Performance Evaluation between GA versus PSO

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Abstract - *Wireless sensor network is a collective arrangement of interconnecting tiny sensor nodes. These sensor nodes are deploy into a physical area for various monitoring purpose, battlefield surveillances etc. These sensor nodes are equipped with a limited battery, processing circuit, transceivers etc. When sensor nodes are in operation, performing their task most of their energy is depleted in improper routing, uneven distribution of traffic load and sometime congestion of traffics or data frames. So in this paper we are proposing two metaheuristic based load balancing techniques GA and PSO and have a comparative result analysis in between them.*

***Key Words*: WSN, Genetic algorithm (GA), Particle swarm optimization (PSO), Load balancing, Optimization, Metaheuristics.**

1.INTRODUCTION

Energy of wireless sensor node is an important characteristic for the whole network to be stay long lasting period. As the nodes energy is depleted faster, nodes will dies earlier and network lifetime of WSN system decrease, whole network will shut down. The cause of nodes energy depletion due to several reasons like as improper routing paths, uneven distribution of traffic loads[5], congestion and hardware problem etc. So for the long lasting stay of WSN system we enhance the nodes energy by some optimizing technique by which energy consumption will be fewer and lifetimes of nodes can be increased. In some recent years, some biological metaheuristic swarm intelligence based optimization technique is proposing their algorithms to optimize the energy or lifetime of WSN system. Swarm intelligence is a computational technique which is inspired from social behaviour of bird flocking, fish schooling, nest building and adopt their behaviour into computational and computer graphics. In this paper we are proposing two load balancing metaheuristic techniques[6] GA and PSO which will minimize the load balancing energy cost value and execution time so as to decrease the energy consumption of sensor nodes and enhance the lifetime of WSN system.

Research Objective

In this paper we are finding the impact of increasing number of iteration and percentage of load distribution on WSN nodes.

1. In first case we are going to minimize the load balancing energy cost and execution time of WSN node by proceeding maximize the no. of iterations and load distributions.
2. In second step we are finding the result analysis by which proposed methodology will minimize the load balancing and execution time of sensor nodes and have a comparison in between them.

II. GA (GENETIC ALGORITHM)

GA is swarm intelligence based metaheuristic technique that minimize the process of natural selection. This technique is used to generate optimal solutions to optimization and search problems. Genetic algorithms belongs to the higher class of evolutionary algorithms (EA), which generate solutions to optimization problems using techniques inspired by natural methods, like inheritance, mutation, selection and crossover.

How GA Works

In a genetic algorithm [2], a population of randomly generated solutions called candidate solutions to an optimization problem is targeted toward a better solution. Each candidate solution has a set of properties which can be mutated and altered for an optimal solution. The process is usually starts from a population of randomly generated solution and with the population in each iteration called a *generation*. For each generation, the fitness value of each solution in the population is evaluated; the fitness value is usually the criteria of the objective function in the optimization which is to be solved for a problem. The best solution is selected randomly from the current population of solution and modified solutions are generated for no. of iterations. The new generation of candidate solutions is then used in the next iteration of the algorithm. Algorithm terminates when either a maximum number of generations or iterations has been reached, or a satisfactory fitness value has been achieved for the population. Once the genetic representation and the fitness function are defined, GA proceeds to initialize a population of solutions and then to improve the solution through the mutation, crossover, inversion and selection operators.

Flow chart

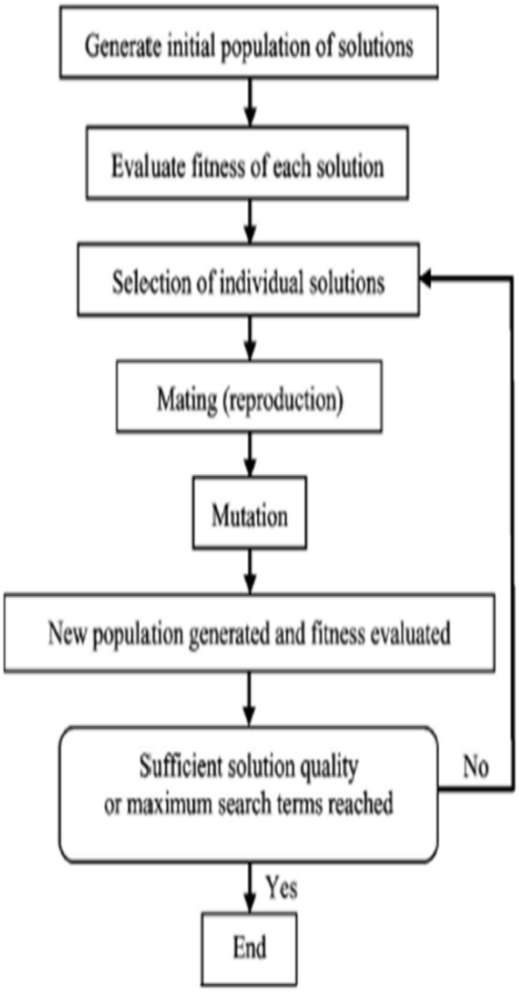

Fig 1: flow chart for GA

III. PSO (PARTICLE SWARM OPTIMIZATION)

PSO (Particle swarm optimization)[7] was provided by Kennedy and Eberhart in 1995. It has origins in the simulation of communal behaviours retaining instruments and thoughts grabbed from computer graphics and communal psychology research

PSO is inspired by the bird flocking and fish schooling pattern of swarms. These two methods developed computer software simulations based on birds flocking around food sources, and then later realized how well their algorithms worked on optimization problems.

How PSO Works

In the PSO Algorithm PSO models social behavior of a flock of birds. It consists of a swarm of s candidate solutions called particles, which investigate an n-dimensional hyperspace in search of the global solution (where n shows the number of optimal parameters to be find out). A particle having position and velocity in a search space. Each particle node is determined through an objective function. The fitness value of a particle node is near to the global solution is lower (higher) than that of a particle that is farther. PSO is to minimize or maximize the cost (fitness) value function. In the global best version of PSO the position where the particle i has its lowest cost-fitness value stored as (pbest). Besides gbest, the position of the best particle node. In every single iteration k, velocity V and position X are evaluated and updated. The update process is iteratively repeated until either a suitable gbest is obtained or a fixed number of iterations kmax is reached.

ADVANTAGE OF PSO OVER GA

1. Genetic algorithm requires some genetic operator like as crossover, mutation, selection etc. but in PSO only few parameter are to adjust, easy to implement.
2. In GA computational cost is very high but PSO minimize this function.
3. PSO is a multicriteria function, check local and global functions but GA checks only present fitness function.
4. PSO have memory to store previous fitness value, GA doesn't.

Flow Chart

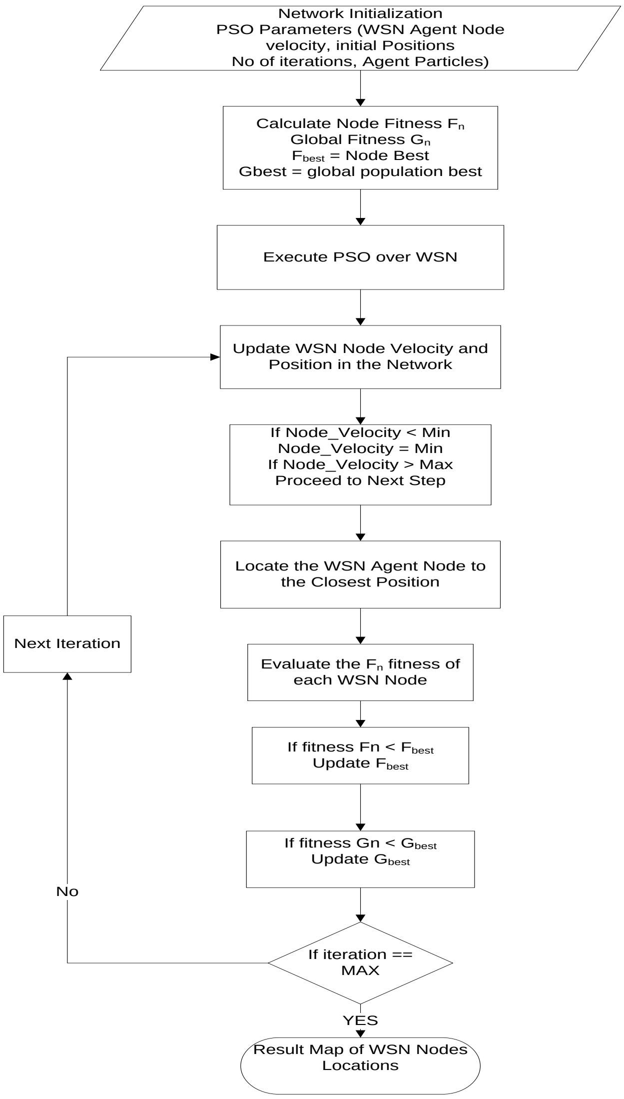

Fig 2: flow chart for PSO

IV. SIMULATION AND RESULT

The results are optimized through proposed load balancing technique using GA and PSO has been simulated with the software MATLAB 2012b.Results are simulated using the parameters load balancing energy cost and execution time of WSN nodes in the following cases:

1. When no. of iterations are changing.
2. When % of load distribution is changing.

Results are optimized in comparison of these two methodologies which technique will minimize the LB energy cost and execution time of nodes to increase the network lifetime of WSN system.

Case 1: when no. of iteration changing

A. Load balancing energy cost GA/PSO

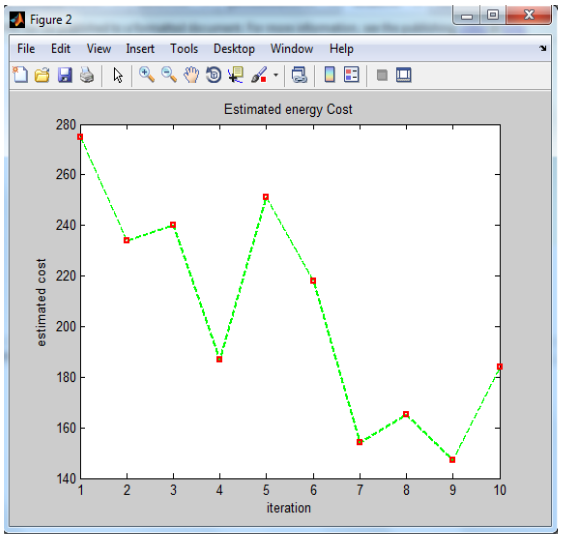

Fig 3: GA energy cost value(10 iteration)

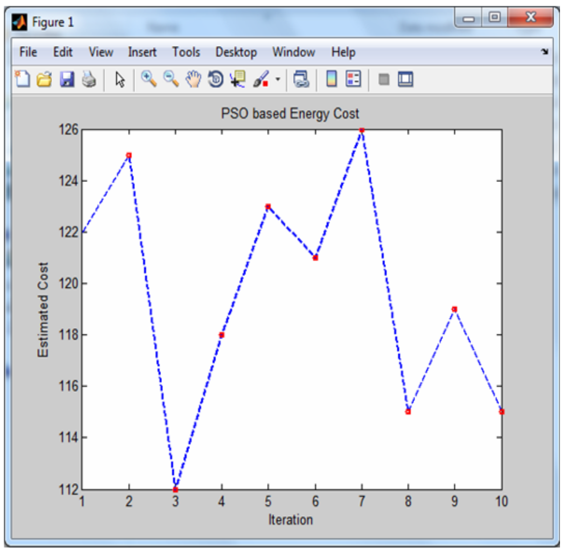

Fig 4: PSO energy cost (10 iteration)

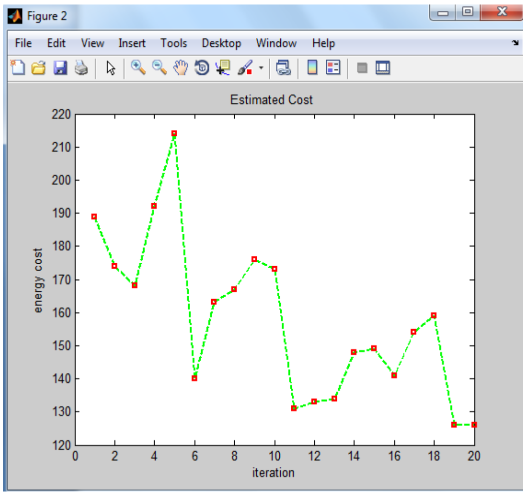

Fig 5: GA energy cost(20 iteration)

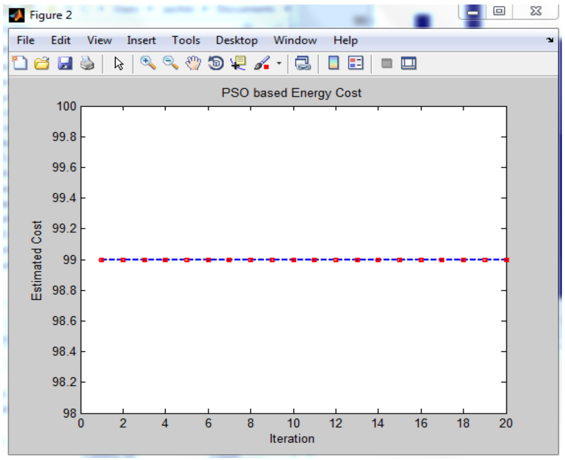

Fig 6: PSO energy cost(20 iteration)

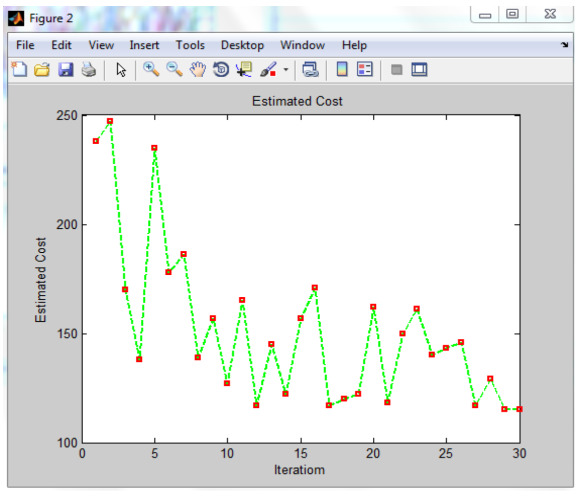

Fig 7: GA energy cost (30 iteration)

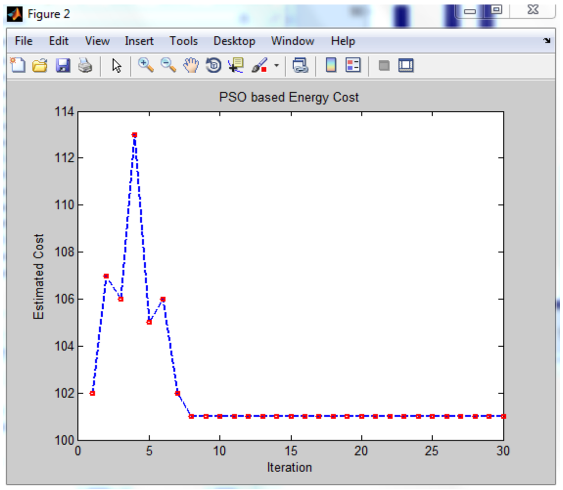

Fig 8: PSO energy cost(30 iteration)

B. Execution time GA/PSO

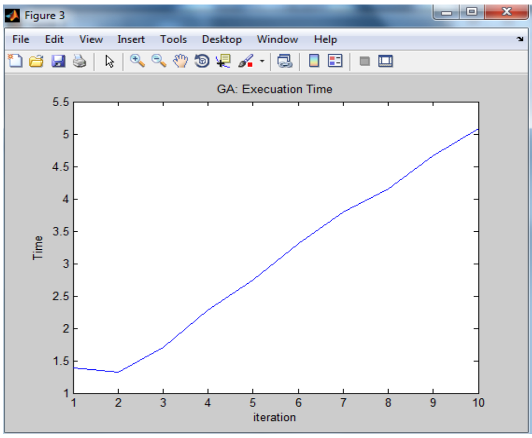

Fig 9: GA execution time(i=10)

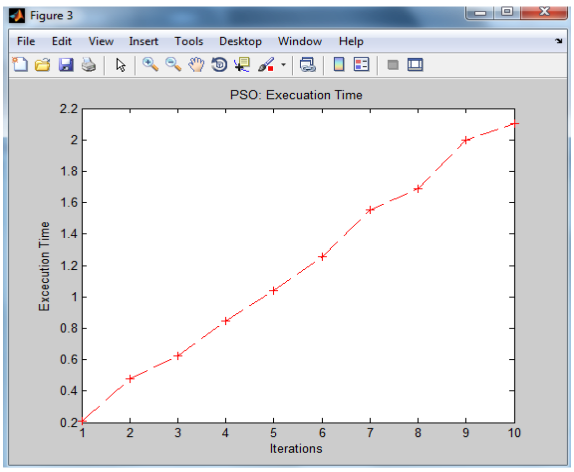

Fig 10: PSO execution time(i=10)

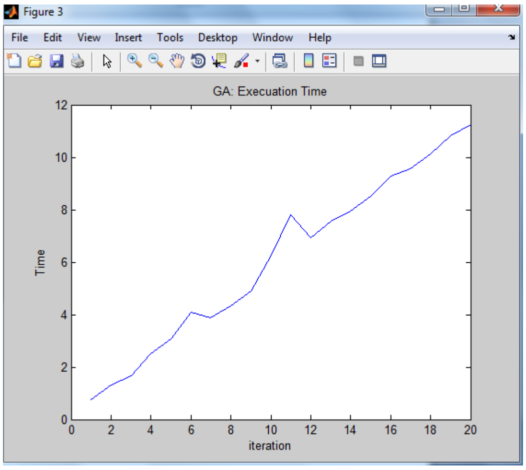

Fig11: GA execution time (i=20)

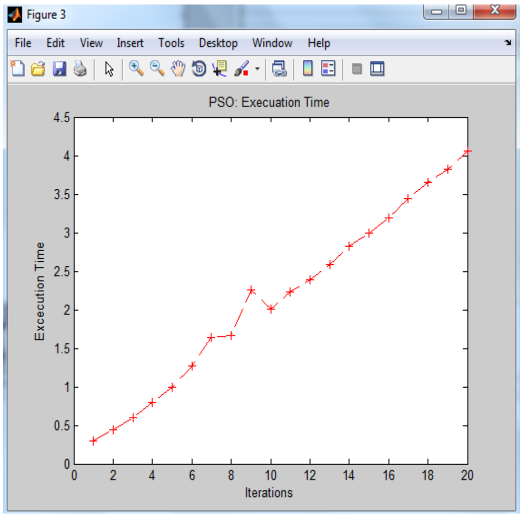

Fig 12: PSO execution time(i=20)

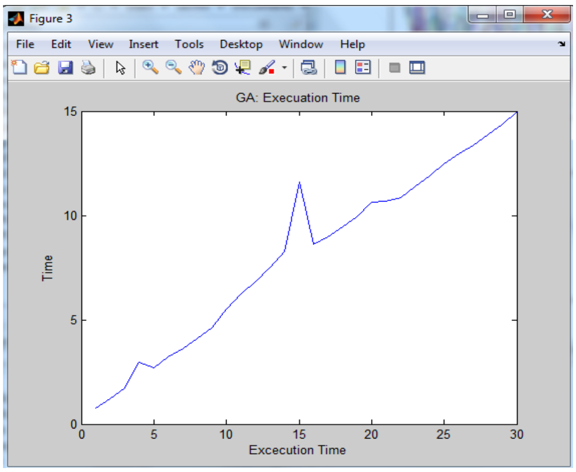

Fig 13: GA execution time(i=30)

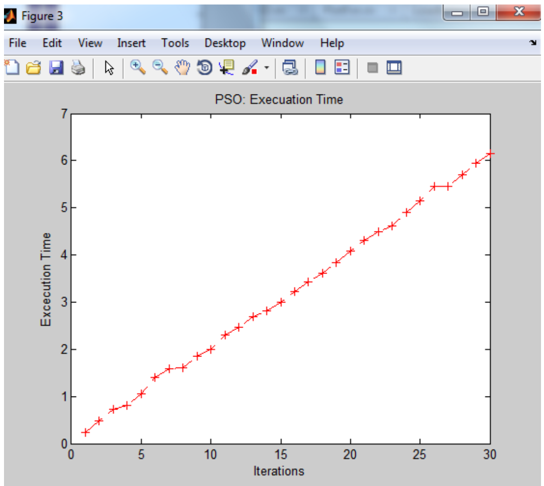

Fig 14: PSO execution time(i=30)

Case 2: when % of load distribution is changing

A. Load balancing energy cost

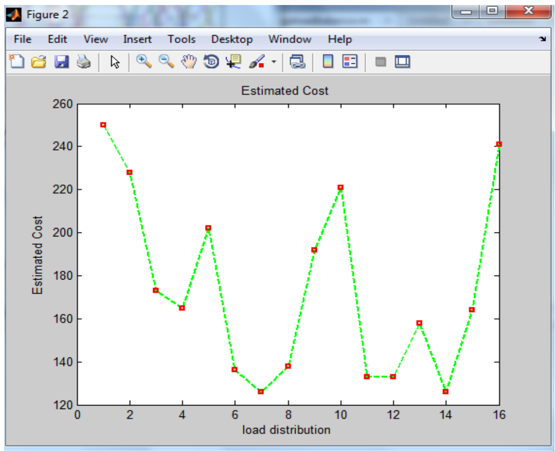

Fig 15: GA energy cost(load=16%)

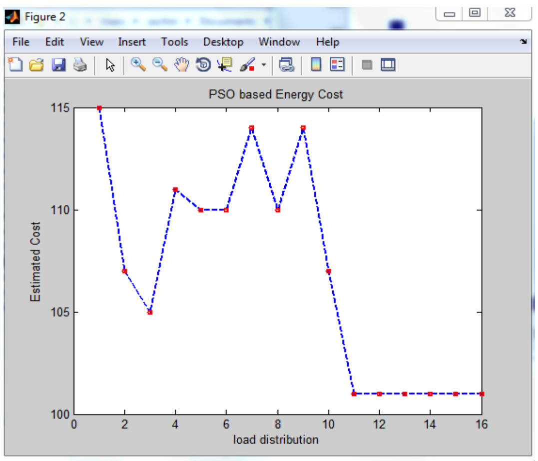

Fig 16: PSO energy cost (load=16%)

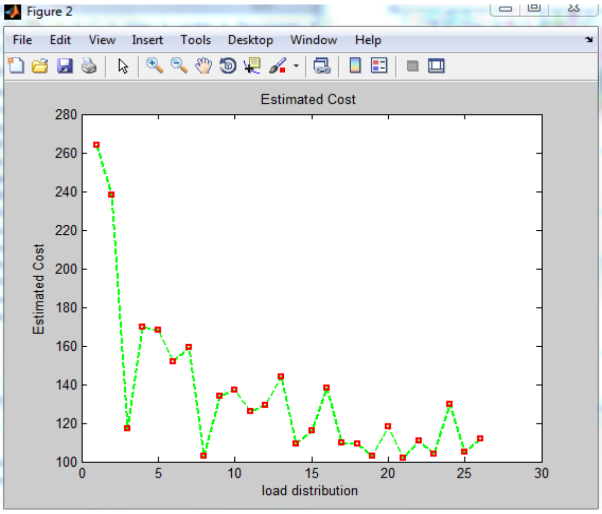

Fig17: GA energy cost(load=26%)

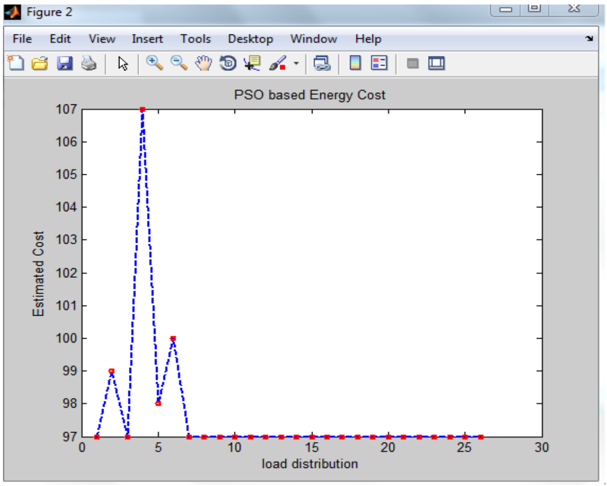

Fig 18: PSO energy cost(load=26%)

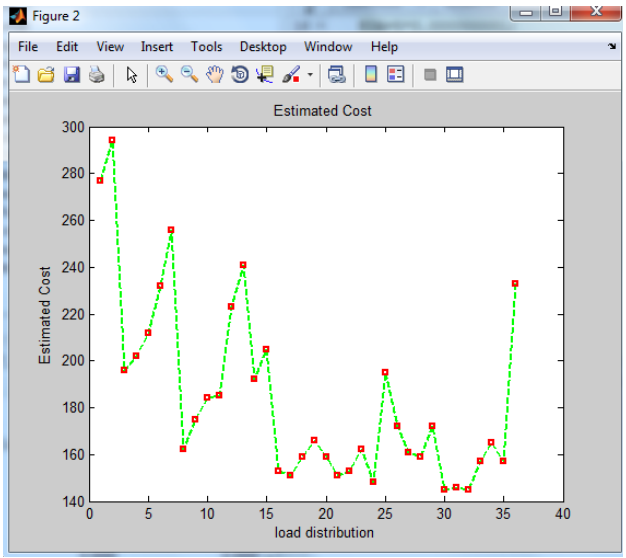

Fig 19: GA energy cost(load=36%)

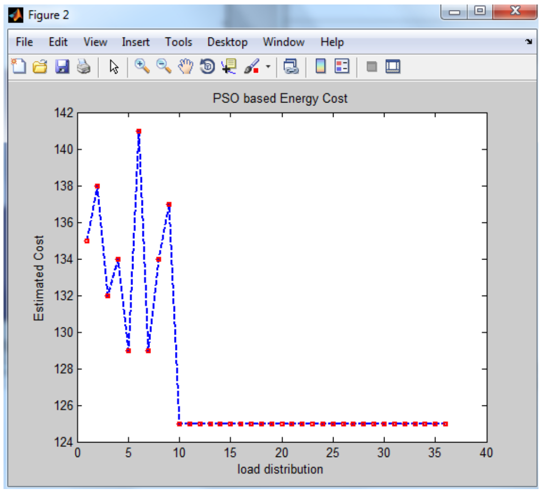

Fig 20: PSO energy cost(load=36%)

B. Execution time GA/PSO

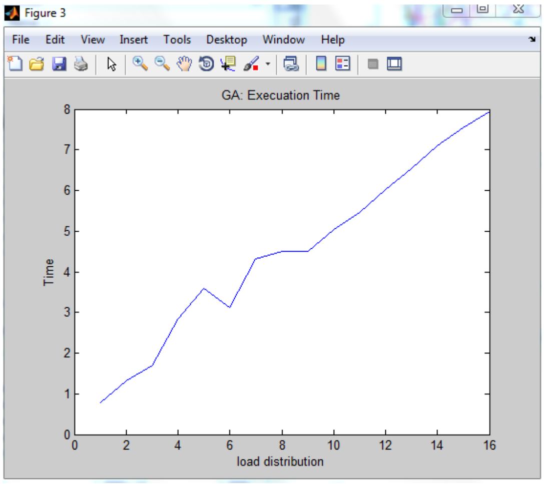

Fig 21: GA execution time(load=16%)

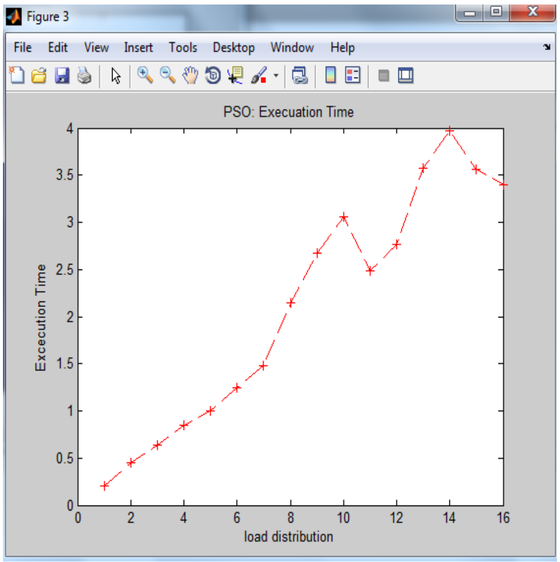

Fig 22: PSO execution time(load=26%)

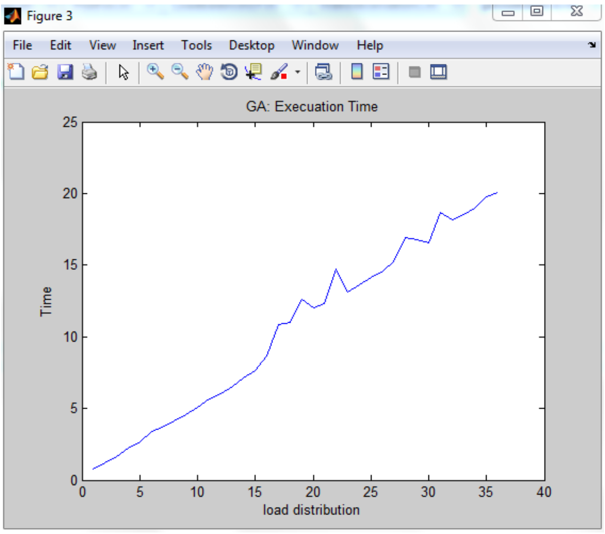

Fig 23: GA execution time(load=36%)

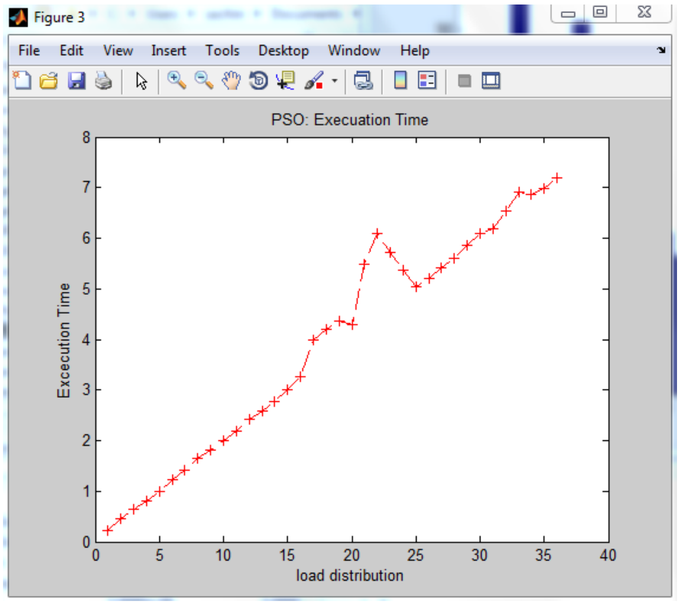

Fig 24: PSO execution time(load =36%)

Case 1	Iteration	LB cost GA (min.)	LB cost PSO (min.)	Exec. time GA	Exec. time PSO
When iteration changing	10	144	**112**	2.79	**1.095**
	20	125	**99**	5.52	**2.18**
	30	125	**101**	7.16	**3.53**

Table 1: for case 1 (no. of iteration changing)

Case 2	Load%	LB cost GA min.	LB cost PSO min	Exec. time GA	Exec. time PSO
When % of load change	16	124	**101**	4.63	**2.26**
	26	100	**97**	6.11	**2.76**
	36	144	**125**	8.46	**3.86**

Table 2: case 2(% of load changing)

V. CONCLUSION

Performance evaluation shows that both the parameters load balancing energy cost and execution time of sensor node are minimized significantly in case of PSO rather than GA. PSO shows best results for increase of no. of iterations and % of load distribution for the WSN nodes.

VI. FUTURE SCOPE

Position of a node is tremendously vital s sensor network. As arranging positioning arrangements, load balancing across sensor nodes is one of the most vital characteristics so that estimated energy cost and execution time can be reduce d for the network. In Upcoming future scope we can work on an agent-based burden balancing positioning algorithm for wireless sensor networks. Also, presentation of the WSN Burden balancing is more maximized if dependencies over tasks are employing Bacterial forging optimization

(BFO) established WSN Configurations also we can additionally examine Managed Diffusion and Burden Aggregation for enhancing energy efficiency.

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BIOGRAPHIES

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