A Spectrum Sensing Scheme for Partially Polarized Waves

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A spectrum holes sensing approach is developed for Cognitive Radio (CR) systems based on the estimation of the Stokes parameters of partially polarized electromagnetic waves. The performance of the proposed approach is compared with the energy detection method. An expression for the probability of detection based on the proposed method is derived using $\alpha - \mu$ generalized gamma fading model.

Recent works on polarization detection in CR were concerned with completely polarized waves, in which some practical considerations were not accounted for, namely the assumption that the polarization state is not changed with spectrum-sensing time. In this work, a polarization-based spectrum sensing scheme is proposed where a statistical model for the primary user signal polarization parameters is adopted. Figure 1 depicts a block diagram for the used system. The polarization of a quasi-monochromatic wave is quantified using an average polarization state vector which may be defined in terms of four measurable components, viz. $\vec{X} = [x_0 \;\; x_1 \;\; x_2 \;\; x_3]^T$. These components are known as the Stokes parameters. The degree of polarization W is defined as the ratio of the polarized to the total power in the wave, i.e.

$$W = \left[\frac{\sum_{l=1}^{l=3} x_l^2}{x_0^2}\right]^{1/2}$$

For $\alpha - \mu$ distribution fading channel, the probability of detection $\overline{p}_d$ was determined as

$$\overline{p}_d = 1 - k \sum_{n=0}^{\infty} a_n (0.0464)^2 (11)^{\mu} B(2n, \mu + N + 1)\, F_1(\mu + 2n; \mu + 2n + N + 1; -11\mu/\overline{\gamma})$$

where B is the beta function and F_1 is the Kummer confluent hypergeometric function.

From the results, it is obvious that the proposed method can provide superior performance for a wide range of SNR. Also, the performance of the proposed method for various known fading environments is investigated.

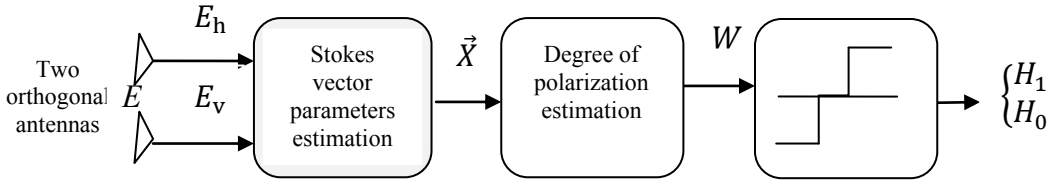

Fig.1 The system model