【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Mathematical and Physical Sciences)

Title of Project : Renovating Solutions and Applications of Coefficient Inverse Problems for Partial Differential Equations

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Research Project Number : 15H05740 Researcher Number : 50182647
Research Area : Mathematical and physical sciences
Keyword : Inverse boundary value problem, Determination of Riemannian metric, Non-Newtonian fluid, Fractional differential equation

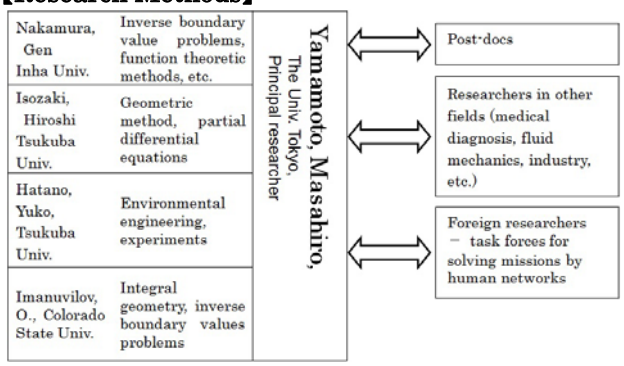
【Purpose and Background of the Research】

We study mathematical analysis and applications of coefficient inverse problems which are the determination of coefficients in partial differential equations by partial data of solutions. The inverse problems are concerned with medical diagnosis, prediction of pollution in environments, etc. Our main targets are: (A) inverse boundary value problems, (B) determination of Riemannian metrics, (C) inverse problems for non-Newtonian fluids, and (D) inverse problems for anomalous diffusion.

(A) is related e.g. to the determination of conductivity inside human bodies, while (B) is the determination of metric of Riemannian manifold by shortest distances between arbitrary two boundary points. Both request repeats of observations.

(C) is the determination of physical properties of non-Newtonian fluids such as viscoelasticity, and (D) is inverse problems for fractional diffusion equations, and both formulations are with a single measurement. (A)–(D) are typical inverse problems, and our achievements can provide effective solutions to other kinds of inverse problems.

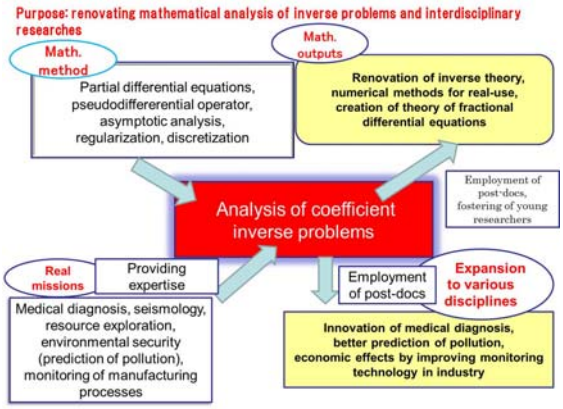
【Research Methods】



The figure indicates our teams and for the missions (A)–(D), we study theoretical issues: uniqueness and stability. Then we develop numerical methods which can be used for real-use. Collaborating with researchers in applied disciplines, we aim at industrial applications of our results. By networks of world-wide experts, we organize task forces to overcome difficulties.

【Expected Research Achievements and Scientific Significance】

1. Comprehensive methodology for various inverse problems.
2. Numerical methods based on theoretical results.
3. Creation of complete theory of fractional differential equations.
4. Innovation in medical diagnosis, long-term prediction of pollution, etc.
5. Bilateral development of both mathematical researches and applications to other disciplines.



【Publications Relevant to the Project】

[1] K. Sakamoto and M. Yamamoto: Initial value/boundary value problems for fractional diffusion-wave equations and applications to some inverse problems, *J. Math. Anal. Appl.*, **382** (2011), 426-447.

[2] O.Y. Imanuvilov, G. Uhlmann and M. Yamamoto: The Calderón problem with partial data in two dimensions, *J. Amer. Math. Soc.*, **23** (2010), 655-691.

【Term of Project】 FY2015-2019

【Budget Allocation】 140,000 Thousand Yen

【Homepage Address and Other Contact Information】 http://www.ms.u-tokyo.ac.jp/~myama/kiban_S/index.html