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Original article

A modified Kulkarni's method based on a discrete spline quasi-interpolant☆

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Abstract

We use a discrete spline quasi-interpolant (abbr. dQI) defined on a bounded interval for the numerical solution of linear Fredholm integral equations of the second kind with a smooth kernel by collocation and a modified Kulkarni's method together with its Sloan's iterated version. We study the approximation errors of these methods and we illustrate the theoretical results by a numerical example.

Keywords: Integral equation; Quasi-interpolation; Collocation

1. Introduction

Let us consider the linear equation

$$u - \mathcal{K}u = f, \tag{1}$$

where $\mathcal{K}$ is a compact linear operator on the Banach space $\mathcal{X}$. The operator $(\mathcal{I} - \mathcal{K})$ is assumed to be invertible, so that the equation has a unique solution $u \in \mathcal{X}$ for any given $f \in \mathcal{X}$. Let $\mathcal{K}$ be the integral compact linear operator defined by

$$\mathcal{K}u(s) := \int_0^1 K(s,t)u(t)\,dt, \qquad s \in I := [0, 1],$$

where $\mathcal{X} := \mathcal{C}(I)$ and the kernel $K \in \mathcal{C}(I^2)$. A standard technique to solve (1) approximately is to replace $\mathcal{K}$ by a finite rank operator. The approximate solution of (1) is then obtained by essentially solving a system of linear equations. Let π_n be a sequence of linear interpolatory projection operators onto finite dimensional subspaces $\mathcal{X}_n$ of $\mathcal{X}$ converging to the identity operator pointwise. In the collocation method $\mathcal{K}$ is replaced by $K_n^C := \pi_n K$ and the right hand side f is

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