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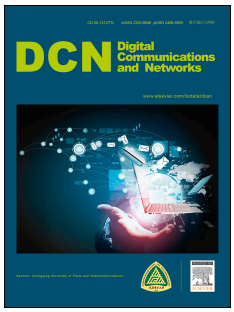

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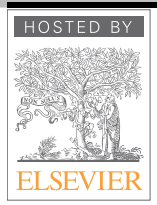

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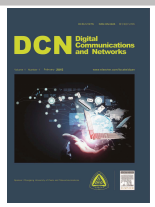

Windowed Overlapped Frequency Domain Block Filtering Approach for Direct Sequence Signal Acquisition

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Abstract

This paper applies a windowed frequency domain overlapped block filtering approach for the acquisition of direct sequence signals. The windows, as a novel viewpoint, not only allow pulse shaping without front end pulse shaping filter, but also increase the performance of the spectrum sensing unit which can efficiently be implemented into this frequency domain receiver and may further be used for spectrum sensing in cognitive radios or narrowband interference cancellation in military radios. The proposed receiver is applicable for initial time synchronization of different signals containing a preamble. These signals include single carrier, constant envelope single carrier, multicarrier and even generalized multicarrier signals which makes the proposed receiver structure a universal unit. Furthermore, the receiver can be used to perform filtering with long codes, compute the sliding correlation of an unknown periodic preamble. It can further be modified to handle large Doppler shifts. We will also demonstrate the computational complexity and analysis of the acquisition performance in Rayleigh and Rician fading channels.

KEYWORDS:
Synchronization, pseudonoise coded communication, matched filters.

1. Introduction

Initial synchronization, or acquisition of a direct sequence (DS) signal appears to be a quite common first step that a communication receiver has to perform after switching the power on because many wireless standards either use a DS signaling or their preamble, used for synchronization purposes, is a DS signal. These standards include GSM, LTE, UMTS, GPS, GALILEO, WIMAX, Zigbee, and many others wireless standards [1, 2, 3, 4]. For example, LTE systems use two DS signals, i.e., a 62-length Zadoff-Chu sequence and an 31-length M-sequence, as primary and secondary synchronization signals [5]. On the other hand, military communication systems require robust acquisition. One way to increase robustness is to use interference cancellation (IC) signal processing. The notch filters are a well known example of these. Another use for these IC units is spectrum sensing in cognitive radios. A notch filter may be a separate stand-alone unit in the front of a usual receiver but they may also be integrated into a frequency domain receiver, which reduces complexity since needed transformations may be shared. Frequency domain receivers have attained somewhat interest recently since they offer complexity reduction, e.g. in filtering. One particularly interesting filtering is matched filtering which allows fast acquisition [6, 7]. In the traditional frequency domain filtering, where the filter is in a one piece, overlap-save (OLS) or overlap-add (OLA) methods have to be acquired to properly handle the convolution process [8]. In addition, the frequency domain receivers may be of interest in multipur-

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