



On the numerical solution of weakly singular integral equations of the first kind using a regularized projection method

Tahar Bechouat & Nadjib Boussetila

To cite this article: Tahar Bechouat & Nadjib Boussetila (28 May 2024): On the numerical solution of weakly singular integral equations of the first kind using a regularized projection method, International Journal of Computer Mathematics, DOI: [10.1080/00207160.2024.2358119](https://doi.org/10.1080/00207160.2024.2358119)

To link to this article: <https://doi.org/10.1080/00207160.2024.2358119>



Published online: 28 May 2024.



Submit your article to this journal [↗](#)



View related articles [↗](#)



View Crossmark data [↗](#)



On the numerical solution of weakly singular integral equations of the first kind using a regularized projection method

Tahar Bechouat^a and Nadjib Boussetila^b

^aFaculty of Science and Technology, Department of Mathematics and Informatics, Mohammed Cherif Messaadia University, Souk Ahras, Algeria; ^bDepartment of Mathematics, University 8 Mai 1945 Guelma, Guelma, Algeria

ABSTRACT

This study investigates a numerical method based on the Jacobi–Gauss quadrature for solving Fredholm integral equations of the first kind with a weakly singular kernel by combining the Tikhonov regularization and projection methods. This numerical method reduces the solution of the weakly singular integral equations of the first kind to the solution of a linear system of algebraic equations. The theoretical analysis of the proposed technique is provided. Finally, several tests are presented to show the validity and efficiency of this approach.

ARTICLE HISTORY

Received 3 May 2023
Revised 7 October 2023
Accepted 8 May 2024

KEYWORDS

Ill-posed problems; Tikhonov regularization; Legendre polynomials; Gauss–Jacobi quadrature; weakly singular integral equations

2010 MATHEMATICS SUBJECT CLASSIFICATIONS

45B05; 65J20; 65M30

1. Introduction

Various important applications of Fredholm integral equations with weakly singular kernels have been demonstrated in the fields of electrochemical machining, low-frequency electromagnetic problems, fluid mechanics, elastic contact problems, combined infrared radiation and the theory of porous filtering, as evidenced by [6,14,20].

In recent times, multiple methods have been developed to solve singular integral equations. As an example, Shoukralla et al. [31–34] have demonstrated multiple strategies and techniques for solving Fredholm integral equations of the first kind that possess a logarithmic singularity in the kernel. Meanwhile, Dmitriev et al. [11] utilized an iterative approach to solve a Fredholm integral equation of the first kind with a logarithmic singularity in an arbitrary domain of definition. In [19], the sinc-collocation method is presented for approximating the solution of nonlinear Fredholm integral equations of the first kind that feature a weakly algebraic singular kernel. Furthermore, the authors in [13] employed Chebyshev polynomials to resolve singular integral equations of the first kind that possess a Cauchy kernel. However, the research on Fredholm integral equations of the first kind with algebraic or logarithmic singularities in the kernel has been limited. Conversely, there are several papers that have proposed multiple simple and precise approaches for solving weakly singular Fredholm integral equations of the second kind, such as [1–3,7,9,25,37]. Also, it is important not to overlook the most recent research on these numerical methods. For example, we can mention the following [4,5,16,17,28–30].