A Parallel Simulated Annealing Implementation for Uncapacitated Facility Location Problems

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Facility Location Problems, which are generally NP-Hard problems, have been played important role in operation research and manufacturing context. The uncapacitated facility location problem (UFLP) is basically a member of the family of location problems. This problem is also known simple plant location problem. In a general form, the problem is to determine the optimal number of facility echelons, the number and location of facilities in each facility echelon, the assignment of distribution activities / commodities to facilities, and the allocation of customer demand among the facilities. The UFLP has several application, such as bank account location problem, clustering problem, economic lot sizing, vehicle routing, network design, distributed data and communication networks etc.

The modular simulated annealing (MSA) algorithm is the partitioned SA algorithm into shorter slices to be implemented in various configurations together with different methods and environments. The idea behind modular SA is to have a more uniform distribution of random moves along the SA procedure. In fact, SA provides the solution process by a logarithmic distribution of random moves such that each random move starts a new hill climbing process to reach the global minimum. However, the logarithmic nature of this distribution may not help to rescue the solution from local minimum as in the case, when SA is applied to very difficult combinatorial optimisation problems like some of the hard benchmark job shop scheduling and facility location problems. Such problems need more random moves even in the latter part of the optimisation process. But the probability of having a random move at that stage is so low as to make it longer to reach the global optimum. On the other hand, MSA takes such a short time that it can be considered an operation when applied with a context of evolutionary processes, and it can be constantly applied to a particular solution as well as a population of solutions. This algorithm is so modular that it can be implemented into distributed and parallel and evolutionary computation environments.

UFL problems have been studied for many years and thus there is a very rich literature in operations research for this kind of problems. Since they have NP-Hard nature, the larger the size of the problem, the harder to find the optimal solution and furthermore, the longer to reach a reasonable results. Due to these facts, distributed and parallel programming based multi agent implementations will give better results within acceptable time length. So, the aim of this paper is to discuss the usability of a parallel implementation of MSA running on distributed environment like Distributed resource machine (DRM) to solve the large size UFL problems those take longer time to be solved by other serial methods. We get the benchmark problems from OR Library in Beasley (1996).