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A modified Lavrentiev iterative regularization method for analytic continuation

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Abstract. We consider the problem of numerical analytic continuation of an analytic function $f(z) = f(x+iy)$ on a strip domain $\Omega_+ = \{z = x+iy \in \mathbb{C} | x \in \mathbb{R}, 0 < y < y_0\}$, where the data is given approximately only on the line $y = 0$. This is a severely ill-posed problem. Motivated by the advantage of iterative methods for solving ill-posed problems, we propose a new modified iterative method to solve this problem under both a-priori and a-posterior parameter choice rules. Moreover, some sharp error estimates between the exact solution and its approximation are proved. Some interesting numerical examples are conducted for showing that the newly-developed method works well.

Keywords: Ill-posed problems; Analytic continuation; modified Lavrentiev iterative; error estimate.

1 Introduction

The analytic continuation is an old yet persistent problem, which arises from many practical applications[1-4], moreover, analytic continuation is a very useful tool for solving ill-posed problems, especially in medical imaging [5-6] and integral transformation [7].

In this study, we consider the following problem:

Let the function $f(z) := f(x+iy)$ is an analytic function in $\overline{\Omega}_+$. And $\Omega_+ = \{z = x+iy \in \mathbb{C} | x \in \mathbb{R}, 0 < y < y_0, y_0$ is a positive constant$\}$,where i is the imaginary unit.The data is only given on the real axis, i.e., $f(z)|_{y=0} = f(x)$ is known approximately,and the noisy data is denoted by $f^\delta(x)$. We want to extend $f(z)$ analytically from this data to the whole domain Ω_+.

Recently the problem has been well studied. It is well-known that this problem is seriously ill-posed problem [8]. Some regularization theory [9-12] should be applied for solving this problem. In [13], Hào presented a mollification method for solving this problem, in [14], Deng considered a new mollification method, in [15], Fu gave a modified Tikhonov method based on Fourier transform, in [16], Fu presented a spectral cut-off method, in

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