应用

基于改进时频分析方法的雷达信号瞬时频率估计

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摘要：

瞬时频率估计(Instantaneous Frequency, IF)在雷达信号处理中有着重要的研究意义，时频分布峰值检测是IF估计研究和应用中较为普遍和有效的方法，但由于噪声的影响，时频分布峰值往往偏离真实的IF曲线。针对低信噪比下的IF估计，文中首先对WVD及CWD的时频分布矩阵作Hadamard积，得到一种混合的时频分析方法，而后采用多样本信号时频能量累乘的方法，进一步抑制噪声在时频面上的分布；然后以时频分布峰值在信号自项时频聚集区域的分布概率为准则，计算出时频分布的数据窗长，并根据该窗长得到IF的初始估计；最后依据初始IF，采用交叉置信区间算法对时频分布峰值进行检测，得到信号的瞬时频率估计值。文中对NLFM、LFM和FSK信号的IF估计进行了研究，并与WVD峰值检测法和时频分布一阶矩法进行了比较，仿真结果表明了本文方法的有效性。

关键词： 瞬时频率；时频分布；Hadamard积；交叉置信区间

Instantaneous Frequency Estimation for Radar Signals Based on Improved Time-Frequency Distribution

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Abstract:

Abstract：Instantaneous frequency (IF) estimation has great signality in radar signal processing. Detecting the peak of time-frequency distribution is an effective approach for IF estimation, but error usually occurs when some points outside the signals' auto-term surpass values of the peak of time-frequency due to false maxima detection in noise environment. To estimate the IF accurately in the condition of low SNR, a hybrid time-frequency distribution method is proposed, which combines the Wigner-Ville Distribution(WVD) and Choi-Williams Distribution(CWD) based on the Hadamard product of time frequency matrices. Simultaneously, the time-frequency distribution of the noise is suppressed by adopting time-frequency energy integration. The probability that the time-frequency distribution takes a maximal value outside the auto-term position is considered as the guide line for selecting the window length of time-frequency analysis, and then the initial IF is estimated. The intersection of the confidence intervals algorithm is applied to detect the IF along with initial IF finally. The proposed approach is employed to estimate the IF of NLFM, LFM and FSK signals, and compared with the method of the first moment of the time-frequency distribution and the peak of the WVD. The validity of the proposed method is demonstrated by experiments.

Keywords: Instantaneous Frequency Time Frequency Distribution Hadamard Product the Intersection of the Confidence Intervals

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