Discussion of Parallel Model of Multi-Objective Genetic Algorithms on Heterogeneous Computational Resources

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Categories and Subject Descriptors

G.4 [**Mathematical Software**]: Parallel and vector implementations

General Terms

Algorithms

Keywords

Multi-objective optimization, Genetic algorithms, Parallelization, Heterogeneous

1. INTRODUCTION

Many studies of parallel Multi-Objective GA have been reported, most of which have made use of the master-slave model or island model. On the other hand, the recent development of large clusters and grid computing, which have unified the calculation resources online, have made huge resources easily available for such computational tasks. These resources are not homogeneous but are heterogeneous, and there is no parallel model supporting these environment. In this paper, we propose and discuss the parallel model of Multi-objective Genetic Algorithms supporting heterogeneous computational resources.

2. PARALLEL MOGA SUPPORTING HETEROGENEOUS ENVIRONMENT

The proposed model extends the master-slave model, *i.e.*, the master process sends two individuals as crossover pair in the current population to each slave process. After each slave process receives two individuals, crossover is performed, then offspring is evaluated. The proposed parallel model is illustrated in Figure.1. As the proposed method is based on NSGA-II, the algorithm has the same flow. The proposed method differs from Multi-Objective GAs, such as NSGA-II, in two respects: neighborhood crossover and the number of generated offspring after crossover. In the neighborhood crossover, two individuals that are close each other are selected as parents. These two individuals are sent to the calculation resource. Each slave process receives two individuals and iterate performing crossover, mutation, and evaluation of offspring in a given time. By iterating crossover, mutation, evaluation in a given time, the number of crossover and the number of offspring is changed dynamically adapting to the performance of the each calculation resource. Therefore, many offspring are generated on the high performance calculation resource and a smaller number of offspring are generated on the low performance calculation resource. Then, the two best offspring are chosen and returned to the master process. This mechanism is suitable for heterogeneous calculation environments, and a high degree of parallelization can be achieved. In addition, total communication cost can be reduced by increasing processing load of the slave processes, and reduction of the overhead time is expected.

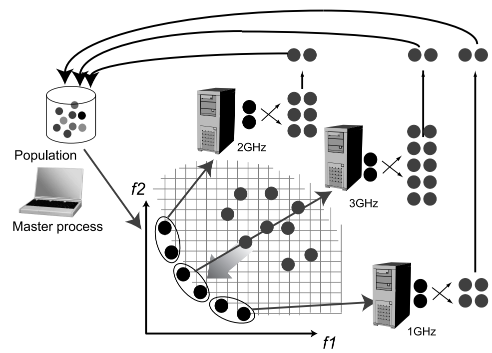

Figure 1: Proposed parallel model

3. NUMERICAL EXPERIMENTS AND RESULTS

We verified the validity of the proposed parallel model through the computational experiment on heterogeneous computational resources using a 4-PC Cluster comprised of PCs that differed in performance. The results indicated that that the proposed model has a high search ability, and was able to utilize the maximum performance of all calculation resources and reduce the overhead time.

A full version of this paper is available at `http://mikilab.doshisha.ac.jp/dia/research/report/2006/0820/011/report20060820011.html`

GECCO'07, July 7–11, 2007, London, England, United Kingdom.
ACM 978-1-59593-697-4/07/0007.