Name: YAMAMOTO, Masahiro

Research field: 10, 14

My research field is inverse problems in mathematical sciences. In particular, I am studiyng determination of parameters such as coefficients, nonhomogeneous terms in evolution equations and determination of shapes of domains from overdetermining data.

Key words: applied analysis, industrial mathematics

Present research:

For proving the uniqueness and the conditional stability for inverse problems of determining spatially varying coefficients in evolutionary equations by means of finite numbers of observations of solutions in subboundaries or subdomains, as key tools we can use Carleman estimates which are weighted L^2 estimates. Indeed a method by Carleman estimate is a unique mathematical methodology for such inverse problems, and I have been working many years and published many papers. In Vol. 25 (2009) of"Inverse Problems" which gains the highest reputations as the journal on inverse problems, I published a survey paper on Carleman estimate and its applications to inverse problems.

The Dirichlet-to-Neumann map is a common formulation of the coefficint inverse problem for stationary partial differential equations such as elliptic systems. Initiated by O. Imanuvilov, G. Uhlmann and M. Yamamoto: "The Calderon problem with partial data in two dimensions", J. Amer. Math. Soc. **23** (2010), pp. 655-691, I am continuing to study the uniquenss in inverse boundary value problems by Dirichlet-to-Neumann map on arbitrary subboundary in two dimensions and three dimensions, and for the Lamé system and the Navier-Stokes equations.

For fractional diffusion equations modelling anomalous diffusion, I established a Carleman estimate and a conditional stability result in determining coefficients in the case where the fractional order is the half. Related to growth rate modeling and determination of boundary condition, I published numerical approaches as well as theoretical results.

I am applying mathematics in oder to solve problems in the real world such as industry. Mathematics is not only a system of theories but also is powerful machinery for solutions of practical problems, by its character of abstraction and generalization. Moreover by applications, one expects more development of mathematics itself. In 2012 I extended activities of the mathematics for industry. I am one of the main organizers of "Study Group Workshop for Solving Problems from Industry" in August of 2012 and January of 2013 within GCOE Program of the Graduate School. The former was co-organized with Institute of Mathematics for Industry of Kyushu University. In total 10 companies proposed problems and the participants composed mainly of graduate students have worked towards practical solutions. Moreover I have continued joint research projects with companies.

Notice for the students: The inverse problem has recently become more popular and demanded. The inverse problem is concerned for example with determination of state in the past or determination of cause by result, and the inverse problem is very comprehensive and is important in many fields such as medicine, engineering. In spite of strong demands from practical viewpoints, there have been not enough mathematical researches, with which one can expect the creation of more effective numerical methods. Therefore the inverse problem is not only theoretically interesting, but also required for the improvement of the modern technology, and is still rapidly developing and waiting your participation and contribution. The needed mathematical backgrounds are (i) calculus, linear algebra, some of advanced calculus such as Fourier series and (ii) keeping interests in classical physics and engineering.

References: C.W. Groetsch, Inverse Problems, Math. Association of America, Washington D.C., 1999: contains many physical examples which inspire you to study inverse problem.