ICMAT
INSTITUTO DE CIENCIAS MATEMÁTICAS

PhD
THESIS DEFENSE

ASYMPTOTIC PROBABILITY TECHNIQUES IN MONOCHROMATIC WAVES AND FLUID MECHANICS

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ABSTRACT: This thesis addresses different questions concerning probability, partial differential equations, fluid mechanics and some aspects of economic theory. We try to answer whether some events in these fields are "typical", how different probability settings modify their likelihood and how some probability techniques can give us information about expected values of important magnitudes or help us to construct deterministic realizations. The thesis is divided into two parts. In the first part we study the nodal set and the set of critical points of monochromatic random waves, that is, the structure of the zero level set of solutions of the Helmholtz equation (and their gradient) on the Euclidean space. In the second part of this thesis we study these probability techniques applied to two different fields: fluid mechanics and economic theory. First, motivated by Arnold's vision of stationary Euler flows in dimension 3, we show that, with probability 1, a random Beltrami field exhibits chaotic regions that coexist with invariant tori of complicated topologies. Similarly for the three dimensional torus. Second, following a Bayesian approach, we study the probability of the thesis of a well-known result in social choice theory.

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