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Quaternion linear canonical S-transform and associated uncertainty principles

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In this paper, we introduce the notion of quaternion linear canonical S-transform (Q-LCST) which is an extension of the linear canonical S-transform and study the uncertainty principles associated with the Q-LCST. First, we propose the definition of Q-LCST and then study the fundamental properties of Q-LCST including linearity, shift, modulation, orthogonality relation and reconstruction formula. Second, we derive the associated Heisenbergs uncertainty inequality and the corresponding logarithmic version for Q-LCST. Finally, some potential applications of the Q-LCST are introduced.

Keywords: Linear canonical transform; linear canonical S-transform; quaternion linear canonical S-transform; uncertainty principle.

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1. Introduction

A nontrivial generalization of the classical real and complex Fourier transform is the quaternion Fourier transform (QFT).[16,19,21,30] This generalization using quaternion algebra has been of great interest to the mathematicians and physicists for so many years. On the other side, an extension of the quaternion Fourier transform, which is the quaternion linear canonical transform (QLCT), received much attention in recent years. Recently, researchers have been focussing more on the construction of various new transformations by coupling the QLCT with other transforms and their generalized versions. In Refs. 26–25, authors proposed the generalized versions of the quaternion linear canonical transform. Some basic properties of generalized transform were investigated in detail. In Refs. 15–5, authors studied Wigner–Ville distribution associated with the Quaternion linear canonical transform and the