

## CONSIDERATION ON DISTRIBUTED IMMUNE ALGORITHM IN JOB-SHOP SCHEDULING PROBLEM

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**ABSTRACT.** *In this paper, we propose a Distributed Immune Algorithm (DIA) in which Immune Algorithm (IA) is distributed based on the island model, and examine its effectiveness. In the proposed DIA, each subpopulation does not have memory cells respectively but all subpopulations share common memory cells in terms of each subpopulation's cooperating and searching for the solution, because the memory cells in conventional IA are the set of the discovered solutions. In our experiment using ft10, which is one of the benchmark problems in Job-shop Scheduling Problem (JSP) and is composed of ten-jobs and ten-machines, we have shown that our proposed DIA improves "discovery rate of the optimal solution" and "average number of generations for searching" compared with conventional IA with a single population.*

**Keywords:** Immune algorithm, Distributed processing, Island model, Job-shop scheduling problem

1. **Introduction.** The Genetic Algorithm (GA) [1, 2, 3, 4] is an approximate method for obtaining quasi-optimal solutions in optimization problem, which needs many iterative calculations. Therefore, a number of studies have been made on distributed and parallel processing for GA [5]. In addition, the Distributed GA (DGA), that is called island model, is one of the distributed processing models [6].

In the DGA, the population is divided into several subpopulations that are called islands. And genetic operators are independently applied to each subpopulation. Further, a subpopulation transmits individual's information to other subpopulations by the migration of individuals in the subpopulation every several generations.

It has been shown that the DGA can search solution more effectively than Simple GA (SGA) and decrease computation time [7]. Then, coarse-grained parallelization is decided from migration interval and migration rate. The migration interval is the interval of the number of generations to apply the migration. And the migration rate is used to decide the number of antibodies that migrate to another subpopulation from one subpopulation.

On the other hand, it has been shown that Artificial Immune System (AIS) [8] can search a solution at the same level of accuracy as the DGA in Job-shop Scheduling Problem