded holomorphic function. The construction uses a modification of Uchiyama's method of decomposing BMO functions into u + H(v), where u and v are bounded functions. I will also discuss some open problems in this area.

Peter Jones, James E. English Professor of Mathematics and Applied Math at Yale, is a specialist in the field of complex and harmonic analysis, probability theory, dynamical systems and the theory of complexity in theoretical political science. He came to Yale in 1985 after teaching for six years at the University of Chicago. For several years he lived in Sweden, where he served as assistant director of the Institut Mittag-Leffler. He was the Goran Gustafsson Professor at the Royal Institute of Technology; KTH, in Sweden in 1990. At Yale, he was director of graduate studies in mathematics 1993-95. In 1994, Jones became the youngest person to receive an honorary degree from KTH for his "pathbreaking scientific contributions to modern mathematic analysis" and for promoting the study of mathematics at the institute. He continues to maintain strong ties with the Swedish mathematical community. Jones' other honors include a Sloan Foundation Fellowship, the Salem Prize and a Presidential Young Investigator Award.

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