New quadratic phase Wigner distribution and ambiguity function with applications to LFM signals

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Abstract

The most well-known time–frequency tools for assessing non-transient signals are the Wigner distribution (WD) and ambiguity function (AF), which are used extensively in signal processing and related disciplines. In this article, a new kind of WD and AF associated with the quadratic phase Fourier transform (QPFT) is proposed; this new quadratic phase Wigner distribution (NQPWD) and the new quadratic phase ambiguity function (NQPAF) are defined based on the flexibility of the Fourier kernel. Firstly, the main properties and physical meanings of the NQPWD and NQPAF are investigated, the results show that the NQPWD and NQPAF generalize the classical WD and AF. Then some essential properties and relations with short-time Fourier transform of the newly defined WD and AF are investigated. Moreover, the convolution and correlation theorem for NQPWD are derived. Finally, with the help of simulations, applications of NQPWD and NQPAF for the detection of single-component and multi-component LMF signals are also presented in this work.

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