ANISOTROPIC INVERSE PROBLEMS

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In this talk we consider inverse problems in various physical settings, in particular for the conductivity equation and for Maxwell's equations in an anisotropic medium.

Typical inverse problems in an anisotropic medium are not uniquely solvable. Indeed, it is well known that often a change of coordinates changes the equation but does not change the boundary data. However, there is often an underlying manifold structure that can be uniquely determined. Thus the inverse problem in a subset of the Euclidean space can solved in two steps. The first one is to reformulate the problem in terms of manifolds and to reconstruct the underlying manifold structure from the boundary data. The second step is to find an embedding of the constructed manifold to the Euclidean space. The embedding is generally non-unique, but if we have enough a priori knowledge about the form of equation, we can determine the embedding uniquely, or at least choose an optimal embedding. To demonstrate these steps in practice, we consider the following particular problems

1. Inverse problem for Maxwell's equation in time domain when permittivity and permeability are scalar functions or matrices that are conformal to each others. Results are obtained in collaboration with Y. Kurylev and E. Somersalo.
2. Inverse conductivity problem in $\Omega \subset \mathbb{R}^2$ when conductivity is an $L^\infty(\Omega)$-smooth matrix. Results are obtained in collaboration with K. Astala and L. Päivärinta.
3. Inverse conductivity equation in $\Omega \subset \mathbb{R}^2$ when conductivity is known to be isotropic but the domain Ω is not known. In this case the boundary measurements are identified with a matrix corresponding to electrode measurements done on the boundary. Results are obtained in collaboration with V. Kolehmainen and P. Ola.

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