High order numerical solution of the linear integral equations

Javad Farzi

Sahand University of Technology,

Tabriz, Sahand New Town, Iran, P.O. Box 51335/1996.

farzi@sut.ac.ir

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We consider the Fredholm integral equation of the second kind

$$u(x) + \lambda \int_a^b k(x,y)u(y)\,dy = f(x), \tag{1}$$

where the functions $k(x,y)$ and $f(x)$ are smooth functions. The numerical solutions of this problem has been discussed in many books and papers, for example see[1, 2]. We derive an explicit representation of the extrapolation methods to provide an efficient method for numerical approximation of the integrals in an arbitrary grid points:

$$T_{j-1}^{(k+1)} = \sum_{i=0}^{N} w_i f(x_i). \tag{2}$$

The order of this method is increasing with N. The convergence of the given approximation for a small number of nodes is evident in numerical analysis. The discretization of the integral equation based on this approximation will provide many advantages in practical methods. Some of them are: the rapid convergence, using the arbitrary set of points in the discretization, the straightforward extension of the method for the integro-differential equations and many other advantages can easily verified. The implementation of this method for nonlinear problems is also a interesting problem and has many applications in science and engineering.

References

[1] Delves, L.M. and Mohamed, J.L.: Computational Methods for Integral Equations, Cambridge University Press, (1988)

[2] Jerri, A.J.: Introduction to Integral Equations with Applications, Sampling Publishing, second edition, (2008)