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Wigner-Ville distribution associated with the quaternion linear canonical transform and their generalized uncertainty principles

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Abstract
Wigner-Ville distribution (WVD) in the frame work of quaternion linear canonical transform (QLCT) (WVD-QLCT) is the generalized version of WVD in the quaternion algebra. Recently, some properties and applications in detection of linear frequency modulated (LFM) signals have been studied for the WVD-QLCT. In this paper, we first establish a relationship between WVD-QLCT and QFT and then we derive different uncertainty principles (UPs) which includes the Heisenberg's UP, logarithmic UP, Hardy's UP, Donoho Stark's UP and Beurling's UP associated with the WVD-QLCT.

Keywords Wigner-Ville distribution · Quaternion linear canonical transform · Uncertainty principle · Donoho-Stark.

Mathematics subject classification 42C40 · 42B10 · 42C30 · 11R52

1 Introduction

The Fourier transform(FT) [1]- is a classical tool that has been widely used to study stationary signals. In the recent years, it has become very famous to study integral transforms from real and complex systems to quaternion systems. In this context we have now quaternion Fourier transform (QFT) [2–5], the qauaternion fractional Fourier transform(QFrFT) [6], the quaternion wavelet transform (QWT) [7, 8], the quaternion linear canonical transform (QLCT) [9, 10] and the quaternion offset linear canonical transform (QOLCT) [11–16]. It has been shown in [17–19] that QFT is a very

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