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# A SPECTRAL COLLOCATION METHOD FOR MULTIDIMENSIONAL NONLINEAR WEAKLY SINGULAR VOLTERRA INTEGRAL EQUATION

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ABSTRACT. This paper is concerned with the convergence properties of Chebyshev spectral collocation method when used to approximate the solution of multidimensional nonlinear Volterra integral equation of the second kind with a weakly singular kernel. We consider the case that the underlying solution is sufficiently smooth. The Chebyshev collocation discretization is proposed for this equation. In the present paper, we provide a rigorous error analysis which justifies that the errors of approximate solution decay exponentially in weighted  $L^2$  norm and  $L^\infty$  norm. Numerical results are presented to demonstrate the effectiveness of the spectral method.

## 1. INTRODUCTION

Volterra integral equation arises widely in scientific fields. It should be solved with efficient numerical methods. There are many existing numerical methods for solving Volterra integral equation, such as homotopy perturbation method [2, 4, 12, 13], differential transform method [1, 3], hp-discontinuous Galerkin method [7] and Runge-Kutta method [5, 28]. In practice, spectral method has excellent error properties. The literature [22] proposed a Legendre-spectral method for one-dimensional Volterra integral equation with a regular kernel. Subsequently, Chen and Tang [9, 10, 11] developed the spectral method for linear weakly singular Volterra integral equation in one-dimensional

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