Physical Communication

Amplitude quantization method for autonomous threshold estimation in self-reconfigurable cognitive radio systems

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Abstract:
Self-adaptive threshold adjustment algorithms (SATAs) are required to reconfigure their parameters autonomously (i.e. to achieve self-parameter adjustment) at runtime and during online use for effective signal detection in cognitive radio (CR) applications. In this regard, a CR system embedded with the functionality of a SATA is termed a self-reconfigurable CR system. However, SATAs are challenging to develop owing to a lack of methods for self-parameter adjustment. Thus, a plausible approach towards realizing a functional SATA may involve developing effective non-parametric methods, which are often pliable to achieve self-parameter adjustment since they are distribution-free methods. In this article, we introduce such a method termed the non-parametric amplitude quantization method (NPAQM) designed to improve primary user signal detection in CR without requiring its parameters to be manually fine-tuned. The NPAQM works by quantizing the amplitude of an input signal and then evaluating each quantized value based on the principle of discriminant analysis. Then, the algorithm searches for an effective threshold value that maximally separates noise from signal elements in the input signal sample. Further, we propose a new heuristic, which is an algorithm designed based on a new corollary derived from the Otsu's algorithm towards improving the NPAQM's performance under noise-only regimes. We applied our method to the case of the energy detector and compared the NPAQM with other autonomous methods. We show that the NPAQM provides improved performance as against known methods, particularly in terms of maintaining a low probability of false alarm under different test conditions.