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On the Performance of Prime Sequence Codes for Fiber Optic Code-Division Multiple-Access Networks

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Abstract

The comparison of two different methods for calculating the bit-error-rate (BER) performances of prime sequence codes in fiber optic code-division multiple-access (CDMA) networks is presented. (These) Those are the methods (used,) (as) presented in (the works of) Yang and Kwong (1995); and Lee and Green (1998). It is shown that the approach of (the) BER performance analysis presented in Lee and Green, (1998) give indications of better performance than the approach proposed by Yang and Kwong (1995). We also point out the errors in the work of Lee and Green, (1998) and provide the correct interpretation of the BER performance of prime sequence codes in fiber optic CDMA systems.

Keywords*: Optical communications, code-division multiple-access, optical code-division multiple-access, sparse codes, prime sequence codes, BER performances.*

Introduction

Code-division multiple-access (CDMA) is a spread spectrum technique, which has been well researched and implemented in mobile radio communications employing electrical signal processing. In this approach each receiver on the network is assigned a unique 'address' sequence that is approximately orthogonal to the sequences assigned to all other receivers. Data bits to be transmitted are then modulated by the assigned sequence of the targeted receiver before being sent. The targeted receiver in turn detects the incoming data by correlating it to its own 'address' sequence. It is (Thus, making it) possible for a number of users to simultaneously access the network as long as the total sum of the cross-correlations of the approximately orthogonal sequences to the targeted receiver is not excessive.

In CDMA systems, the transmitted spectrum of CDMA signals is broader, than the spectrum of the original data. In order to accommodate many subscribers and a large number of simultaneous users, long sequences or large spreading factors are required. However, the available bandwidth in radio channels is normally strictly limited by regulatory authorities, hence, the use of long sequences is not possible. Although copper cables are not subject to this restriction, their bandwidth is generally insufficient for large networks. In contrast, single-mode optical fibers have enormous bandwidths and the limitations of radio and copper-cable CDMA systems are effectively eliminated. Therefore, in such optical systems, spreading factors can, in principle, be increased to very high values (Prucnal *et al.* 1986). Hence, CDMA techniques can be implemented in fiber optic networks with a large number of users to provide ultra-fast communications and achieve very high throughput.

In recent years, some non-coherent fiber optic CDMA schemes have been proposed. Compared to coherent systems non-coherent systems have the advantages of fewer stability requirements for optical encoders and decoders (Marhic 1993). In non-coherent systems, because the correlation is based on power