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Properties and applications of octonion fractional Fourier transform for 3-D octonion signals

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Highlights

- In this paper, the differential properties of the left side octonion fractional Fourier transform (LOFRFT) in time domain and frequency domain are studied, and the convolution theorem in the LOFRFT is derived according to the existing fractional convolution theorem.
- The applications of LOFRFT in time-invariant systems in series, parallel and feedback connection are discussed.
- Examples and simulations are provided to demonstrate that the proposed transform effectively captures the LOFRFT-frequency components with more flexibility and multi-scale analysis capabilities.

Abstract

In the field of signal processing, especially when dealing with complex signals and multidimensional data analysis requirements, traditional transformation methods often struggle to meet practical application needs. Although the Fourier transform and its derivative methods (such as the fractional Fourier transform) play an important role in signal processing, these methods have obvious limitations in handling high-dimensional non-stationary signals, particularly in capturing the intrinsic structure and time-frequency characteristics of multidimensional signals. To address this issue, this paper