Utilization of GA and HPSO for allocation: A Systematic Review

Roop Jyot Kaur[1], Rajeev Kumar[2], Reeta Bhardwaj[3]
[1] Assistant Professor Department of Computer Science and Engineering, DAVIET, Jalandhar, Punjab, India
[2] Assistant Professor Department of Information Technologies, DAVIET, Jalandhar, Punjab, India
[3] Assistant Professor Department of Computer Applications, DAVIET, Jalandhar, Punjab, India
[1] erroopjyotkaur@yahoo.co.in, [2]rajeev.daviet@gmail.com, [3]er.reeta@gmail.com

***Abstract*- Allocation affects our daily routine work as it decides the sequence for completion of task. Similarly, it affects output response by sequence of placements. Allocation is a NP-hard problem and has more than one solution. The selection depends on the type of problem to be solved. Allocation deals with placements of jobs (to minimize response time) in execution process, distribution of resources (to use them optimally), space management, data division etc. This paper presents an overview of the techniques (GA and HPSO) of allocation which affect the time and cost for the results based on the placing for execution (scheduling).**

***Keywords* - Allocation, GA, HPSO, cost, response time**

I. INTRODUCTION

Allocation means assigning and sequencing the steps of work. Allocation decides the time taken by the process to solve a particular problem. We can have different solutions to perform a specific task but selection of a particular sequence depends on the objectives to be accomplished (that works as constraints). Allocation affects the cost as well as time. A proportional increase in cost is noted with the increase in time taken to execute a task. The reduction in both by developing a sequence which provides solution for parallel execution of the activities is desirable. Genetic Algorithm (GA) and Hybrid Particle Swarm Optimization (HPSO) can be used for allocation purposes. GA consists of a stochastic, non-linear optimization routines based on theories of biological genetics [1]. Actually, they are exploration algorithms used to search the optimal solution. In GAs, each optimization parameter (xi) is encoded by a gene using an appropriate representation, such as a real number or a string of bits [1]. The parameters are encoded in form of combination of bits to make the chromosome. A population is a set of chromosomes representing on which operation applied to produce new chromosomes. Steps included in GA technique are [1]:

a) Initialize population randomly.
b) Evaluate population on fitness values.
c) Generate new individuals by applying operators.
d) Evaluate the new generated population.
e) Keep the size constant in all populations.

GA is based on three principles of Selection, Crossover and Mutation [1].The advanced version of GA known as Multi-objective GA can also be used for allocation [2],[3]. HPSO is hybrid Particle Swarm Optimization. In HPSO, movement of the particles is decided based on the new updated velocities. The position of the best particles in the population with respect to other particles is the key deciding factor in particle movement. The process is repeated itself for some terminating condition. Quality of solution is improved by hill-climbing heuristic during iterations [4]. Steps in HPSO are as follows [5], [6]:

1. **Initialize.**
   1.1 Generate an initial swarm of *N* particles at random.
   1.2 Generate initial velocities at random.
2. **Repeat until a given maximal number of iterations is achieved.**
   2.1 Evaluate the fitness of each particle.
   2.2 Determine the best vector *pbest* visited so far by each particle.
   2.3 Determine the best vector *gbest* visited so far by the whole swarm.
   2.4 Update velocities V_i
   2.5 Update particle vectors.
   2.6 Improve the solution quality of each particle using the parameter-wise hill-climbing heuristic.

II. RELATED WORK

The authors have described the utilization of hybridized PSO [hybrid of Particle swarm optimization with simulated annealing (SA)] for periodic job shop scheduling problem (PJSSP). To solve the problem for allocating periodic job to schedule with particular sequence of task operations, they have

considered the constraints with the arrival orders. Further, a comparison of the proposed SA and PSO algorithms with branch-and-bound algorithm has been carried out. The research work revealed hybrid PSO-SA as an optimal solution for allocation purposes in PJSSP [4]. In this paper, authors have explained about minimization of query execution in distributed databases design. A detailed discussion regarding allocation of the sub queries to different sites in order to reduce the response time is explained. To resolve the issue, authors have proposed different cost models for the same. Genetic algorithm (GA) has been tested with complex queries and showed that GA produced optimal solutions in lesser time. To solve the problem, two objective functions were considered namely, response time and cost. To reduce response time parallelism of query executions was used and the cost was reduced as per resources utilized [1]. The authors have used HPSO for the task assignment problem in the distributed environment. The task is independent and non-preemptive in nature which is assigned to heterogeneous process. Comparison of the results based on number of iterations between different variants revealed different variants of HPSO provide better results. These results have also been compared with GA to show its effectiveness [7]. HPSO which is Hybridization either with SA (simulating Annealing) or TS (Tabu Search) has been discussed in detail by authors. SA and TS are basically used to improve the quality of solution provided by PSO. The authors considered scheduling based on number of jobs and number of stages for comparison. The authors found HPSO works better and has competitive performance with GA [5]. In a distributed computing system, different modules are allocated to processors with resource constraints. To solve the problem of finding optimal allocation authors used HPSO in task allocation which works on particles experience for movements which is a positive feedback process to the fitness of particles to get solution. Penalty functions are calculated as per constraints. The HPSO embeds a local search into iterations for the convergence [8]. Here the authors discussed GA and PSO for the optimization problems. A is in the parallel nature of search. It implements hill climbing which preserves multiple solutions. Crossover are used to generate new solutions, weak solution are not included because of operators so it will converge in fewer generations. PSO is same as GA but updation occurs on fitness values but no operators are included. Only the best particle provides information and thus is a one way information and is easier to implement as parameters are lesser [9]. A hybrid form of PSO i.e. PSO with TS to schedule the jobs has been discussed by authors in the research work. The idea of hybridization is promising as with TS it will improve the local search possibilities but is a lacunae with PSO. This paper provides information regarding deadlock and their solution with HPSO to increase the effectiveness. The authors have also explained other variants of HPSO [10].

III. CONCLUSION

Both the techniques differ in their utilization. GA can be used where the values closer to exact values are required with lesser time. The convergence is also better in GA .In context of implementation HPSO is better as lesser parameters are to be adjusted.

IV. REFERENCES

[1] Narasimhaiah Gorla, "Subquery Allocations in Distributed Databases Using Genetic Algorithms", JCS&T, Vol. 10, No. 1, pp 31-37, Apr 2010.

[2] Ishtiaq Ahmed, M. Rizwan Beg, Kapil Kumar Gupta, Mohd. Isha Mansoori, "A Novel Approach for Query Optimization for Genetic Population", (1694-0814), International Journal of Computer Sciences, Vol. 9, Issue-2, March 2012.

[3] D. Sundar, B. Umadevi, K Algarsamy, "Multiobjective Genetic Algorithm for Optimized Resource Usage and the Prioritization of Constraints in the Software Project Planning", International Journal of Computer Applications, Vol. 3, No. 3, pp 1-4, Jun 2010.

[4] Amin Jamili, Mohammad Ali Shafia, Reza Tavakkoli-Moghaddam, "A Hybrid Algorithm based on Particle Swarm Optimization and Simmulated Annealing for a Periodic Job Shop Scheduling Problem", Int J Manuf Technol, Sep 2010.

[5] M. Fikret Ercan (2009). Particle Swarm Optimization and Other Metaheuristic Methods in Hybrid Flow Shop Scheduling Problem, Particle Swarm Optimization, Aleksandar Lazinica (Ed.), ISBN: 978-953-7619-48-0, InTech, DOI: 10.5772/6746. Available from:

[6] Ghaemi, Fard, Tabatabaee, and Sadeghizadeh, "Evolutionary Query Optimization for Heterogeneous Distributed Database Systems", World Academy of Science,Engineering and Technology, pp 43-48 2008.

[7] P Visalakshi. (2009), "Dynamic Task Scheduling with Load Balancing Hybrid Particle Swarm Optimization", Int. J. Open Problems Compt Math. Vol. 2, No. 3, Sep 2009.

[8] Peng-Yeng Yin, Shiuh-Sheng Yu, Pei-Pei Wang, Yi – Te Wang, "Task Allocation for Maximizing Relaibility of a Distributed System Using Hybrid Particle Swarm Optimization", The Journal of System and Software (80), pp 724-735, 2007.

[9] Karl O. Jones, "Comparison of Genetic Algorithm and Particle Swarm Optimisation", International Conference on Computer Systems and Technologies, 2005.

[10] Xiaoyu Song, "Hybrid particle swarm algorithm for job shop scheduling problems", School of Information and Control Enineering, Shenyang Jianzhu University China