iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** XII **Month of publication:** December 2017

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 5 Issue XII December 2017- Available at www.ijraset.com

DEPSO-"Hybrid Differential Evolution and Particle Swarm Optimization": A Improve Scheme for WSN Node Deployment

Sumit Kumar[1], Dr. R.K. Chauhan[2]
[1]M.Tech Scholar, Dept. of Computer Science and Applications, Kurukshetra University, Haryana, India
[2]Professor, Dept. of Computer Science and Applications, Kurukshetra University, Haryana, India

Abstract: In this paper, we propose a hybrid algorithm. We aim at the overall improvement of the wireless sensor network by using this hybrid algorithm. This algorithm helps in the improvement in the overall performance of WSN by increasing the remaining energy, packets to base station and number of alive nodes it also decrease the number of dead nodes. Extensive simulations show that the proposed algorithm with the random deployment helps in the improvement of the performance of the WSN.
Keywords: WSN, Differential Evolution, Particle Swarm Optimization, Node Deployment, Leach, Sep

I. INTRODUCTION

Wireless sensor network is a network consisting of several numbers of heterogeneous nodes. These nodes are called sensors nodes and are spatially distributed all over the location. These networks are used to monitor physical or environmental conditions such as temp, pressure, sound, vibration at these locations. Wireless communication enables the co-operation of nodes to fulfill bigger tasks that single nodes cannot. Nodes in WSN are densely deployed and are greater in numbers as compared to mobile ad hoc networks. These nodes communicate with each other and pass data along from one to each other from source to sink. Basically Sensor nodes bridge the gap between physical world and the virtual world. Each node consists of processing capability. It may contain many processing units like multiple types of memory, have a RF transceiver. It also has a power source like battery, and accommodates various sensors and actuators.

A sensor network generally consists of several tiny sensor nodes and a few powerful control nodes. These control nodes are also called base stations or sink. Sensor nodes are usually densely set up in a large area and communicate with each other in short distances through wireless communication. Although particular sensor nodes have limited number of resources, they are able to achieve worthy task of big volume when they work as a team member. Information gathered by and transmitted on a sensor network of wireless networks describes conditions of physical environments of the area where the sensor network is set up. Feng Zhao et al [1]present that sensor networks may interact with an IP network via a number of gateways. A gateway tracks the user queries or commands to appropriate nodes in a sensor network. It also directs or routes sensor data, sometimes aggregated and summarized, to users at user end who have requested it or expected to use the information. They present that for optimization in performances and resources such as energy, we may need to reconstruct TCP/IP stack so that our needs and constraints are satisfied[1].

II. PROPOSED WORK

A. DEPSO (Differential Evolution Particle Swarm Optimization)

The proposed work here is hybrid algorithm which combines two algorithms (Differential Evolution) DE and (Particle Swarm Optimization) PSO.

B. Differential Evolution (DE)

Differential evolution algorithm [2] is a novel evolutionary algorithm on the basis of genetic algorithms first introduced by Storn and Price in 1997. The algorithm is a bionic intelligent algorithm by simulation of natural biological evolution mechanism. Its main idea is to generate a temporary individual based on individual differences within populations and then randomly restructure population evolutionary. The algorithm has better global convergence and robustness, very suitable for solving a variety of numerical optimization problems, quickly making the algorithm a hot topic in the current optimization field.

Because it is simple in principle and robust, DE has been applied successfully to all kinds of optimization problems such as constrained global optimization [3], image classification, neural network, linear array, monopoles antenna, images segmentation [9], and other areas[4]. However, DE algorithm can easily fall into local optimal solution in the course of the treatment of the multipeak and the large search space function optimization problems. In order to improve the optimization performance of the DE, many scholars have proposed many control parameters methods [5]. Although all the methods can improve the standard DE performance to some extent, they still cannot get satisfactory results for some of the functions. In this paper, we propose an adaptive parameter adjustment method according to the evolution stage [4].

C. Particle Swarm Optimization (PSO)

Particle Swarm Optimization might sound complicated, but it's really a very simple algorithm. Over a number of iterations, a group of variables have their values adjusted closer to the member whose value is closest to the target at any given moment. Imagine a flock of birds circling over an area where they can smell a hidden source of food. The one who is closest to the food chirps the loudest and the other birds swing around in his direction. If any of the other circling birds comes closer to the target than the first, it chirps louder and the others veer over toward him. This tightening pattern continues until one of the birds happens upon the food. It's an algorithm that's simple and easy to implement.

1) *The algorithm keeps track of three global variables:*
2) Target value or condition
3) Global best (gBest) value indicating which particle's data is currently closest to the Targ
4) Stopping value indicating when the algorithm should stop if the Target isn't found[6].

PSO is initialized with a group of random particles (solutions) and then searches for optima by updating generations. In every iteration, each particle is updated by following two "best" values. The first one is the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value is called pbest. Another "best" value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the population. This best value is a global best and called gbest. When a particle takes part of the population as its topological neighbors, the best value is a local best and is called lbest[7].

III. DEPSO PSEUDO CODE

Designate a candidate solution (agent) in the population is called the *crossover probability*. Let be called the *differential weight*. Both these parameters are chosen by the practitioner along with the population size (see below). The basic DE algorithm can then be described as follows

A. Initialize all agents with random positions in the search-space.
B. Until a termination criterion is met (e.g. number of iterations performed, or adequate fitness reached), repeat the following:
C. For each agent in the population d

D. Pick three agents , and from the population at random, they must be distinct from each other as well as from agent
E. Pick a random index (being the dimensionality of the problem to be optimized)
F. Compute the agent's potentially new position as follows:
G. For each , pick a uniformly distributed number

H. If or then set otherwise set
I. for each particle $i = 1, ..., S$do
J. Initialize the particle's position with a uniformly distributed random vector: $x_i \sim U(b_{lo}, b_{up})$
K. Initialize the particle's best known position to its initial position: $p_i \leftarrow x_i$
L. if$(p_i) < f(g)$ then
M. update the swarm's best known position: $g \leftarrow p_i$
N. Initialize the particle's velocity: $v_i \sim U(-|b_{up}-b_{lo}|, |b_{up}-b_{lo}|)$
O. while a termination criterion is not met do:
P. for each particle $i = 1, ..., S$do
Q. for each dimension $d = 1, ..., n$do
R. Pick random numbers: $r_p, r_g \sim U(0,1)$

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S. Update the particle's velocity: $v_{i,d} \leftarrow \omega\, v_{i,d} + \varphi_p r_p (p_{i,d}-x_{i,d}) + \varphi_g r_g (g_d-x_{i,d})$

T. Update the particle's position: $x_i \leftarrow x_i + v_i$

U. If$f(x_i) < f(p_i)$ then

V. Update the particle's best known position: $p_i \leftarrow x_i$

W. if$f(p_i) < f(g)$ then

X. Update the swarm's best known position: $\mathbf{g} \leftarrow \mathbf{p}_i$

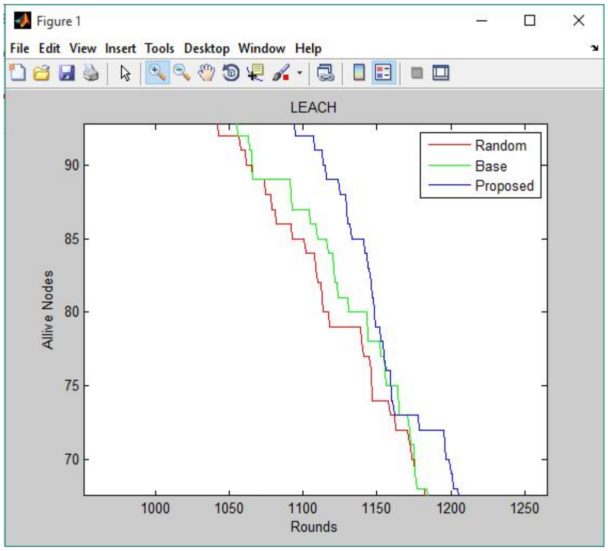
Y. (In essence, the new position is the outcome of the binary crossover of agent with the intermediate agent).

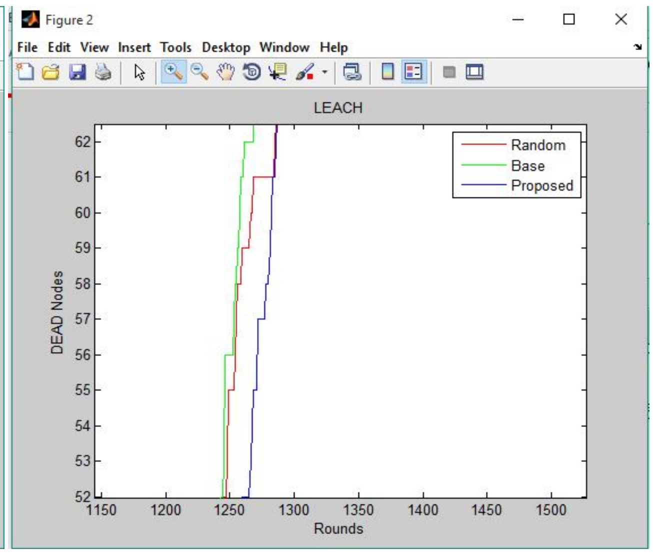
Z. If then replace the agent in the population with the improved candidate solution, that is, replace within the population.

Pick the agent from the population that has the highest fitness or lowest cost and return it as the best found candidate solution.

IV. RESULTS

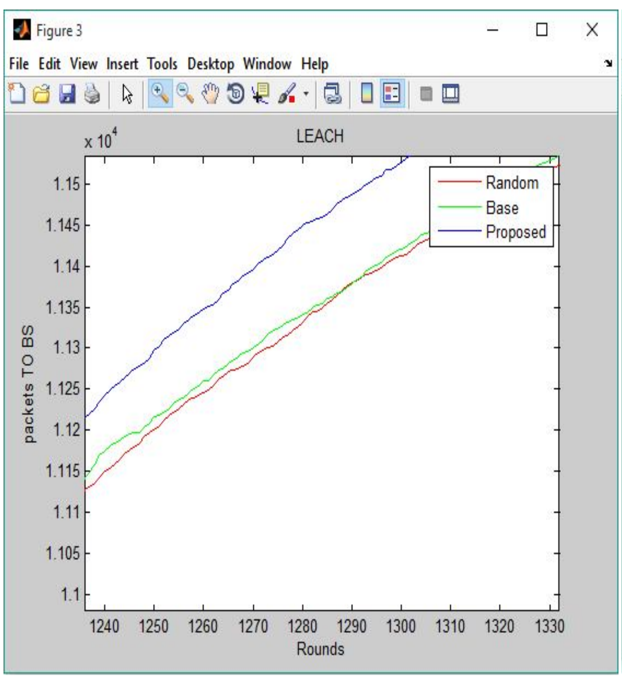
A. Leach

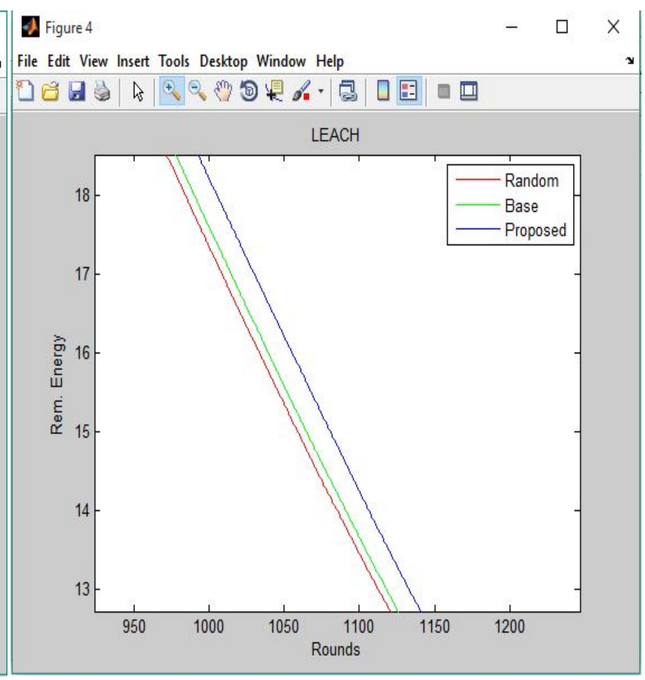




Alive nodes Vs No of rounds

Dead nodes Vs No of rounds





Packets of Base Station Vs no of rounds

Remaining energy Vs no of rounds

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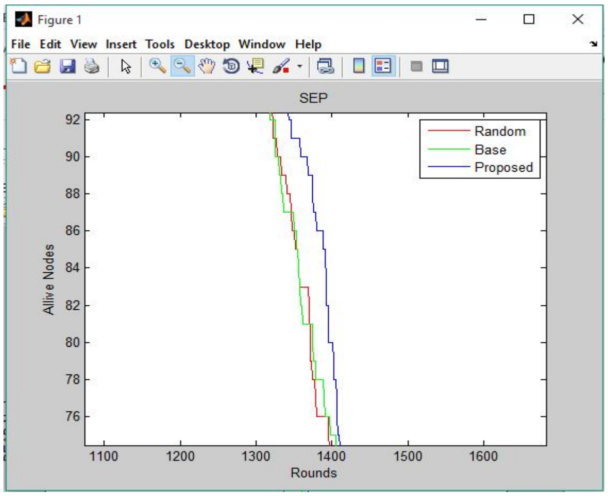
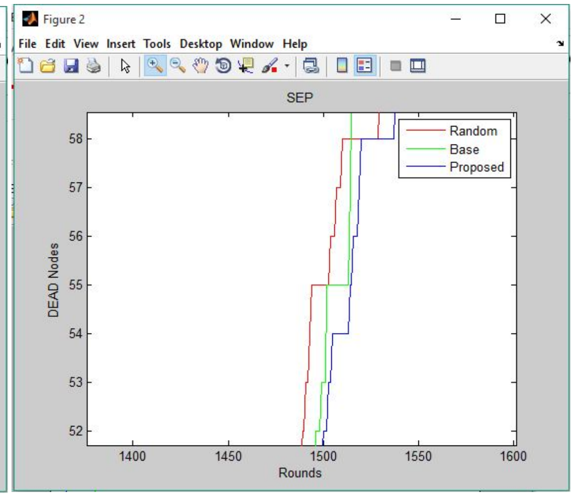
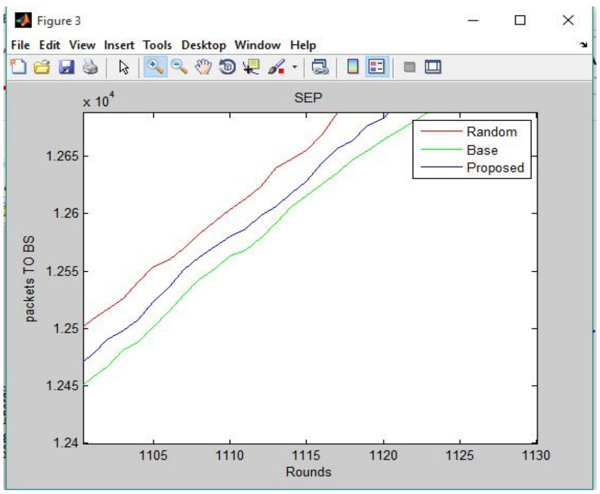
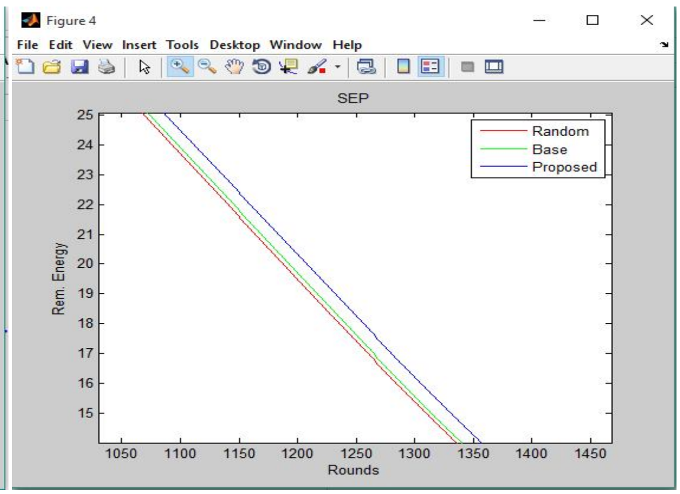
B. EP





Alive nodes Vs No of rounds Dead nodes Vs No of rounds





Packets of Base Station Vs no of rounds Remaining energy Vs no of rounds

V. CONCLUSION AND FUTURE SCOPE

Deployment strategy is one of the critical issues to achieve better network performance in wireless sensor network.

In this paper, we present a new hybrid algorithm for WSN. This algorithm provides a new scheme for deployment by optimizing the random deployment. We define a hybrid algorithm DEPSO a hybrid of DE (Differential evolution) and PSO (Particle Swarm Optimization).The proposed algorithm helps in the improvement of random development and in the overall performance of the network.

We compared by simulation, our proposed algorithm with base paper[8] and standard protocols of WSN, LEACH and SEP. our proposed algorithm helps in increasing the remaining energy no. ofalive nodes, packets to base station and decrease in the no. of dead nodes.

In future work we can improve the execution time of the proposed algorithm and further this algorithm can also be used with other deployment schemes to improve overall performance of WSN.

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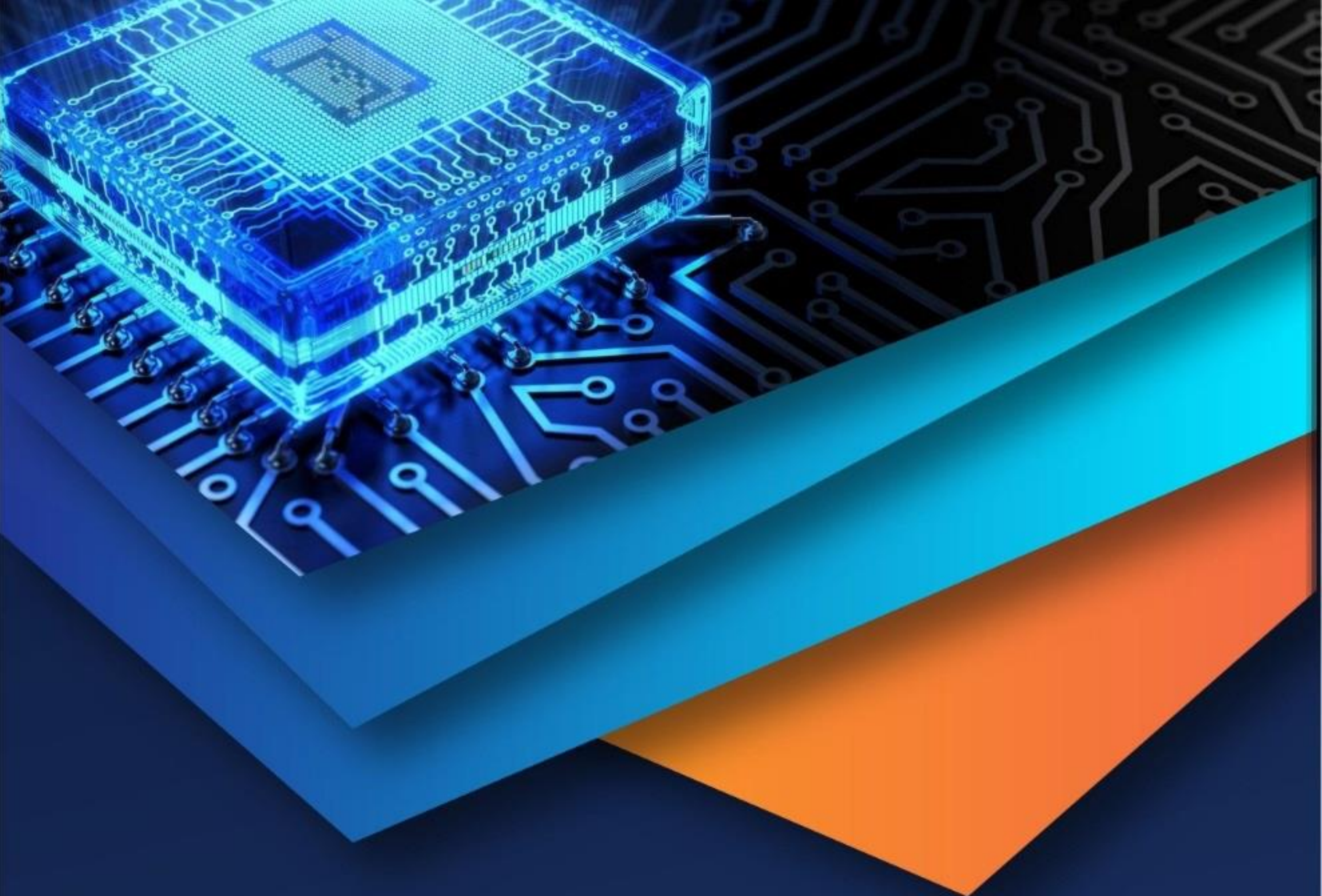

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