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DELAY-HOPPED, TRANSMITTED-REFERENCE ULTRA-WIDEBAND DIGITAL RADIO[1]

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Abstract. This paper describes a form of impulse radio called delay-hopped, transmitted-reference (DHTR). The primary advantages of this scheme relative to other UWB transmission schemes are its cost of implementation, its performance in high multipath environments and the ease with which it can be synchronized at the receiver. Its primary disadvantage is the transfer function between Eb/N0 and bit error rate, as compared to standard communication schemes. For short range, low data rate applications such as telemetry, however, more than enough bit energy can be delivered for the scheme to operate at low bit error rates.

Keywords. : transmitted-reference, ultra-wideband, spread spectrum, delay hopping.
AMS (MOS) subject classification: 94A05.

1 Introduction

Delay-hopped transmitted-reference (DHTR) is a UWB digital radio scheme [1,2] recently proposed by the authors. It is well-suited to short-range transmissions in a high multipath environment requiring multiple access, and, in contrast to time-hopped (e.g. pulse position modulated) impulse radio [3], it is easy to synchronize at the receiver and inexpensive to implement in hardware. This scheme has recently attracted the interest of several research groups, and some interesting extensions and generalizations have been proposed [4, 5, 6, 7]. The present paper gives an overview of the basic DHTR approach. This work is an extension of a technical report [8] that has not been generally available, and that did not explicitly deal with the effect of multipath on single-user detection, as this paper does. Preliminary analysis of multiple access capacity of the delay-hopping (DH) scheme in multipath is available [9], and hardware design and experimental results obtained with a prototype system [10] have also been published.

Transmitted-reference (TR), direct sequence spread spectrum techniques have been known and studied since the 1940's, and even before. R.A. Scholtz has written a history of spread spectrum which is available as part of a recently published book [11], and in it he identifies the earliest known TR scheme as having been disclosed in a patent application filed in 1922 [12].

[1]Invited paper.