On Wavelet Transform as an Extension of Fractional Fourier Transform and its Applications

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Abstract:

Wavelet theory is associated with building a model for a signal, system or processes with a set of special signals and is emerged as a powerful tool of signal denoising.The main objective of this paper is to study the wavelet transform as an fractional Fourier transform (FrFT) and its some basic properties. Applications of the extended wavelet in solving generalized nth order linear nonhomogeneous ordinary differential equations. Also gives applications in signal processing and convolution of mother wavelet and Mexican Hat Wavelet.

Keywords: fractional Fourier transform, wavelet transform, signal processing

Introduction:

The theory of fractional Fourier transforms (FRFTs) has advanced considerably since its inception, largely driven by the need to extend the classical Fourier transform for diverse applications in optics, signal processing, and quantum mechanics.[10] A core tool involves the Fourier domain computation of an approximate digital random transform. The Fractional Fourier Transform (FrFT), a generalization of the Fourier Transform (FT), depends on a parameter α, which corresponds to the angle in the phase plane [1]. Curvelet transforms exploit sparsity and have found numerous applications [3,4]. The wavelet transform is a powerful tool for multi-scale geometric image analysis [7]. It decomposes a signal into a representation that reveals signal details as a function of time. Traditionally, the wavelet transform and the Fractional Fourier Transform (FrFT) have been widely used in signal and image processing. Wavelet transforms, as extensions of the FrFT, have proven valuable in solving ordinary and partial differential equations, such as the heat equation and the Schrödinger equation [9]. Wavelet-based multi-resolution techniques have been extensively applied in various fields, including signal and image processing, bioinformatics, computer vision, scientific computing, and optical data analysis[6]. The FrFT has also shown significant utility in addressing certain problems in quantum physics. The growing interest of