短文与研究通讯

改进的基于分形盒维数的共信道多信号存在性检测算法

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摘要：

针对时频重叠的共信道多信号存在性检测问题，提出了一种改进的基于分形盒维数的算法。算法用瞬时幅度的盒维数作为检测统计量，通过理论推导得出噪声瞬时幅度的盒维数为一定值1.415，共信道多信号瞬时幅度的盒维数近似等于1，并以此得出了检测的理论门限。如果接收信号瞬时幅度的盒维数小于设定的检测门限则说明有信号，否则没有信号。共信道多信号为MASK、MPSK、MQAM和MFSK任意类型混合时，仿真结果表明在加性高斯噪声背景下算法准确有效，信噪比大于-2dB时检测概率达到100%且虚警概率极低。另外，算法对信号调制类型、调制参数、信号源个数具有很好的鲁棒性，计算简单复杂度低、可实时处理。相比于已有研究，本算法门限值的设定更加精确，检测性能有大幅提升。

关键词： 共信道多信号；时频重叠；分形盒维；信号检测

Improved Algorithm for Detecting the Presence of Co-channel Multi-signal Based on Fractal Box Dimension

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Abstract:

To tackle the problem of detecting the presence of time-frequency overlapped co-channel multi-signal, an improved algorithm based on fractal box dimension is proposed. The box dimension of instantaneous amplitude is used as detection statistics, which of noise is proved to be a constant 1.415 by theoretical deduction, while which of co-channel multi-signal is turned out equaling to 1 approximately. According to the result, the theoretical threshold can be set. It is signal if the received signal's box dimension of instantaneous amplitude is less than the threshold, otherwise it is noise. The co-channel multi-signal is overlapped by several independent signals, of which the modulation types include MASK, MPSK, MQAM and MFSK. Simulation results prove that the method is effective and accurate in the additional Gaussian noise environments. When SNR is more than -2dB, the detection probability reaches 100% while false-alarm probability is very low. Additionally, it is robust to modulation types, modulation parameters and source number, easy to compute and can be used as real-time processing. Compared to the existing methods, the threshold proposed in this paper is more accurate, and the performance is improved greatly.

Keywords: co-channel multi-signal   time-frequency overlapped   fractal box dimension   signal detection

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