

In this paper, we investigate a frequency domain approach for eigenvalue-based detection of a primary user, based on equal gain combining (EGC) and spectrum estimation with Bartlett's method. This paper considers two techniques for eigenvalue detection which are Maximum Eigenvalue Detection (MED) and the Maximum-Minimum Eigenvalue (MME) detector. We exploit the eigenvalues that are associated with the Hermitian form representation of Bartlett's estimate to assess the performance of the aforementioned eigenvalue techniques in the frequency domain. For each case, we quantify the performance based on the probabilities of false alarm and missed detection over Rayleigh and Rician fading. A bivariate Mellin transform approach is employed to obtain the probability distribution function for the ratio of the extreme eigenvalues under each hypothesis. All obtained formulas are validated via Monte-Carlo simulations, and the results give a clear insight into the performance of the investigated methods. In frequency domain, MED outperforms both the MME detector and Periodogram-based energy detection even in a worst case scenario of noise uncertainty, while the MME detector exhibits heavy-tailed statistical characteristics and thus its receiver operating characteristics tend to stay on the line of no-discrimination. The performance of MED is further enhanced by careful choice of combinations of the total length of the sensing frame and number of sub-slots.