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Uncoded Integrated Interleave Division Multiple Access Systems in Presence of Power Interleavers

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Abstract—Interleaving is one of the most common methods known to eradicate the effects of multiple user interference. Removal of different interferences is one of the major challenges for advanced communication system designers. Several methods of interleaving have been proposed in literature and their performances have been analyzed on different communication systems to prove their worthiness in multiple user interference removal. One of such interleavers is power interleaver, which can be employed in communication systems as a means to control burst errors and reduce the multiple user interference. In this paper, performances of two different integrated interleave division multiple access (IIDMA) techniques i.e. SCFDM-IDMA and OFDM-IDMA have been analyzed. Novelty of this work is in the sense that the entire analysis has been performed in the presence of power interleavers for the above two IIDMA techniques as the conventional IDMA fails to mitigate the problems of inter-carrier and inter-symbol interferences. Hence, the two techniques in presence of power interleavers empower the idea of quality communication without any interference for future generation communication systems.

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INTRODUCTION

Interleaving is a popular term among the researchers working in the areas of wireless (cellular) communication, digital communication, information theory and/or cyber security. In the field of communication and information theory, the main role of interleaving is to facilitate the controlling of burst errors by distributing these errors among multiple blocks of data. Hence, these distributed error bits obtain their individual identity in their respective blocks and thus can be detected and corrected by any moderate level error detection and correction codes [1].

Interleave division multiple access (IDMA) system is one of the advance communication systems primarily based on the allocation of user specific interleaving patterns [2]. Here, users are distinguished from each other following a unique interleaving pattern assigned to them. Therefore, the role of interleaving is no more limited to control the burst errors only. In IDMA systems, interleaving also serves as a means to overcome the multiple user and multiple access interferences similar to CDMA systems [3].

CDMA and IDMA systems have quite similar physical architectures, they only differ in the fact that former has user specific PN sequences and a common interleaving pattern for all users, while the latter has user specific interleaving patterns i.e. interleavers, and a common PN sequence for all users [4].

In literature, different types of interleavers have been proposed, analyzed and implemented for IDMA and some other communication systems. Examples of such interleavers are random interleaver, user-specific chip-level interleaver, tree interleaver, cyclic-shift interleaver, modified collision free interleaver, etc. [5–10, 16, 17]. Most of these interleavers were designed to be implemented with conventional IDMA systems.

This is the first time power interleavers are being applied on OFDM-IDMA and SCFDMA-IDMA systems. The topicality of these interleavers lies in the fact that different types of interleavers are being proposed time-to-time by the researchers for conventional IDMA and Integrated IDMA, which required to maintain a competitive bit error rate (BER) along with the minimum memory and computation complexity.

An IDMA system, in its conventional form, has its own limitations. As far as multiple users and multiple access interferences are the main concern, IDMA system delivers considerable BER results, but its

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