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Summary of Abstract

Even the most basic differential equations have a direct correspondence to realistic physical phenomena, such as exponential growth and decay, population dynamics, spring mass system, arm race model, carbon dating, pre-predator model, electrical circuits, competitive species, infectious disease, fluid flow, heat conduction, and wave propagation. Combining the fundamental models may frequently describe more complicated natural processes. The primary goal of this thesis is to provide more accurate numerical approaches for solving such initial and boundary value problems using wavelets. The thesis consists of six chapters. The chapter-wise summary is given herewith.

Chapter 1: This chapter discusses the history of neutral delay differential equations, Lane-Emden and Emden-Fowler type equations, fractional differential equations, fractional order neutral delay differential equations, and fractional differential equations on metric star graphs. Basic definitions of several wavelets are also provided.

Chapter 2: In this chapter, wavelet-based collocation methods are proposed for solving neutral delay differential equations. The Legendre, Hermite, Chebyshev, Laguerre, Gegenbauer and Bernoulli wavelets are used to solve the neutral delay differential equations numerically.

Chapter 3: The purpose of this chapter is to develop computational methods based on Hermite, Bernoulli and Jacobi wavelets for the solution of second and third-order Lane-Emden and Emden-Fowler boundary value problems arising in many real-life problems.

Chapter 4: This chapter aims to develop an improved Hermite wavelet resolution method for solving space-time-fractional partial differential equations (STFPDE). We have directly formulated the Riemann–Liouville fractional integral (RLFI) operator for Hermite wavelets of general order integration.

Chapter 5: In this chapter, p type fractional neutral delay differential equations (p-$FNDDE$) and delay partial differential equations (p-$FNDPDE$) are investigated using the generalized Gegenbauer wavelet.

Chapter 6: In this chapter, a wavelet collocation method based on the Haar wavelet is proposed to investigate the numerical solution of the time fractional diffusion equation (TFDE) on a metric star graph. The Riemann-Liouville definition of the fractional integral operator together with the Haar wavelet are utilized to obtain the Riemann-Liouville fractional integral operator for the Haar wavelet (RLFIO-H).