A Taylor Collocation Approach for Solving Systems of Two-Dimensional Volterra Integral Equations

C. Hennous [1] and H. Laib [1,2*]

[1] *Laboratory of Mathematics and Its Interactions,*
Abdelhafid Boussouf University, Mila, Algeria.
[2] *Ecole Normale Supérieure Echeikh Mohamed Elbachir Elibrahimi, Algiers, Algeria.*

Abstract: This work presents a numerical approach for solving systems of linear two-dimensional Volterra integral equations (2D-VIEs), which frequently arise in modeling dynamical systems with memory effects, including applications in control theory, population dynamics, and epidemic modeling. An algorithm based on Taylor polynomials is developed to construct a collocation solution for these systems. The convergence of the proposed method is established, ensuring accurate and efficient approximations while preserving the integral structure of the system. Numerical examples are provided to illustrate the accuracy and applicability of the method in solving problems relevant to systems theory.

Keywords: *system of two-dimensional Volterra integral equations; spline approximation; power series; error analysis.*

Mathematics Subject Classification (2020): 41A15, 45D05, 45L05, 65R20, 37N25.

1 Introduction

The numerical solution of integral equations, particularly systems of Volterra integral equations (VIEs), is crucial for modeling and solving complex problems in science and engineering. Such equations frequently arise in fluid dynamics, signal processing, control theory, mathematical biology, and various other areas of nonlinear dynamics and systems theory. For instance, in nonlinear dynamical systems, VIEs are used to describe systems with memory effects, such as in population dynamics, where the interaction between

---