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MULTI-USER DETECTION IN DS-CDMA SYSTEMS USING A GENETIC ALGORITHM WITH REDUNDANCY SAVING STRATEGY

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Abstract. *This study demonstrates that the configuration of a fixed generation number in the conventional genetic algorithm–based multi-user detector (GA-MUD) induces considerable redundant iterations and thus results in a computational inefficiency. To overcome this difficulty, this research suggests a redundancy saving strategy for the GA-MUD (RSGA-MUD) based on the cost statistics of the GA solutions in a synchronous direct-sequence code division multiple access (DS-CDMA) system. Computer simulations for the synchronous DS-CDMA systems in perfect power control, near-far, and increased population scenarios are conducted to examine the performance of the proposed RSGA-MUD. Experimental results show that the RSGA-MUD can significantly reduce the computational burden of the conventional GA-MUD with only a slight performance degradation in perfect-power control and near-far scenarios. Furthermore, in the increased population scenario, the bit error rate (BER) performance is comparable to that of the optimum multi-user detector (OMD) with a computational complexity less than that of the conventional GA-MUD. Moreover, this study provides a novel mechanism that allows for a trade-off between computational reduction and acceptable degradation of GA-MUD performance by simply adjusting the cost threshold. Notably, the proposed redundancy saving strategy can be applied directly to various GA-based MUDs in order to increase their computational efficiency since it does not alter the essential structure of GA.*

Keywords: Direct-sequence code division multiple access (DS-CDMA), Genetic algorithm (GA), Multi-user detector (MUD), Redundancy saving (RS)

1. **Introduction.** As a multiple access scheme developed for 3G wireless broadband communication systems, in which multiple users are allowed to access a channel simultaneously, a direct-sequence code division multiple access (DS-CDMA) system assigns each user signal a distinct pseudo noise (PN) code (or PN signature waveform). The received signal is then the superposition of the signals transmitted by each user. Compared with other conventional multiple access techniques such as frequency division multiple access (FDMA) and time division multiple access (TDMA), DS-CDMA is more flexible and has a significantly higher capacity potential [1,2]. While detecting each user separately by considering the others as interference or noise, the conventional single user detection approach in DS-CDMA delivers the received signal through a conventional detector (CD), which consists of a bank of filters matched to the user's PN code; user information bits are then