

Colloquium Talks 2016-2017

The School Colloquia are given by world-famous speakers and present an overview of important topics of general interest in the mathematical sciences.

These invited lectures are intended to be accessible to all graduate students and academics in the department. MMath and MSc students may also benefit from these presentations. The talks normally take place on Wednesdays, 15:10 - 16:10, at the lecture room E/0.15 on the ground floor of the School.

All are welcome to attend. For more information, please contact; Dr Timothy Logvinenko

12 October 2016

Speaker: Prof. Felix Otto ([MPIMS, Leipzig](#))

Title: Effective behavior of random media: From an error analysis to regularity theory

Abstract: Heterogeneous media are often naturally described in statistical terms, reflecting a lack of knowledge of details. How to extract their effective behavior on large scales, like the effective conductivity $\alpha_{\text{hom}} = \text{const}$, from the statistical specifications, which are encoded in a stationary probability measure or ensemble $\langle \cdot \rangle$ on the space of microscopic conductivities $\alpha = \alpha(x)$? A practitioners numerical approach is to sample the medium according the $\langle \cdot \rangle$ and to determine α_{hom} in the Cartesian directions by imposing simple boundary conditions. What is the error made in terms of the size of this "representative volume element"? Our interest in what is called "stochastic homogenization" grew out of this error analysis, and now also includes a characterization of the leading-order fluctuations.

In the course of developing such an error analysis, connections with the classical regularity theory of elliptic equations have emerged. More precisely, stochastic homogenization sheds a new light on a "generic" large-scale behavior of α -harmonic functions --- which is more regular than suggested by the classical counter-examples. This might be rephrased in geometric terms: How flat at infinity does a metric α have to be such that the space of harmonic functions of a given polynomial growth rate has exactly the same dimension as in the Euclidean case α_{hom} . We give a sufficient criterion that is almost surely satisfied for the type of probability measures $\langle \cdot \rangle$ on metrics α considered in stochastic homogenization.

26 October 2016

Speaker: Dr. James Maynard ([Oxford](#))

Title: Primes with restricted digits

Abstract: Many of the most important questions about prime numbers can be phrased as 'given some set A of integers, how many primes are in A ?'. Unfortunately, even simple versions of such questions are often well beyond current techniques, and this is especially difficult if A is a 'thin' set of integers.

I will talk about recent work which shows that there are infinitely many prime numbers with no 7's in their decimal expansion, giving an example of a thin set where we do get a satisfactory answer. Ideas from probability (such as Markov chains), diophantine geometry (lattice point counting and rational approximation) and combinatorics all turn out to be important ingredients, alongside traditional analytic number theory.

2 November 2016

Speaker: Prof. Robert Weismantel ([ETH, Zurich](#))

Title: Integer Polynomial Optimization

Abstract: [Download and read the abstract.](#)

1 February 2017

Speaker: Dr. Nina Golyandina ([St Petersburg](#))

Amended Colloquium time: 16:00 - 17:00, E/0.15

Title: Singular spectrum analysis as a universal approach for finding structure in time series and digital images.

Abstract: Singular spectrum analysis (SSA) is an effective method for processing different objects such as time series and digital images, finding their structures and then using the found structure for trend and periodicity extraction, smoothing, parameter estimation, forecasting, gap imputations. SSA is known as a nonparametric tool, which is able to analyse time series without a-priori assumptions about the object model. The method success is based on a specific construction of an adaptive decomposition, which is generated by the object itself. It is surprising how such a model-free method can solve problems which are conventional for parametric methods. We discuss this kind of paradox and demonstrate the method abilities as well as the mathematics underlying the SSA approach.

15 March 2017

Speaker: Prof. Caroline Series FRS ([Warwick](#))

Title: [The cover of the December AMS Notices](#)

Abstract: The cover of the December 2016 AMS Notices shows an eye-like region picked out by blue and red dots and surrounded by green rays. The picture, drawn by Yasushi Yamashita, illustrates Gaven Martin's search for the smallest volume hyperbolic orbifold. It represents a family of two generator groups of isometries of hyperbolic 3-space which was recently studied, for quite different reasons, by myself, Yamashita and Ser Peow Tan.

After explaining the coloured dots and their role in Martin's search, we concentrate on the green rays. These are Keen-Series pleating rays which are used to locate spaces of discrete groups. We also introduce some rather mysterious 'fake' pleating rays which partially fill the space of non-discrete groups and relate to a condition of Bowditch, mentioned but not explained in the Notices.

22 March 2017

Speaker: Prof. Frances Kirwan FRS ([Oxford](#))

Title: Moduli spaces of unstable curves.

Abstract: The construction of the moduli spaces of stable curves of fixed genus is one of the classical applications of Mumford's geometric invariant theory (GIT), developed in the 1960s. Here a projective curve is stable if it has only nodes as singularities and its automorphism group is finite. The aim of this talk is to describe these moduli spaces and outline their GIT construction, and then to explain how recent methods from non-reductive GIT can help us to classify the singularities of unstable curves in such a way that we can construct moduli spaces of unstable curves (of fixed singularity type).