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彈性系統相關的正問題及反問題(3/3)
研究成果報告(完整版)

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Report on "Some direct and inverse problems for the elasticity system (3/3) (95-2115-M-002-003-)"

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This is a report on the NSC grant 95-2115-M-002-003 entitled "Some direct and inverse problems for the elasticity system (1/3)". The main theme of this grant is to investigate some direct and inverse problems for elasticity systems. My aim is to understand some fundamental properties of elasticity systems with anisotropic medium. This is a special kind of elliptic systems. I am grateful to the grant support from NSC. Now I list several results benefited from this grant.

1. G. Uhlmann and J.-N. Wang, *Complex geometrical optics solutions and reconstruction of discontinuities*, to appear in SIAM J. Appl. Math.

In this paper we provide a framework for constructing general complex geometrical optics solutions for several systems of two variables that can be reduced to a system with the Laplacian as the leading order term. We apply these special solutions to the problem of reconstructing inclusions inside of a domain filled with known conductivity from local boundary measurements. Computational results demonstrate the versatility of these solutions to determine electrical inclusions.

2. G. Uhlmann, J.-N. Wang, and C.-T. Wu, *Reconstruction of inclusions in an elastic body*, preprint.

We consider the reconstruction of elastic inclusions embedded inside of a planar region, bounded or unbounded, with isotropic inhomogeneous elastic parameters by measuring displacements and tractions at the boundary. We probe the medium with complex geometrical optics solutions having polynomial-type phase functions. Using these solutions we develop an algorithm to reconstruct the exact shape of a large class of inclusions including star-shaped domains and we implement numerically this algorithm for some examples.

3. X. Li and J.-N. Wang, *Determination of viscosity in the stationary Navier-Stokes equations*, to appear in J. Differential Equations.

In this paper we consider the stationary Navier-Stokes equations in a bounded domain with a variable viscosity. We prove that one can uniquely determine the viscosity function from the knowledge of boundary data.

Report on "NSC Travel grant 2006-2007"

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This is a report on my visit to University of Washington in Seattle from July 6th, 2007 to August 28th, 2007. This visit is partially supported by the NSC (95-2115-M-002-003). First of all, I would like to thank NSC for the financial support. The purpose of this visit is to complete some ongoing projects with Professor Uhlmann at the mathematics department of University of Washington.

One of the jobs is to respond the referee's reports on our joint work "Complex geometrical optics solutions and reconstruction of discontinuities". In this paper, we provide a framework for constructing general complex geometrical optics solutions for several systems of two variables that can be reduced to a system with the Laplacian as the leading order term. We apply these special solutions to the problem of reconstructing inclusions inside of a domain filled with known conductivity from local boundary measurements. Two follow-up papers are currently under working. One is on the isotropic elasticity system and the other one is on the conductivity equation with general anisotropic medium. During this visit, we outlines what we are going to present in the paper on the anisotropic conductivity equation.

Furthermore, we also talked about another long term project on the cloaking problem. This is a hot topic right now. Roughly speaking, it is on the counterpart of the inverse problem. It involves how to make things "invisible", at least, in terms of mathematical theory. We hope to first study the potential equation with magnetic field. It was proved by Prof Uhlmann and his collaborators that one can not determine a potential when the potential is too "singular". This result has many interesting implications. One of the interesting problems is to see whether the similar technique can be applied to the conductivity equation to create invisibility. Also, we are interested to know whether the addition of appropriate magnetic field will break the invisibility.

On the lighter side, it is very comfortable and pleasant to stay in Seattle in the summer. The mathematics department of University of Washington also provides a friendly working environment and excellent facility. I benefited a lots from this trip.