

THE NUMERICAL SOLUTION OF FREDHOLM INTEGRAL EQUATIONS OF THE SECOND KIND*

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1. Introduction. A general method is presented for the numerical solution of the Fredholm integral equation,

$$(1) \quad \lambda x(s) - \int_a^b K(s, t)x(t) dt = y(s), \quad a \leq s \leq b.$$

In the equation, λ is a nonzero complex number, $[a, b]$ is a finite interval, $y(s)$ is complex-valued and continuous on $[a, b]$, and the integral operator $\mathcal{K}$,

$$(2) \quad (\mathcal{K}x)(s) = \int_a^b K(s, t)x(t) dt, \quad a \leq s \leq b,$$

is assumed to be a compact (completely continuous) operator on $C[a, b]$ into $C[a, b]$. The set $C[a, b]$ consists of all complex-valued continuous functions on $[a, b]$, and with the maximum norm,

$$\|x\| = \max_{a \leq s \leq b} |x(s)|,$$

it is a Banach space.

Although quite general, the method presented is intended to treat (1) when the kernel $K(s, t)$ has singularities, e.g.,

$$\log |s - t|, \quad |s - t|^\alpha \quad \text{for } \alpha > -1, \quad \log |\cos s - \cos t|.$$

When the kernel has several continuous derivatives, the method reduces to replacing the integral with a numerical integral and then to solving a finite linear system; see [1], [2], [3], [5], [11], [13].

In the following section, a generalized form of numerical integration is given for functions of one variable. It is applied to (1) in §3, and convergence of the resulting method is shown in §4. Section 5 contains computational notes and a numerical example.

2. Generalized quadrature. Assume $f \in C[a, b]$ and $\varphi(t)$ is Lebesgue integrable on $[a, b]$; denote $\int_a^b |\varphi(t)| dt$ by $\|\varphi\|_1$. (For most practical prob-

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