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Max-Min SNR Signal Energy Based Spectrum Sensing Algorithms for Cognitive Radio Networks with Noise Variance Uncertainty

Abstract:

This paper proposes novel spectrum sensing algorithms for cognitive radio networks. By assuming known transmitter pulse shaping filter, synchronous and asynchronous receiver scenarios have been considered. For each of these scenarios, the proposed algorithm is explained as follows: First, by introducing a combiner vector, an over-sampled signal of total duration equal to the symbol period is combined linearly. Second, for this combined signal, the Signal-to-Noise ratio (SNR) maximization and minimization problems are formulated as Rayleigh quotient optimization problems. Third, by using the solutions of these problems, the ratio of the signal energy corresponding to the maximum and minimum SNRs are proposed as a test statistics. For this test statistics, analytical probability of false alarm (P_f) and detection (P_d) expressions are derived for additive white Gaussian noise (AWGN) channel. The proposed algorithms are robust against noise variance uncertainty. The generalization of the proposed algorithms for unknown transmitter pulse shaping filter has also been discussed. Simulation results demonstrate that the proposed algorithms achieve better P_d than that of the Eigenvalue decomposition and energy detection algorithms in AWGN and Rayleigh fading channels with noise variance uncertainty. The proposed algorithms also guarantee the desired $P_f(P_d)$ in the presence of adjacent channel interference signals.