A New Selection Algorithms for Distributed Evolutionary Algorithms

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Abstract

Parallel genetic algorithms are particularly easy to implement and promise substantial gains in performance. Its basic idea is to keep several subpopulations that are processed by genetic algorithms. Furthermore, a migration mechanism produces a chromosome exchange between subpopulation. In this paper, a new selection method based on non-linear fitness assignment presented. The use of proposed ranking selection permits higher local exploitation search, where the diversity of population is maintained by parallel subpopulation structure. Experimental results show that the relation between local-global search balance and the probabilities of reaching a desired solution.

1 Introduction

Evolutionary algorithms (EAs) comprises techniques that have been inspired by biological mechanisms of evolution and have been proven useful in a variety of search and optimization problems where calculus-based algorithms cannot be applied. The behavior of evolutionary algorithms is strongly determined by the balance between exploitation and exploration. The loss of alles due to excessive exploitation may produce a lack of diversity in the population. The premature convergence problem of EAs is caused by the lack of diversity[1]. Othrewise, highly exploratory EAs hardly find good local solution as well as random search does. Extensive researches on the optimal parameters for the balance of exploration and exploitation were performed[2][3].

Diversity preservation methods based on spatial separation have been proposed in order to avoid premature convergence[4]. Parallel genetic algorithms (parallel GAs) are the most famous spatial separation algorithm which separates the population to several subpopulations. Besides of diversity preservation ability, the algorithm has an important advantage for implementing to real world problem by using parallel machine. There are many research topics about parallel GAs. Population size, migration rate, connection topology, and genetic operators are the most important topics in parallel GAs[5]. The local selection method based on fitness evaluation is also important in parallel GA as well as in single population GA. Because the selection pressure determines the local search speed and diversity of population, more accurate analysis on the effect of selection pressure for parallel GA is required.

In this paper, we propose an local selection and migration algorithm for multi-population GAs with real-valued coding. The real-coded GA use different crossover and mutation operator used in traditional GAs. Many crossover operators with real-coded GA was studied by Herrera and Lozano[6] and mutation operator was proposed in evolutionary strategy and evolutionary programming. Also we analyze the effect of balance between local search operation and migration algorithm to guide the design of parallel GAs for real problems.

The paper is organized as follows. The next section summarizes a short overview on the structure and basic algorithm of parallel GAs. Section 3 describes how the subpopulation size, migration rate, and the proposed local selection mechanism affect the performance of parallel GAs. Also, we explain the comparison results through a few simulation experiments in section 3. Finally, section 4 concludes with some remark and future research directions.