A Quadrature-Difference Method to solve a System of coupled second order Fredholm Integro-Differential Equations with constant Coefficients

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Abstract

The use of integro-differential equations plays an important role in modeling many mathematical and physical problems nowadays. One example is Option Pricing in the field of Financial Mathematics. When the underlying asset follows a jump-diffusion process, the resulting equation after applying appropriate stochastic tools, is a partial integro-differential equation. If a more complex underlying process for the asset is used like regime-switching or jump-telegraph diffusion process, then we obtain a system of partial integro-differential equations. In most of the cases, close solution does not exist and the system can only be solved numerically.

In this paper we present a Quadrature-Difference Method (QDM) to solve a system of second order coupled Fredholm Integro-Differential Equation with constant coefficients. The basic idea is to fully discretize the coupled equations of the system using a finite difference technique on the differential part and combine it with a quadrature formula on the integral parts of the equation. After the overall discretization we arrive to two systems of linear algebraic equations that can be solve simultaneously as a matrix block system. Some numerical problems are presented to test the performance and accuracy of the proposed method. Moreover, we compute the numerical order of convergence of the proposed method.