

Reproducing Kernel Methods for Solving Inverse Problems

Bo Han* and Wenyan Wang

Department of Mathematics, Harbin Institute of Technology, Harbin 150001, PR China

Inverse problems arise in scientific and technical fields such as geophysics, life science, remote sensing technology, pattern recognition, financial science, etc. Therefore, inverse problems have attracted much attention and have been studied by many authors [1,2]. However it is usually difficult to solve inverse problems. In particular, most inverse problems are very complex with a large amount of calculation. Thus, it is very important to obtain the algorithm to solve inverse problems with advantages such as high precision, little calculation, good convergence and strong stability. Good properties of reproducing kernel in calculation made it an important function approximation technique. In recent years, reproducing kernel theory is developing very rapidly, and successfully applied to wavelet transforms, signal processing, stochastic processes, iris recognition, neural network, and so on.

Recently we have successfully applied the reproducing kernel theory to inverse heat problems, two dimensional parabolic inverse problems with final over determination, and inverse source problems of two-dimensional fractional diffusion equations. And we improved the precision, decreased considerably the runtime. Numerical simulation experiments and error analyses indicate that the reproducing kernel method has many advantages as follows: numerical programming

structure is simple, calculations are very fast, precision is very high, convergence is very good, and stability is strong.

However, it is well known inverse problems are always ill-posed. For the stable numerical reconstructions of solutions, regularization techniques can be used. Castro et al. [3], T. Takeuchi and Yamamoto [4] have obtained some better results combining regularization with reproducing kernels. Further, we will combine the advantages of regularization and reproducing kernels to solve more general inverse problems, and we will discuss in a forthcoming paper.

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*Corresponding author: Bo Han, Department of Mathematics, Harbin Institute of Technology, Harbin 150001, PR China, E-mail: bohan@hit.edu.cn

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