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Enhanced Bundle-based Particle Collision Algorithm for Adaptive Resource Optimization Allocation in OFDMA Systems

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Abstract
The necessity for an efficient algorithm for resource allocation is highly urgent because of increased demand for utilizing the available spectrum of the wireless communication systems. This paper proposes an Enhanced Bundle-based Particle Collision Algorithm (EB-PCA) to get the optimal or near optimal values. It applied to the Orthogonal Frequency Division Multiple Access (OFDMA) to evaluate allocations for the power and subcarrier. The analyses take into consideration the power, subcarrier allocations constrain, channel and noise distributions, as well as the distance between user's equipment and the base station. Four main cases are simulated and analyzed under specific operation scenarios to meet the standard specifications of different advanced communication systems. The sum rate results are compared to that achieved with employing another exist algorithm, Bat Pack Algorithm (BPA). The achieved results show that the proposed EB-PAC for OFDMA system is an efficient algorithm in terms of estimating the optimal or near optimal values for both subcarrier and power allocation.

KEYWORDS: OFDMA, Enhanced Bundle-based Particle Collision Algorithm, Resource Allocation, Particle Collision Algorithm, optimization, communication systems, Adaptive Resource Allocation, power allocation algorithm, multi-objective optimization.

I. INTRODUCTION

In recent years, global demand for higher data transmission rates with quality of services in wireless communication systems have been growing enormously. However, the available communication resources are too limited to satisfy such huge demand [1] – [3]. There are many resource allocation protocols and algorithms were proposed to manage the case. Orthogonal frequency–division multiple access (OFDMA) has been adapted as one of the efficient schemes of resource allocation [4], [5]. In OFDMA systems, Radio Resource Management (RRM) algorithms are the key elements. It crucially affects the current and overall future communication performance largely by providing different QoS experienced by each of the end users [6]–[8]. The key issue in OFDM/OFDMA is solving the resource allocation problem which means finding the optimal or suboptimal resource allocation - for the subcarrier (subchannel) and the power.

Four key cases are analyzed under some specific optimization scenarios with employing the EB-PCA. In the first case, a relatively small equal number of users and subcarriers (7 each) are considered to estimate the best subcarrier and power allocation. The second case is conducted to discuss when the number of users is less than the available subcarriers (half number of available subcarriers is taken), While in the third case the contrary situation is discussed (the available subcarriers are less than the number of users). It mimics the scenario for sharing a limited subcarrier to provide a reasonable data rate to each user with respect to the channel conditions. Finally, case four discussed the case when both number of users and subcarriers are doubled.

The achieved results show that the proposed EB-PAC for OFDMA system is an efficient algorithm in terms of estimating the optimal or near optimal values for both subcarrier and power allocation.

Section 2 investigates some related work and Section 3 of this paper presents a theoretical background for the resource allocation and the algorithms used in this work whereas Section 4 reports the main simulation results. A comparison with that achieved by employing Bat Pack