abstract

MINI-COURSE IN GEOMETRIC PDE
Topic:

Speaker:

Affiliation:

Date:

Time/Room:

When we look at a differential equation in a very irregular media (composite material, mixed solutions, etc.) from very close, we may see a very complicated problem. However, if we look from far away we may not see the details and the problem may look simpler. The study of this effect in partial differential equations is known as homogenization. The effect of the inhomogeneities oscillating at small scales is often not a simple average and may be hard to predict: a geodesic in an irregular medium will try to avoid the bad areas, the roughness of a surface may affect in nontrivial way the shapes of drops laying on it, etc. The purpose of this lecture is to discuss three problems in homogenization and their interplay. In the first problem, we consider the homogenization of a free boundary problem. We study the shape of a drop lying on a rough surface. We discuss in what case the homogenization limit converges to a perfectly round drop. It is taken mostly from the joint work with Antoine Mellet [2]. The second problem concerns the construction of plane like solutions to the minimal surface equation in periodic media. This is related to homogenization of minimal surfaces. The details can be found in the joint paper with Rafael de la Llave [3]. The third problem concerns existence of homogenization limits for solutions to fully nonlinear equations in ergodic random media. It is mainly based on the joint paper with Panagiotis Souganidis and Lihe Wang [4]. We will try to point out the main techniques and the common aspects. The focus has been set to the basic ideas. The main purpose is to make this advanced topics as readable as possible. In every case, the original papers are referenced. The lecture notes for this mini-course has been written up in [1].

References:
1. Luis Caffarelli and Luis Silvestre, "Issues in homogenization for problems with non divergence structure", Calculus of variations and nonlinear partial differential equations,

43--74, Lecture Notes in Math., 1927, Springer, Berlin, 2008.

2. Luis A. Caffarelli and Antoine Mellet, "Capillary drops on an inhomogeneous surface", Preprint, 2005.

3. Luis A. Caffarelli and Rafael de la Llave,"Planelike minimizers in periodic media", Comm. Pure Appl. Math., 54(12):1403-1441, 2001.

4. Luis A. Caffarelli, Panagiotis E. Souganidis, and Lihe Wang, "Homogenization of fully nonlinear, uniformly elliptic and parabolic partial differential equations in stationary ergodic media", Comm. Pure Appl. Math., 58(3):319-361, 2005.