



Fractional Fourier Transform, Signal Processing and Uncertainty Principles

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Abstract

The fractional Fourier transform (FrFT) is one of the generalizations of the Fourier transform (FT). This paper is centered on the compression of different forms of signal in FrFT domain in order to extract some properties of each one with a comparison between the FrFT and the usual FT. Also, our focus here will be on two qualitative uncertainty principles for the fractional Fourier transform: The Cowling–Price’s theorem and the $L^p - L^q$ version of Morgan’s theorem for the FrFT. These two results estimate the decay of two fractional Fourier transforms $F_\alpha(f)$ and $F_\gamma(f)$, with $\gamma - \alpha \neq n\pi, \forall n \in \mathbb{Z}$, which allows us to deduce the usual uncertainty principles between a function f and its fractional Fourier transform $F_\gamma(f)$.

Keywords Fractional Fourier transform · Signal processing · Fractional $L^p - L^q$ version of Morgan’s theorem · Fractional Cowling–Price’s theorem

1 introduction

Uncertainty principles are mathematical results that give limitations on the simultaneous concentration of a function and its Fourier transform [13]. This idea has been studied first by Heisenberg [14] then by Faris, Donoho and Stark [25, 26], so-called quantitative uncertainty principles. They are just an other name for some special

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Fractional Fourier Transform

Terry C. Jones



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Fractional Fourier Transform Introduction

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