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Quaternionic One-dimensional Fractional Fourier Transform

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Abstract

In this paper, we introduce quaternionic fractional Fourier transform of integrable (and square integrable) functions on \mathbb{R} and prove that it is satisfying all the expected properties like linearity, inversion formula, Parseval's formula, convolution theorem and product theorem.

Keywords: Fractional Fourier transform, Convolution, Quaternion valued functions

2010 MSC: 44A15, 44A35, 46S10

1. Introduction

The fractional Fourier transform was introduced in [20] and the explicit definition of the kernel $K_\alpha(t, u)$ of this transform is given from [5] as follows.

For $\alpha \in \mathbb{R}$, let

$$K_\alpha(t, u) = \begin{cases} \sqrt{\frac{1-i \cot \alpha}{2\pi}} e^{i \frac{t^2+u^2}{2} \cot \alpha - iut \csc \alpha}, & \alpha \notin \pi\mathbb{Z} \\ \delta(t-u), & \alpha \in 2\pi\mathbb{Z} \\ \delta(t+u), & \alpha + \pi \in 2\pi\mathbb{Z}. \end{cases}$$

Subsequently, many research works have been done on fractional Fourier transform. See [7, 8, 14, 15, 16, 20, 25, 30].

In view of signal processing,

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