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Solving inverse problems in applied spectroscopy with random fractal noise

S.S. Kharintsev, R.R. Nigmatullin, M.Kh. Salakhov*

Physics Department, Kazan State University, Kremlevskaya str., 16, Kazan 420008, Russia

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Abstract

In the framework of the statistical regularization method new algorithms of solving inverse problems in applied spectroscopy in the presence of correlated fractal noises are suggested. Statistical properties of fractal noises are investigated in terms of R/S-analysis. As an example illustrating the efficiency of the algorithms suggested the smoothing problem of experimental data is considered.

1. Introduction

The theory of the inverse problems has significantly developed in the last few years. The most widespread problems of applied spectroscopy are [1–4]: signal smoothing, detection, instrument distortions elimination, decomposition of analytical signals into elementary components, reduction problems in plasma spectroscopy and atomic absorption, differentiation (including fractional one), solution of the Abel's equation for the case of axially symmetric plasma or solution of tomography problems for a plasma of an arbitrary symmetry and others.

As a rule the problems mentioned above are referred to as the so-called inverse problems of mathematical physics: they reverse causal relationship, i.e. the cause is derived from the consequence. In general, these problems can be described by the integral equation of the type

$$K\varphi = f, \tag{1}$$

* Corresponding author. Tel.: + 8432-362-597; fax: + 8432-362-597.

E-mail addresses: red@ksu.ru (S.S. Kharintsev), raoul.nigmatullin@ksu.ru (R.R. Nigmatullin), msalakh@tatincom.ru (M.Kh. Salakhov).

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