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Histogram partitioning algorithms for adaptive and autonomous threshold estimation in cognitive radio–based industrial wireless sensor networks

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Abstract

Modern energy detectors typically use adaptive threshold estimation algorithms to improve signal detection in cognitive radio–based industrial wireless sensor networks (CR-IWSNs). However, a number of adaptive threshold estimation algorithms often perform poorly under noise uncertainty conditions since they are typically unable to auto-adapt their parameter values per changing spectra conditions. Consequently, in this paper, we have developed two new algorithms to accurately and autonomously estimate threshold values in CR-IWSNs under dynamic spectra conditions. The first algorithm is a parametric-based technique termed the histogram partitioning algorithm, whereas the second algorithm is a fully autonomous variant termed the mean-based histogram partitioning algorithm. We have evaluated and compared both algorithms with some well-known methods under different CR sensing conditions. Our findings indicate that both algorithms maintained over 90% probability of detection in both narrow and wideband sensing conditions and less than 10% probability of false alarm under noise-only conditions. Both algorithms are quick and highly scalable with a time complexity of O(V), where V is the total number of input samples. The simplicity, effectiveness, and viability of both algorithms make them typically suited for use in CR-IWSN applications.