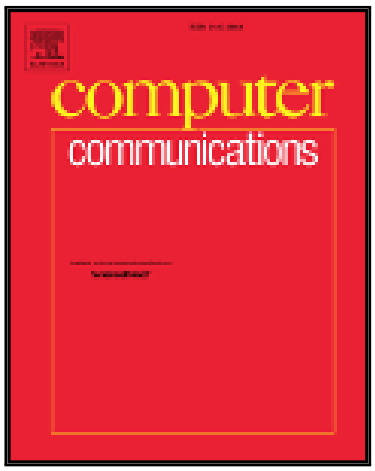

Algorithm for Spectrum Hole Identification in Cognitive Radio Network Based on Discrete Wavelet Packet Transform Enhanced with Hilbert Transform

P.Y. Dibal , E.N. Onwuka , J. Agajo , C.O. Alenoghena

PII: S0140-3664(17)31000-9
DOI: 10.1016/j.comcom.2018.04.015
Reference: COMCOM 5691

To appear in: *Computer Communications*

Received date: 21 September 2017
Revised date: 12 February 2018
Accepted date: 20 April 2018

Please cite this article as: P.Y. Dibal , E.N. Onwuka , J. Agajo , C.O. Alenoghena , Algorithm for Spectrum Hole Identification in Cognitive Radio Network Based on Discrete Wavelet Packet Transform Enhanced with Hilbert Transform, *Computer Communications* (2018), doi: 10.1016/j.comcom.2018.04.015

Algorithm for Spectrum Hole Identification in Cognitive Radio Network Based on Discrete Wavelet Packet Transform Enhanced with Hilbert Transform

*P.Y. Dibal, *E.N. Onwuka, **J. Agajo, *C.O. Alenoghena,
*Telecommunications Engineering Department, Federal University of Technology Minna
** Computer Engineering Department, Federal University of Technology Minna

Abstract— As wireless devices and applications increase, it is envisioned that spectrum utilization by licensed users will go from low to medium occupancy state. The CRs will need to sense wider bands to obtain free channels. Therefore development of enhanced wideband sensing algorithms is needed. Enhancing old tools for new applications could be quite useful. The discrete wavelet packet transform (DWPT) is a good mathematical tool that can be enhanced for better application in wireless communications. This paper presents an algorithm to identify spectrum holes in a cognitive radio system. The algorithm is based on the application of discrete wavelet packet transform enhanced with Hilbert transform in spectrum sensing. The enhancement with Hilbert transform has the effect of sharpening the PSD edges for better detection. Using histogram analysis for a discrete wavelet packet decomposed signal, the algorithm which we call DWPT-HiSHIA (Discrete Wavelet Packet Transform – Histogram Spectrum Hole Identification Algorithm) determines if a sub-band channel has a spectrum hole or not. Simulation results show the effectiveness of the algorithm in the identification of spectrum holes in sub-band channels for a discrete wavelet packet decomposed signal.

Keywords— Discrete Wavelet Packet Transform; Cognitive Radio; Heisenberg Uncertainty; Spectrum Hole; Threshold.

I. INTRODUCTION

In today's world, wireless devices and services have become an integral part of human life. Thus, these devices and services can be said to have a pervasive influence on modern human societies. The resultant effect of this is the exponential growth in the number of wireless devices, services, and applications [1,37,38,42], all of which have increased the problem of spectrum scarcity in the available electromagnetic radio spectrum. A second contributing factor to the scarcity of spectrum is the lack of dynamism in the way and manner regulatory agencies allocate spectrum to primary users. This has resulted in a less than optimal utilization of the spectrum because investigation as shown in Fig 1 [2] has indicated that most primary users hardly make complete utilization of their allocated spectrum at a given temporal and spatial locations.

To mitigate the effect of these two causative factors of spectrum scarcity, cognitive radio technology has been proposed in literature. It is a smart wireless communication system capable of acquiring spectral information from its surrounding environment by operating autonomously. Through this autonomous operation, a cognitive radio is able to evaluate its spectral environment, and then dynamically access suitable spectrum. The autonomy is driven by suitable algorithms embedded at the heart of the cognitive operations, which confers intelligence on the