Analysis and Differential Geometry Colloquium

Geometric regularity theory for diffusive processes and their intrinsic free boundaries

Eduardo Teixeira
University of Central Florida

Abstract: Diffusion is a phenomenon associated with averaging, spreading, or balancing of quantities in a given process. These are innate trends in several fields of natural sciences, and this is why diffusion is such a popular concept across disciplines. When models involve sharp changes in the parameters that describe them, free boundaries and interfaces are formed and the mathematical treatment of such problems becomes rather more involved. Throughout the last 40 years or so, a robust mathematical theory has been developed to investigate diffusive phenomena presenting free boundaries. Methods, ideas, and insights originating from different fields of research merged together as to produce a comprehensive geometric regularity theory for free boundary problem, and in this talk I will provide a panoramic overview of such endeavor. Recently, it has been observed that even ordinary diffusive models, i.e. the ones with no concrete free boundaries, carry in their intrinsic geometry a sort of artificial or transcendental or, if you prefer, "non-physical free boundaries. This radical new approach to the analysis of nonlinear PDEs has led to a plethora of unanticipated results and I will discuss some of these achievements.

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