Proceedings of
INTERNATIONAL CONFERENCE ON COMPUTING, COMMUNICATION AND ENERGY SYSTEMS (ICCCES-16)
In Association with IET, UK & Sponsored by TEQIP-II
29th-30th, Jan. 2016

Paper ID: CSEIT 028

SCHEDULING BASED ON PARTICLE SWARM OPTIMIZATION ALGORITHM: REVIEW PAPER

Sonal Y. Sangale
Department of Computer Science and Engineering
RIT, Sakharale, Islampur (Maharashtra), India
Sonalsangale26@gmail.com

Abstract—Nowadays scheduling problems are raised in areas like industry, academic, health care, production and manufacturing areas and in private sectors also. There are number of modern optimization methods to solve the scheduling problems like GA, TLBO, PSO, and ABC. Particle swarm optimization is one of the latest population based optimization algorithm; it is inspired by the social behavior of nature. This paper gives overview about the scheduling problems solved by using particle swarm optimization algorithm. By reviewing through different author papers, it can be seen that particle swarm optimization gives better performance in terms of time, efficiency and balanced workload, etc.

Keywords— Scheduling, Particle swarm optimization.

I. INTRODUCTION

scheduling is the general concept used in many areas, and the problems related to scheduling are difficult to solve because of some factors like high search space, constrained and dynamic nature and variations in the problem depending on areas and applications [1].Scheduling is the process of allocating or distributing work or workloads and tasks to processor, humans or machines to complete within the time constraint.

To solving the optimization problem, there are various traditional techniques are available but sometimes that are fail to solve the problems containing large no. of parameters and non-linear objective functions. To find the solution on these problems researchers introduced some modern optimization techniques and they become popular day by day.

Some popular evolutionary techniques are, [2][3][4]

Genetic algorithm based on the principle of natural selection and the survival of the fittest. Simulated annealing is probabilistic iterative based method used in applied mathematics. Ant colony optimization is probabilistic Meta – heuristic algorithm inspired by behavior of ants searching for optimal path. Particle swarm optimization is based on the Population and this technique is inspired by the social behavior of animals or insects. Artificial bee colony is one of the most recently defined algorithms, motivated by the intelligent behavior of honey bees. Teacher-learning based optimization: It is based on teaching-learning activity.

By author "Qinghai Bai", *5+ it is proved that, compared with the other evolutionary algorithms Particle Swarm Optimization algorithm is has advantages like simplicity, easy implementation and completed easily and use fewer parameters. Also gives the better results than other algorithms.

II. Particle Swarm Optimization

Particle swarm optimization is a non-traditional, modern optimization method. It is population based, it is inspired by the natural behavior of animals or insects e.g., bird flocking, fish schooling. It is introduced by Dr. Kennedy and Dr. Eberhart in 1995. PSO was developed to solve non-linear optimization problems, but nowadays this algorithm has been used in many areas, real-world application problems.

It is important tool of swarm intelligence and it is inspired by natural behavior of birds and fish movement. Consider the scenario; suppose flocks of birds are searching for food from one location to other location, there is no any leader to that flock. All members follow the one bird which is near to the food source and they are transmitting the information to each other. The flock achieves their best position towards the food source through communication to the member which is near to the food source. This process is repeatedly happens until the food source is discovered. For finding the optimal solution PSO algorithm follows the same process [6].

II. Working of PSO

Algorithm is initialized by random 'n' population, search space and choosing random direction to move. In PSO each particle is called as 'swarm' and that flows through the search

space, adjusting their position by their own best position or with respect to its neighbor's best position towards an optimal solution.

1. Initialize the swarm (n) form the solution space

2. Evaluate the fitness value of each particle. (Objective function)

3. Evaluate individual (Pbest) and global bests (Gbest).

4. Calculate the velocity of each individual particle.

$$Vj = Vj(i-1) + c1r1\ [pbest,j - X\ j(i-1)] + c2r2\ [gbest,j - X\ j(i-1)+\ldots.(1)$$

Where

c1, c2= positive acceleration constants.

r1, r2 = random numbers.

5. Calculate the position of each particle.

$$X\ j(i) = X\ j(i-1) + Vj(i)\ \ldots.(2)$$

Go to step2, and repeat until termination condition

Flowchart of PSO algorithm shows in fig 1.

III. Applications of PSO in scheduling:

A. Task Scheduling in grid computing

In paper [5] author Suraj Pandey, LinlinWu, et.al propose an algorithm called Particle Swarm Optimization for Scheduling tasks in Workflow Applications. In this paper author consider both computation cost and data transmission cost. Here author uses two optimization components

1. Scheduling heuristic – scheduling heuristics calculates the computational cost of all tasks on the resources.

2. PSO steps for task-allocation – after calculating the computational cost PSO is computed for all available tasks and these available tasks are assigns to resources according to the solution provided by the PSO. These steps are repeated until all the tasks in the workflow are scheduled. Here, this heuristics algorithm is used to minimize the total cost of execution of tasks. In this paper results of PSO algorithm are compared with the "Best Resource Selection" (BRS) heuristic algo. By the results it has been seen that PSO algorithm is at least three times cost saving than BRS.PSO balances the load on resources by distributing tasks to available resources.

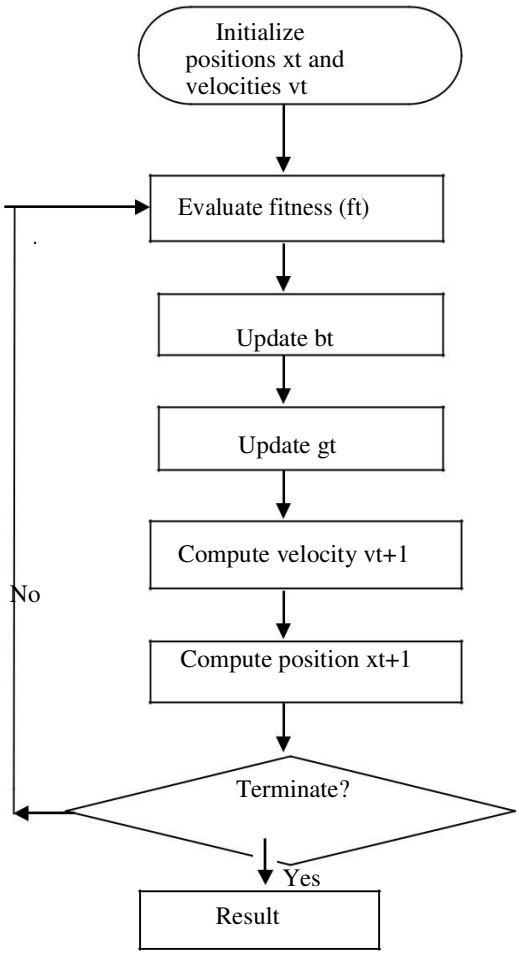

Fig.1 PSO Flowchart

B. Task Scheduling in Cloud Computing

In paper [6] author Lei Zhang, Yuehui Chen et.al represents particle swarm optimization to scheduling tasks in grid computing. In that algorithm each particle shows the possible solution. This approach has aim to get the schedule in minimum time. Here performance of PSO algorithm is compared with the Genetic algorithm and simulated results show that the PSO algorithm gives best results than GA. To solving the problem of task scheduling by using PSO algorithm, author uses the small position value (SPV) rule in the PSO algorithm which is borrowed from the random key representation. Here this approach is used to generate an optimal schedule so the task completed in a minimum time and utilize the resources in an efficient way.

C. Task Scheduling in Cloud Computing Environment

In paper [6] author Ali Al-maamari and Fatma A. Omara propose two new algorithms for scheduling of tasks in cloud computing environments. Task scheduling is the most important thing in the cloud computing because the user has to pay for resource using on the basis of time, which acts to distribute the load evenly among the system resources by maximizing utilization and reducing task execution Time. This paper propose dynamic adaptive particle swarm optimization (DAPSO) algorithm to enhance the performance of basic PSO to scheduling tasks for minimizing make-span and maximizing the resource utilization. Also, another algorithm has been proposed by combining the proposed DAPSO with a cuckoo search (CS) algorithm, called (MDAPSO), to optimize the task scheduling in the Cloud environment to minimize the completion time and increase the resource utilization. By the comparison of PSO, DAPSO, and MDAPSO it is proved that, MDAPSO works better than others in terms of make-span and resource utilization

.

D. Task Scheduling in Cloud Computing Environment

In paper [7] author Solmaz Abdi, Seyyed Ahmad Motamedi et.al compares three heuristics approaches for task scheduling on cloud environment are compared to each other i.e. PSO, Genetic algorithm and modified PSO. In this scenario author considers that number of tasks are more than number of resources so tasks cannot be migrate to different recourses. By the comparative results it can be seen that performance of modified PSO in which SJFP (smallest job to fastest processor) algorithm is merged is better than other techniques in order to improve the performance in terms of minimize time-span to allocate tasks to recourses.

E. Automated timetable generator

In paper [8] author Andeep Kumar et.al propose an automated timetable generator using particle swarm optimization algorithm. There are two objectives in that, First provide a detailed introduction to the topic of timetabling, Particle Swarm Optimization their method and their variations. The second objective is to apply them to the Course Timetabling problem. Author considers four main factors in course timetable problem, i.e. teacher, course, timeslot and classroom. These parameters are already set for this problem. In this approach inertia weight factor is used to find the solution on university course timetabling problem and it is conclude that PSO is better technique to solve the problems like timetabling.

F. Timetable Scheduling

In paper [9] author Shu-Chuan Chu, Yi-Tin Chen et.al states that PSO has good contribution to solve the discrete problems like timetabling problem. Every particle of this method would be self-changed, so particles can take the best positions for the solution and that increases the chance of particles to find a better solution. The rest of the evolutionary approach is iterating many times until it gets optimal timetable. An experimental result shows that PSO gives better solutions on discrete problems of timetabling and there is fewer clashes happened for timetable scheduling.

G. Grid scheduling

In paper [10] author Mr. P.Mathiyalagan et.al adopted a heuristic based particle swarm optimization technique to solve the task scheduling problem in grid environment. By the paper PSO algorithm has better ability of global searching and it applied in many areas. For better performance PSO algorithm is modifying by inertia factor, it produces the optimized results. Inertia parameter is provided with the velocity that controls on the movement of particle and forces to reach the particle at best position of its neighbor. The experimental results show that the modified particle swarm optimization algorithm is able to get the better schedule.

H. Grid resource scheduling

In paper [11] author uses a PSO-based algorithm to effective job assignment in grid environment for reducing the execution time or completion time. In paper author gives the description about grid resource scheduling process. In this algorithm each particle is consider a position in a D-dimensional space and consider a binary value 1 for 'included' and 0 for 'not included', and each particle also has a D-dimensional velocity. Then an ETC matrix [0..(t -1), 0..(m-1)], for a given task heterogeneity and a given machine heterogeneity, can be generated by the range-based method. By this experiment efficiency of PSO algorithm has been proved.

I. Job-shop scheduling

In paper [12] author zufeng zhong proposed improved particle swarm optimization to perform research on flexible job-shop scheduling. Here author describes the traditional and flexible job shop scheduling problem. In traditional job shop problem each task or procedure is assigned to single machine and in flexible job-shop scheduling problem each task or procedure is assigned to several machines. By

introducing the dynamic non-linear factor 'W' in basic PSO algorithm, velocity updating equation is changed. A large number of simulation results shows that this improved PSO algorithm has good feasibility and effectiveness in job-shop scheduling problem than basic PSO algorithm.

J. Task Scheduling In Cloud Computing Environments

In paper [13] author A.I.Awad et.al propose a new modified PSO algorithm called load balancing mutation particle swarm optimization (LBMPSO) .this algorithm is proposed for scheduling and allocating tasks by minimizing the reliability, execution time transmission time make-span transmission cost.PSO has two problems, first is tasks may fail to allocate to virtual machines and other is tasks may allocate to more than one virtual machines. Load balancing mutation parameter is added to the PSO to avoid the problems. To improve the performance in terms of minimize execution make-span, minimize execution time and transmission cost. LBMPSO compared with standard PSO, and it shows that LBMPSO saves make-span, execution time transmission cost. LBMPSO improves the Reliability of cloud computing and good distribution of tasks onto resources compared to other algorithms.

K.Job-shop scheduling

In paper [14] author Wei-jun Xia and Zhi-ming Wu represents a new optimization algorithm based on basic principles of PSO algorithm called HPSO (hybrid PSO). HPSO can be applied to many combinatorial optimization problems by making simple modification in basic PSO. Performance of HPSO algorithm is compared with other evolutionary algorithms; it shown that HPSO algorithm is very effective and efficient. These results indicate that the proposed algorithm is an attractive alternative for solving job-shop scheduling problem and other optimization problems.

L. Dynamic Task Scheduling

In paper [15] author P Visalakshi1, S N Sivanandam propose a method for solving the Task Assignment Problem called Hybrid Particle Swarm Optimization (HPSO). The proposed algorithm is mainly used for dynamic task scheduling. The objective of the proposed algorithm is to schedule the tasks dynamically in a heterogeneous environment. The simulated experimental results show that the Hybrid PSO is effective other variants of PSO. The PSO results of HPSO are also compared with the Genetic Algorithm which is another popular heuristic technique. The results show that the PSO and its variants perform better than the GA.

IV.CONCLUSION

Particle swarm optimization is a global heuristic optimization algorithm, which is a part of swarm intelligence. It is inspired by natural behavior of bird flocking and fish spooling. Brcause of many advantages of PSO, including its simplicity and easy implementation, utilization of few parameters this algorithm can be used widely in the many fields. It can be also used to solve the discrete problems and the many real world engineering problems. By comparing with other optimization algorithms, it can be seen that the PSO method is very simple, can be easily completed and it needs few parameters. By comparing the results of PSO with other evolutionary algorithms it can be seen that PSO outperforms over other algorithms. By literature on scheduling used by PSO it is proved that, PSO gives better results than other evolutionary approach in terms of time ,efficiency.

REFERENCES

[1] Adamuthe, Amol C., Sandeep U. Mane, and G. T. Thampi."Genetic algorithmic approach for security personnel scheduling."Communication, Information & Computing Technology (ICCICT), 2012 International Conference on.IEEE, 2012.

[2] S.elizabethamudhini Stephen,Joe ajay.a "review of ten non-traditional optimization techniques", International Journal of
Mathematics and Computer Applications Research, (IJMCAR), Mar 2013.

[3] Qinghai Bai, "Analysis of Particle Swarm Optimization Algorithm",February 2010.

[4] Rini, Dian Palupi, SitiMariyamShamsuddin, and SitiSophiyatiYuhaniz. "Particle swarm optimization: technique, system and challenges." International Journal of Computer Applications 14.1 (2011): 19-26.

[5] Zhang, Lei, et al. "A task scheduling algorithm based on PSO for grid computing." International Journal of Computational Intelligence Research 4.1 (2008): 37-43.

[6] Al-maamari, Ali, and Fatma A. Omara."Task Scheduling Using PSO Algorithm in Cloud Computing Environments."International Journal of Grid and Distributed Computing 8.5 (2015): 245-256

[7] Abdi, Solmaz, Seyyed Ahmad Motamedi, and Saeed Sharifian."Task scheduling using Modified PSO Algorithm in cloud computing environment."International Conference on Machine Learning, Electrical and Mechanical Engineering. 2014.

[8] Kumar, Andeep, Kawaljeet Singh, and Neeraj Sharma."Automated Timetable Generator Using Particle Swarm Optimization."International Journal on Recent and Innovation Trends in Computing and Communication 1.9 (2013): 686-692.

[9] Chu, Shu-Chuan, Yi-Tin Chen, and Jiun-Huei Ho. "Timetable scheduling using particle swarm optimization."Innovative Computing, Information and Control, 2006.ICICIC'06.First International Conference on.Vol. 3.IEEE,2006..

[10] Mathiyalagan, P., U. R. Dhepthie, and S. N. Sivanandam. "Grid scheduling using enhanced PSO algorithm." Int J ComputSciEng 2.2 (2010): 140-145.

[11] Selvakrishnan, S., and V. Perumal."optimization of grid resource scheduling using particle swarm optimization algorithm."

[12] zhong, zufeng. "research on job-shop scheduling problem based on improved particle swarm optimization." Journal of Theoretical & Applied Information Technology 47.2 (2013).

[13] Awad, A. I., N. A. El-Hefnawy, and H. M. Abdel_kader."Enhanced Particle Swarm Optimization for Task Scheduling in Cloud Computing Environments."Procedia Computer Science 65 (2015): 920-929.

[14] Xia, Wei-jun, and Zhi-ming Wu. "A hybrid particle swarm optimization approach for the job-shop scheduling problem."
The International Journal of Advanced Manufacturing Technology 29.3-4 (2006): 360-366.

[15] Visalakshi, P., and S. N. Sivanandam."Dynamic task scheduling with load balancing using hybrid particle swarm optimization."Int. J. Open Problems Compt. Math 2.3 (2009): 475-488.