Applied Mathematics Seminar
INSCC 110, 3:30pm Monday
April 30, 2001

Imperfect interfaces, inhomogeneities, and neutral inclusions

by

Sergey Serkov

Department of Mathematics, University of Utah

Abstract

The problem of neutral inclusions for two-dimensional conductivity (or, equivalently, anti-plane elasticity) is considered. Such an inclusion when inserted in a matrix containing a uniform applied electric field does not disturb the field outside the inclusion. Consequently, assemblages of neutral inclusions have certain moduli of their effective conductivity tensor which can be determined exactly. The inclusion is assumed to have a hole (or perfect conductor) at its core surrounded by a thick coating of isotropic material. The whole construction is embedded in a possibly anisotropic matrix. Analytic formulae for the boundaries of the core and coating are found with the use of conformal mapping techniques. The admissible inclusion shapes depend on the applied electric field and on the conductivities of matrix and coating. It is shown that the inclusions can have a variety of shapes and are not just restricted to being coated confocal ellipses. However, coated confocal ellipses are the only inclusions which are neutral to multiple applied fields.

In addition to the problem of neutral inclusions I will discuss the mathematical formulation of imperfect interfaces, their asymptotic derivation by considering a layered structure and the Eshelby theorem for perfect and imperfect interfaces. Numerical analysis of neutral shapes will also be shown.