Multi-techniques method for Solving Volterra Integral Equations of the Second Kind

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Abstract

This paper presents a new computational method for solving linear Volterra integral equations of the second kind. Three techniques are used to establish the method; the first technique is based on re-describing the Barycentric Lagrange interpolation in a new formula that reduces the round-off error resulting from the high degree interpolant polynomials; the second technique is based on expanding the Lagrange Barycentric functions into Maclaurin polynomials and expressing them via a monomial basis that facilitates calculations and reduces the procedure's steps. In the third technique, the equidistance Chebyshev interpolation nodes have been chosen so that the bad behavior of the solution near the endpoints of the integration domain is treated. Moreover, the method reduces the solution to the solution of an equivalent matrix equation that can be easily solved by using the undermined coefficients method. The obtained results of the five illustrated examples show that if the unknown function is algebraic, the numerical solutions are found in explicit mathematical form equal to the exact solutions, regardless of the properties of the given function or the kernel. If the unknown function is non-algebraic, the numerical solutions are strongly converging to the exact solutions rather close to the endpoint of the integration domain which ensures the accuracy, efficiency, and authenticity of the presented method.