National Conference on Sustainable Developments in Engineering, Science, Humanities and Management (NCSDESHM – 2025)
28th December, 2025, Raipur, Chhattisgarh, India.

CERTIFICATE NO: NCSDESHM /2025/ C1225902

A Study of Numerical Algorithms Using Wavelet Methods for Differential Equations

Roohi Tarannum

Research Scholar, Ph.D. in Mathematics, Mansarovar Global University, Sehore, M.P., India.

ABSTRACT

Numerical algorithms based on wavelet methods have emerged as powerful tools for solving differential equations due to their multiresolution and localized approximation properties. Wavelets provide a flexible mathematical framework in which functions and their derivatives can be represented efficiently at different scales, making them particularly suitable for problems involving sharp gradients, discontinuities, or localized phenomena. In wavelet-based numerical algorithms, the solution of a differential equation is typically expanded in terms of wavelet basis functions, transforming the original differential equation into a system of algebraic equations. One of the major advantages of wavelet methods is their ability to achieve high accuracy with relatively fewer computational degrees of freedom compared to traditional methods such as finite difference or finite element techniques. Adaptive wavelet algorithms allow automatic refinement in regions where the solution exhibits complex behavior, while coarser representations are used elsewhere, leading to significant savings in computational cost. Wavelet–Galerkin and wavelet–collocation methods are commonly used approaches for discretizing ordinary and partial differential equations. Wavelet methods have been successfully applied to a wide range of problems, including elliptic, parabolic, and hyperbolic differential equations, as well as nonlinear and time-dependent systems. Their inherent capacity for compression and noise reduction also improves numerical stability.