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Xiangtuan Xiong, Qiang Cheng

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# A modified Lavrentiev iterative regularization method for analytic continuation

Xiangtuan Xiong, Qiang Cheng \*

*Department of Mathematics, Northwest Normal University, Lanzhou, China*

**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-posteriori 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  $\Omega_+ = \{z = x + iy \in \mathbb{C} | x \in \mathbb{R}, 0 < y < y_0, y_0 \text{ is a positive constant}\}$ , 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  $\Omega_+$ .*

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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\*Email: cq314156@163.com; xiongxt@gmail.com

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