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Enhancement of Primary User Detection in Cognitive Radio by Scattering Transform

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Abstract : The detecting of an occupied frequency band is a major issue in cognitive radio systems. The detection process becomes difficult if the signal occupying the band of interest has faded amplitude due to multipath effects. These effects make it hard for an occupying user to be detected. This work mitigates the missed-detection problem in the context of cognitive radio in frequency-selective fading channel by proposing blind channel estimation method that is based on scattering transform. By initially applying conventional energy detection, the missed-detection probability is evaluated, and if it is greater than or equal to 50%, channel estimation is applied on the received signal followed by channel equalization to reduce the channel effects. In the proposed channel estimator, we modify the Morlet wavelet by using its first derivative for better frequency resolution. A mathematical description of the modified function and its frequency resolution is formulated in this work. The improved frequency resolution is required to follow the spectral variation of the channel. The channel estimation error is evaluated in the mean-square sense for different channel settings, and energy detection is applied to the equalized received signal. The simulation results show improvement in reducing the missed-detection probability as compared to the detection based on principal component analysis. This improvement is achieved at the expense of increased estimator complexity, which depends on the number of wavelet filters as related to the channel taps. Also, the detection performance shows an improvement in detection probability for low signal-to-noise scenarios over principal component analysis- based energy detection.

Keywords : channel estimation, cognitive radio, scattering transform, spectrum sensing
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