PHYSICAL MATHEMATICS SEMINAR

Variational Methods for Imaging

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ABSTRACT:

A common strategy for finding multiple scatterers buried in a medium consists in illuminating the medium with some type of radiation. The emitted wave interacts with the medium and the objects, and the resulting wave field is measured at a number of receptors. Knowing the measured data, we would like to locate the objects and determine their material properties.

Variational methods aim to reconstruct objects by finding domains and parameters which minimize appropriate constrained cost functionals. In simple problems of acoustic or electromagnetic scattering, the incident radiation is time harmonic and the constraints of the cost functionals are transmission problems for Helmholtz equations. We propose a descent strategy which provides detailed approximations of the geometry of the obstacles and their material parameters in few steps and with scarce data, without any a priori information.

Initial guesses, and successive corrections of the domains are constructed using the topological derivative of the functional. The number, size and location of the objects are correctly approximated in the iterative procedure. Small scatterers and obstacles with holes are detected. Approximations for the material parameters of the different objects are found by a gradient technique that can detect spatial variations.

Similar ideas may be used in acoustic or electromagnetic scattering problems involving more complex constraints, in photothermal imaging with thermal waves or in electrical impedance tomography.

TUESDAY, MARCH 13, 2012
2:30 PM
Building 2, Room 105

Reception at 3:30 PM in Building 2, Room 290
(Math Dept. Common Room)

http://math.mit.edu/pms

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