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Energy Enhancement in Wireless Sensor Network Using Teaching Learning based Optimization Algorithm

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Abstract: Wireless sensor network requires self-organized and self-managed network such as movable network or temporary network. In this study, network protocol is designed using speed and pass time and developed improved AODV network (IM-AODV network) in Ns-2. wireless sensor network-based energy enhancement using Teaching Learning based optimization algorithm (TLBO) along with Cygwin perform for reduce delay, load and increased energy level of packet delivery fraction. The present study focuses on the energy enhancement of routing network of Pdf, NRL, and Delay.TLBO is an algorithm to adapt the best effort routing in IP networks. Which explores the mechanisms behind the behavior of students, using the shortest way to define a meta-heuristic inspired by teacher for combinatorial optimization. It has been successfully applied to a variety of combinatorial problems. This algorithm was suggested improved AODV (IM-AODV) network is the enhanced the energy network accuracy of 98% of Pdf, normalized load 60.39 %, and 80.12 % of average delay with the optimal parameters of 30 m/s speed and 3s pass time.

Keywords: - *TLBO, wireless network, pass time, regression, accuracy, speed, IM-AODV network.*

1. Introduction

Wireless sensor organization can work in an independent manner or might actually be associated with a bigger organization like the Internet. Remote sensor organization can turn the fantasy about getting associated "anyplace and whenever" into reality [1]. Average application models incorporate a debacle recuperation or a tactical activity. Not bound to explicit circumstances, these organizations may similarly show better execution in different spots. For instance, we can envision a gathering of people groups with workstations, in a conference at where no organization administrations are available. They can undoubtedly arrange their machines by framing an AODV network. For instance, we can envision a gathering of people groups with workstations, in a conference at where no organization administrations are available [2]. An exhibition measurement is that when the worth of data is registered utilizing numerical strategies, it shows that even presentation measurements experts pick estimates the worth [1]. These boundary shows the energy network enhancement in remote organization, whereas Pdf is determined by isolating the quantity of parcel got by objective through the number bundle started from source [14-20]. Normal Delay is characterized as the time taken for an information bundle to be sent across a MANET from source to objective. Normalized Load can likewise be characterized as the proportion of directed bundles to information transmissions in a solitary reenactment. It is the directing over-burden per unit information conveyed effectively to the objective hub [5].

Currently, the researchers are focused on the optimization of roto protocol to achieve best rooting network [3]. In particular, parameters such as speed and pass time affect the Pdf, normalized load, and average delay of the mobile AODV network. The majority of the optimization techniques were implemented to achieve the best network on mobile routing. In addition to adjusting algorithm specific parameters, it is also necessary to tune common control parameters, which further increases effort. In this way, there is a need to foster a calculation that doesn't need calculation explicit boundaries, and TLBO is such a calculation. In TLBO, instructive reasoning is consolidated together to see all techniques from instructor to student, and from educator or student to carry out the best system or accomplish ideal outcomes [3-4]. The current work centers around the improvement of energy network precision utilizing TLBO to assess the bundle conveyance proportion, standardized burden, and parcel conveyance. To utilize the impact of speed and sit back of the distinctive

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directing cycles the information is introduced in Table 1. The TLBO procedure is utilized to improve speed and relax to accomplish better organization course convention. TLBO has been displayed to beat exploratory examinations.

2. Related Works

The ideal number of cluster heads in a sensor field is determined by using the teaching learning-based optimization (TLBO) method introduced by Amita Yadav et al.,[21]. This method aims to improve the longevity of networks by decreasing their energy needs. The suggested approach, termed LEACH-T, incorporates the LEACH protocol and takes into account the residual energy while choosing the CHs. A closer look at the simulation data reveals that the suggested method extends the lifespan of the network by decreasing the amount of energy needed to send packets. Furthermore, it is shown that the suggested method is a powerful and efficient tool for choosing CHs.

To handle discrete solutions, M.Masdari et al. [22] introduced a new discrete version of the TLBO method, which uses the swap and mutation operators. To cut down on power consumption, a hierarchical energy-aware clustering strategy was developed for WSNs using the cutting-edge algorithm. In addition, a local search algorithm that takes energy and distance into consideration was supplied to increase the network's durability. Extensive simulations are run to show that this technique is successful in decreasing sensor node power consumption and increasing WSN lifespan.

Energy-efficient coverage optimization was developed by Aparajita Chowdhury et al.[23] using the Voronoi-Glowworm Swarm Optimization-K-means method. Improved coverage with fewer active nodes is achieved by the use of Glowworm Swarm Optimization, the K-means method, and the Voronoi cell structure. This method takes into account the computation of the optimal sensing radius for effective sensor placement. Further, by minimizing the energy required by the installed sensor nodes via multi-hop transmission and the sleep-wake mechanism, the suggested technique extends the lifespan of the deployed network. The simulation results demonstrate that, with the optimal number of active sensor nodes, the suggested technique achieves area coverage of up to 99.99%.

An effective method of content delivery in mobile ad hoc networks was presented by Mahendra Maiti et al., [24]. Each node in the network is given a fitness rating based on its bit rate, energy, and delay tolerance. The top-scoring nodes in terms of fitness are chosen to serve as cluster leaders. Once the nodes meet an energy requirement, only then is it calculated using a teaching-learning-based optimization approach. In order to build the clusters of nodes, the remaining nodes are given to the cluster leaders. It is possible for the cluster leaders to receive the necessary packets from the base station through long range communication and then relay them to the cluster members. This method reduces the amount of power a network needs to function efficiently, extending its useful life. The experimental findings demonstrate the superiority of the suggested method over K-means Clustering and U+M approaches in terms of decreased energy usage and increased network lifespan.

Improved convergence speed of ASO was suggested by S.Barshandeh et al., [25], who made use of chaotic maps with Levy flight random walk. Furthermore, the tree-seed algorithm (TSA) is used with ASO to strengthen its exploratory and exploitative capacities and strike a healthy balance between them. TSA is a novel intelligent meta-heuristic algorithm with a respectable exploratory capability, and it was inspired by the development of trees and the dispersal of their seeds. Additionally, the suggested hybrid algorithm has been modified with a new method to address the issue of moving away from local minima. We further verify the efficacy of our contributions by using the proposed hybrid method to a large collection of benchmark functions that include unimodal, multimodal, fixed dimensional, shifted-rotated, and composite forms. In terms of descriptive and inferential statistics, the acquired findings have been compared with those of a number of other recent and strong meta-heuristic algorithms. Seven actual engineering issues are used to put the algorithms through their paces. The experimental results validated the usefulness of the suggested hybrid algorithm and its superiority over similar alternatives.

In order to facilitate clustering and mobility based software-defined wireless sensor networks, L.Sixu et al.,[26] developed a particle swarm optimization and artificial bee colony technique. The software-defined-network architecture is used to lessen the burden on sensor nodes' resources (both electrical and computational). Cluster routing technique based on particle swarm optimization is used to determine cluster heads and base station resting places. A traversal route algorithm inspired by the behavior of artificial bee colonies is utilized to plan the relocation of the base station. The suggested protocol has lower energy requirements, longer network lifetimes, and lower control overhead than competing solutions.

In order to achieve energy efficiency, P. Baskaran et al. [27] suggested a new method of clustering that uses MapReduction to control mapping and simplify routing processes in order to do away with unnecessary duplication and overlap. This study takes into account intelligent behaviors' to adjust with network changes and add computational intelligence capabilities to

maximize the network's performance. Target node locations and node upgrades are evaluated in terms of energy consumption in the proposed study using better teaching-learning-based optimization. Modifying the Hop size of nodes is an integral part of node upgrading, which is accomplished by including Map reduction. The complexity of communication is simplified by this variant.As a result, reliability is improved and the lifespan of the network is prolonged. Here, we take into account sleep and wake-up nodes for data transmission and compare them to current methods of doing so. The suggested approach is clearly superior to conventional models, increasing nodes' lifespan by 50%, residual energy by 16%, and throughput by 12%. The average waiting time, average queue time, and average energy use have all decreased by 30%, 20%, and 46%, respectively, over time.

For worldwide optimization issues, Barshandeh and Saeid [28] introduced a novel LA-based hybrid optimization technique. The suggested approach improves upon the strengths while minimising the drawbacks of the artificial Jellyfish search algorithm (JS) and the Marine Predator Algorithm (MPA). In addition, the LA's performance is improved by augmenting the vector of probabilities used in the algorithm. The suggested LA mechanism is then applied to a redesigned version of the JS and MPA algorithms. On 38 low- and high-dimensional benchmark functions, the proposed LA-based hybrid is statistically and graphically compared against state-of-the-art techniques. Additionally, the effectiveness of the suggested LA-based hybrid algorithm is examined by way of analysing its application to the issue of data clustering. Ten datasets are used to evaluate the proposed method against other algorithms in the field using a number of different measures. Through experimental verification, the superiority of the suggested LA-based hybrid algorithm became clear.

The suggested approach by M. Eslami [29] is evaluated against a standard set of test functions and compared to the results of the industry-standard sperm swarm optimization (SSO) and other robust metaheuristics. Power system stabilisers (PSS) and thyristor-controlled series capacitor (TCSC) controllers are developed for a 5-area, 16-machine system to show the viability and efficiency of the suggested approach in power systems. Using a nonlinear time-domain simulation, the effectiveness of the proposed controllers is measured on a multi-machine power system in a number of realistic scenarios. The findings show that compared to SSO and other competing algorithms, MSSO is superior and may provide more optimum solutions. The numerical findings show that the modified algorithm (MSSO) converges more quickly than the other approaches when applied to the damping oscillation issue.

As a range-free, distributed localization technique for wireless sensor networks, Gaurav Sharma [30] introduces MDV-TLBO, a variant of the Modified Distance Vector Hop algorithm that makes use of Teaching-Learning-Based Optimization (WSN). As part of the suggested technique, a correction factor is applied to the hop size of the anchor node. In this study, the idea of collinearity is proposed to help lessen the impact of location inaccuracies brought on by identical anchor nodes. To improve localization precision, TLBO is utilised, which is a parameter-free, effective optimization method. Following a location upgrade operation, the target nodes make an estimate of their final coordinates. The MDV-TLBO protocol only requires a single communication between anchor and target nodes to broadcast the former's position. Energy consumption of the nodes has been greatly lowered as a consequence of target-node-level hop size adjustment, optimum selection of anchor nodes, location optimization, and location upgradation. Radio irregularity model is taken into consideration to demonstrate the practicality of the suggested method. The simulation results demonstrate that our proposed method outperforms the state-of-the-art enhanced DV-Hop algorithms in terms of localization accuracy, positioning coverage, and energy efficiency.

3. Propsed Methodology

The present work is implementation of optimization of parameters such as speed and pass time. The different protocols such as AODV and AODV rmed to improve the Pdf, NRL, and delay using TLBO. In this progression, an underlying populace utilizing the organization information creates limitations as indicated by Pdf, NRL, and postponement. The new interaction factors and their related reactions are gotten utilizing the idea of diff_mean. Individual and by and large requirements are assessed for all organizations and arranged. The underlying populace and new populace are joined to get the best arrangement dependent on the position.

Mapping in node and student relation

Here, we consider student as a node and teacher as a head node.

Teacher interact with the class students and students get the knowledge from the teacher.

*There are two ways of getting the knowledge

- Student interact with teacher for knowledge
- Student interact among them self for getting knowledge or other source

student work as a node and communicate with teacher who work as a head node Teacher or higher authorities

work as a base station. Student work as a node and get the knowledge from head node (Teacher). Student (node) get the knowledge from another node and head node.

- Student fitness can be calculated by using exam mode similarly node fitness can be calculated on the basis of accuracy of data transfer is given time
- Teacher fitness can be calculated on the basis of student's feedback similarly head node fitness can be calculated on the basis of node transfer data accuracy.

Experimental Procedure

The energy network enhancement in wireless network was concentrated on the present study. The routing protocol with 20 nodes and initial population size of 50 with a variable size of 10 using AODV and AODV black hole network. Each network started with a new set of parameters and the response values are presented in Table 1.

Table 1. Input parameters and route protocol accuracy percentages

Speed (m/sec)	Pause time	AODV			AODV -**Black hole**		
		Pdf (%)	NRL (%)	Delay (%)	Pdf (%)	NRL (%)	Delay (%)
10	1	82.85	93.475	57.775	59.1413	83	32.15
20	2	86.45	67.575	52.675	57.6013	63	48.55
30	3	89	53.425	56.825	58.3988	48	53.95
40	4	88.15	51.025	70.225	61.5338	48	48.35

Metaheuristic Optimization

The present study introduces a new incorporated technique for multi-response optimization of pass time and speed with TLBO [5]. This technique has been used to enhance network energy. Parameters such as pass time and speed with different routing protocols and their impact of Pdf, NRL, and delay were studied. The Speed, pass time and network route are considered to directly affect the energy. When a combination of parameters produces a little energy enhancement and subsequently affected and it affects the best root network with quality enhancement in energy network as well as Pdf, NRL, and delay. Numerical models are created according to the point of view of interaction boundaries that are utilized to concentrate on the impact of AODV, and AODV dark opening. These models can likewise be utilized to characterize the genuine capacity for the improvement of interaction boundaries [6-13]. The objective functions for Pdf, NRL, and delay for the AODV and AODV black hole were generated using MINITAB19 software and are shown in (1) to (6). The present study focuses on the energy enhancement of routing network of Pdf, NRL, and Delay.

$$Pdf = 76.44+0.741*speed-0.01113*speed*speed \quad (1)$$

$$NRL = 131.1-4.353*speed+0.05875*speed*speed \quad (2)$$

$$Delay = 72.13*-1.898*speed+0.04625*speed*speed \quad (3)$$

$$Pdf = 63.02-0.5046*speed+0.01169*speed*speed \quad (4)$$

$$NRL = 115.50-3.700*speed+0.0500*speed*speed \quad (5)$$

$$Delay = 4.750+3.290*speed-0.05500*speed*speed \quad (6)$$

The first three equations (1-3) are related to AODV and the second equations (4-6) are belongs to AODV block hole network. The regression analysis was performed to this two networks. From this the R-sq value of 99% was obtained. The constraints for the both cases are considered as 10, 20, 30, and 40 m/sec of speed and 1, 2, 3, and 4 as a pass time for energy optimization in network analysis. From the response surface methodology a new combinations of parameters and routing protocol equations were obtained to improve the energy of a network named as Improved AODV (IM-AODV). The regression values of new combinatory parameters are presented in (7) to (9). In this the pass time was not influenced any manner, speed only effected the process.

$$Pdf =71.75+1.815*speed-0.03250*speed*speed \quad (7)$$

$$NRL = 120.6-2.958*speed+0.0363*speed*speed \quad (8)$$

$$DELAY=70.63- 0.3125*speed + 0.01375*speed*speed \quad (9)$$

The results of this response equations are presented in Table 2.

Table 2: The IM-AODV combinatory values

IM-AODV				
Speed (m/sec)	Pause time	Pdf (%)	NRL (%)	Delay (%)
10	1	87	95.5	68.875
20	2	94	73.5	69.875
30	3	98	67	73.625
40	4	92	59.5	80.125

From, the results the relationship between input and responses are plotted and presented in Figure 1.

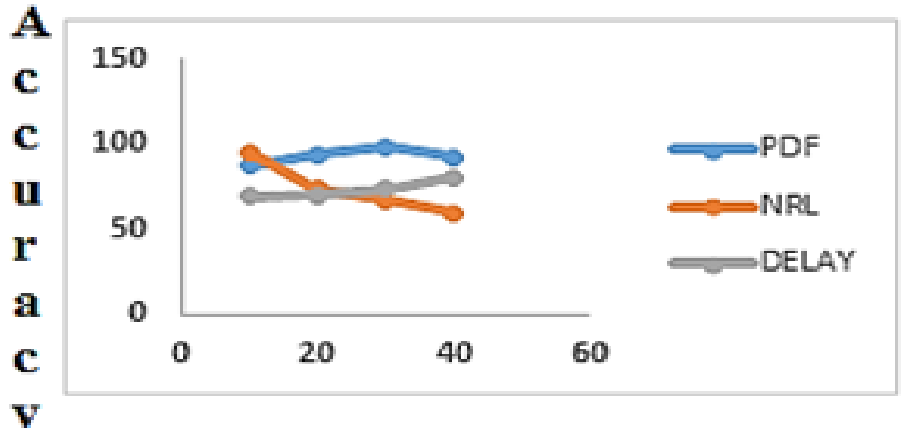


Fig. 1 IM-ADOV schematic representation

After this optimization process was initiated by TLBO. The TLBO code was implemented on MATLAB software for getting the best accuracy values with a good combinatory process values [13]. The TLBO was categorized into two stages, such as Teaching phase and learning phase [11]. In a teacher phase the initial population was taken and individual intercepts for energy were calculated using (7) to (9) equations based on parameters as a constraint. The difference mean was calculated for speed and pass time. In the first rank experiments with process variables, which required the creation of new objective values and new process parameters to obtain constraint values with a random number [5]. The difference means is calculated as follows:

Difference mean =RX(x-y)

To get a new process variable for the further experiments, the difference values are added to the initial process variables and the values. Then, teaching factor was added to the process values, and collect best values for learner phases. The learner phase was initiated and collected best parameters and their response values

.

Pseudocode code

Input : Fitness function lb, ub, N_p ,T

I. Initialization a random population (p)

II. Evaluate fitness of P

III. For t=1 to T

For i= 1 to N_p

Choose X_{best}

Determine X_{mean}

$X_{new} = X_i + r (X_{best} - T_f X_{mean})$

Bound X_{new} and evaluate its fitness f_{new}

Accept X_{new} *if it is better than* X_i

If $f_i < f_p$

$X^i_{new} = X_i + r\,(X_i - X_p)$

else

$X^i_{new} = X_i - r\,(X_i - X_p)$

end

Bound Xnew and evaluate its fitness fnew

Accept Xnew it is better than Xi

end

end

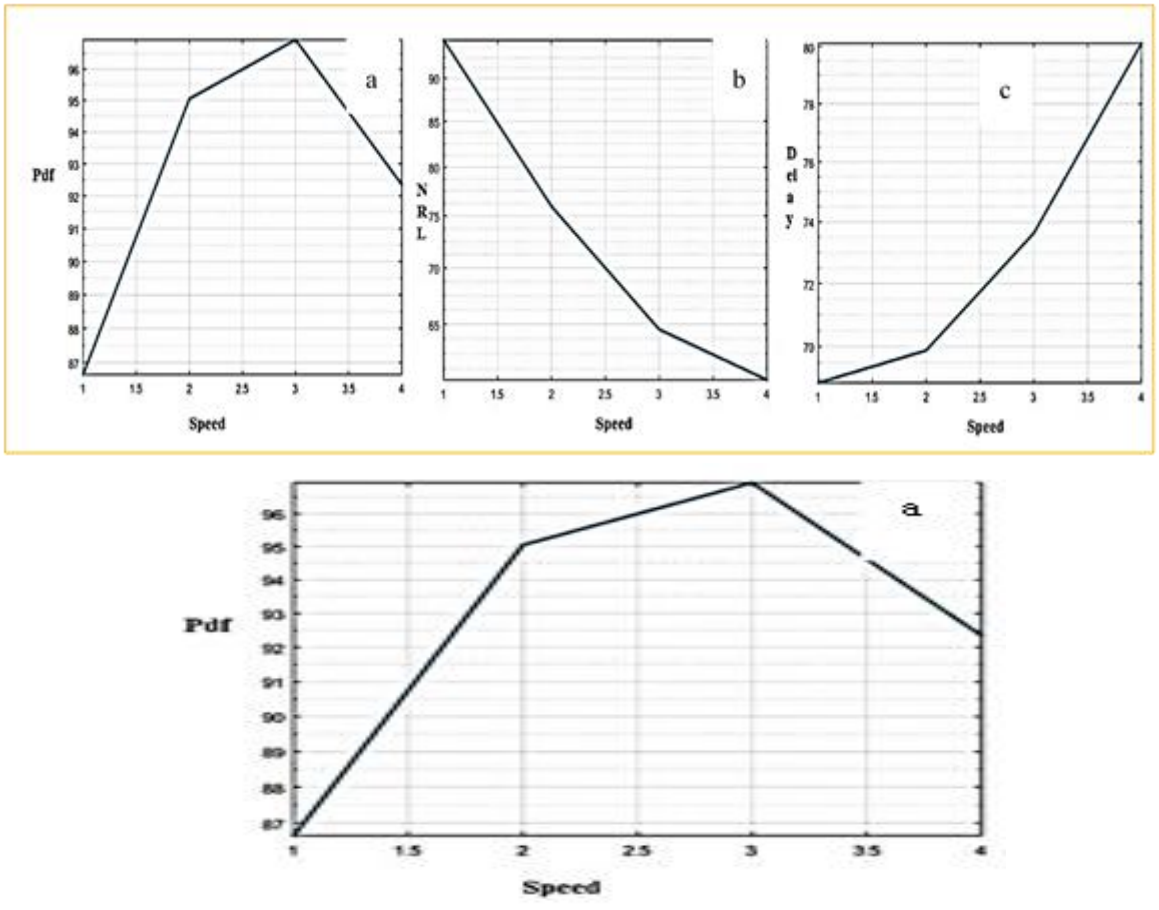
4. Results & Analysis

After implementation the best combinatory parameter values were obtained and presented in the following Table 3.

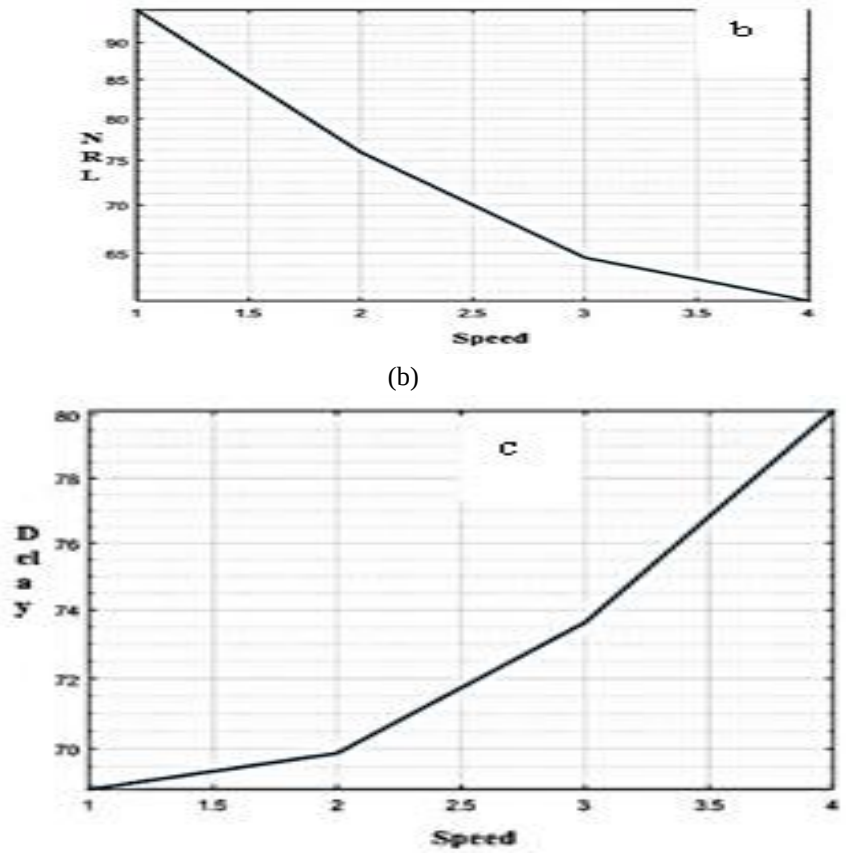
Table 3. Optimized results of TLBO algorithm

Speed (m/sec)	Pass time	Pdf (%)	NRL (%)	Delay (%)	Protocol
30	3	98	60.32	80.12	IM-AODV

The combinatory values of all parameters and enhanced energy values are plotted individually shown in Fig. 2.



(a)



(b)

(c)

Fig.2 Surface plots for Im-Adov

The plots clearly representing the energy enhancement of the wireless network. The packet delivery was represented in Fig. 2 (a), the speed influenced the packet delivery. When the speed increased the packet delivery also increased, after reaching the optimal speed the packet delivery ratio was decreased. Alike when the man as a employee working for a long time the man loss his patience and the output will decreased, the initiation time of the work the employee waste some time to analyze the work. So, at mid the work was enhanced by the employee. Similarly, packet delivery ratio also varied with speed. The maximum packet delivery obtained at a speed of 30 m/sec, and pass time of 3, which gives 98 % accuracy. The ratio of Pdf is 3.23 compared to other routing protocols such as AODV, and AODV block hole. Similarly, Fig. 2 (b) represents the normalized load of mobile network, in which speed increased and the NRL was decreased. Alike, in Fig. 2 (c) represents the delay time was also decreased while speed increased. The combinatory results give enhanced energy network by TLBO compared other algorithms.

5. Conclusions

TLBO is a technique and AODV is a Method. AODV values we solved with the help of TLBO. Due to the best combination of optimized parameters, we obtained a best result. From the study, we examined the AODV and Black Hole in an AODV Networks in NS-2. The TLBO algorithm was used for optimization process. The algorithm suggested combinatory parameter values for routing protocol. In this study improved AODV network was developed instead of AODV and AODV block hole. The improved AODV network improved the Pdf accuracy as 98% and decreased a NRL of 60 %, and delay time was reduced to 80.12 % compared to AODV, AODV block hole network protocol.

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