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PERFORMANCE ANALYSIS OF OPTIMIZATION OF HOM AND CDR SOLUTION USING PSO

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ABSTRACT
Long-Term Evolution (LTE) is standard for wireless broadband communication that is utilized in mobile devices and data terminals. Handover procedures are considered the major function of LTE nodes. Handover margin (HOM) is considered as constant variable which is presenting threshold of difference in captured strength of signal among serving as well as target cells. Handover is implemented after time to trigger (TTT) condition is satisfied. Dropped call rate (DCR) is known as fraction of telephonic calls that are cut off because of technical issue. Reference Signal Received Power (RSRP) has been considered as power of the LTE Reference Signals spread over the full bandwidth and narrowband. The research is focusing on getting optimized HOM and DCR solution. In order to achieve the objective, the Particle swarm optimization (PSO) technique has been used considering that it will provide optimized result. Moreover, it would be capable to provide more accurate optimal solution. In other words, the use of PSO is providing more accuracy with enhanced performance. Proposed work is checking the time to get the optimum solution using PSO in case of HOM as well in case of DCR. It is concluded that PSO is taking less time. Research has provided more accurate optimal solution using PSO. Comparison of time consumption in case of optimized and non-optimized CDR and HOM has been performed. Utilization of such optimization mechanism is providing more accuracy with enhanced performance. Simulation has been performed in MATLAB environment.

KEYWORDS
LTE, HOM, DCR, PSO, OPTIMIZATION, RSRP

1. INTRODUCTION

Long-Term Evolution (LTE) [1] that is utilized in mobile devices and data terminals considers handover procedures major operation. Handover [2] stands for the process in which an incomplete call or data is delivered on the basis of one channel to another associated channel with core network. In satellite transmission, it has been known as a procedure to transfer the satellite control liability from one earth station to another. Here is not scope for loss and interruption in transmission. The drop-call rate is fraction of those telephone calls which will disconnected ahead of answering because of technical reasons. The ringing sound of such calls come to an end ahead of answering. Normally, this portion is considered in the form of overall calls share. Handover margin (HOM) [3] is considered as constant variable which is presenting threshold of difference in captured strength of signal among serving as well as target cells. Handover [4] is implemented after time to trigger (TTT) condition is satisfied. Dropped call rate (DCR) is known as a fraction of telephonic calls that are cut off because of technical issues. Handover methods are a key capacity of LTE [7] eNBs. They are expected to decrease interference time contrasted with the circuit-exchanged handover process in second Generation systems or devices. RSRP is a RSSI type of measurement, as follows there are some definitions of it and some details as well. It is the power of the LTE Reference Signals spread over the full bandwidth and narrowband. A minimum of -20 dB SINR (of the S-Synch channel) is needed to detect RSRP/RSRQ. Handover in LTE systems is discussed here along with its different influencing factors such as HOM, TTT and DCR, RSRP [8]. This research work discusses the challenges related to call data transmission. This call data transfers from one channel to another associated channel within Basic network. It also consists of a proposal for an efficient and vast handover system in LTE systems. The research is focusing on optimizing HOM and DCR with the help of PSO. In order to achieve the objective, the PSO [11] technique is taken into consideration. These techniques are consuming less time. Moreover, it would be capable of providing a more accurate optimal solution. In other words, the use of PSO has provided more accuracy with enhanced performance.

The research paper consists of five sections where the first section is introduction part and section 2 is explaining the existing research related to HOM in LTE with objective, benefits and limitations. Section 3 presents the proposed model where an overview of proposed model, system model and flow chart of used in PSO is represented. The proposed work section presents process flow of research with flow chart and algorithm. Here the HOM and DCR calculation mechanism and optimization process of calculated HOM and DCR has been presented. In section 4 simulations have been performed to find HOM and DCR for different user speeds using their equation. Section 5 is the conclusion part that shows the benefit of proposed research on existing research along with its limitations.

2. LITERATURE REVIEW

Several researchers have proposed a latest transmission method in support of flow distribution in various interconnected system of LTE [1] while some have focused on flow maximization for the purpose of reducing transmission failure among small cell interconnected system of LTE [2]. However, researchers have also introduced energetic transmission control factors in support of those fifth-generation communications which has been done with the help of mobile phones [3]. Some researchers carried out examination in order to make transmission method among LTE network better [4]. In addition to transmission strategy, methods in lte-based femtocell interconnected system [5] have been introduced. A Fuzzy Logic System for Vertical Handover and Maximizing Battery Lifetime in Heterogeneous Wireless Multimedia Networks [6] has been proposed. Research has been made for LTE handover parameters optimization with support of Q-learning technique [7]. Some research provided enhanced approach for RSRP dependent handover in case of LTE scenario [8] while some did fuzzy logic for minimizes influences of assembly transmission among interconnected system of LTE [9]. Effective Network Handovers have been proposed with the help of fuzzy Inference for Heterogeneous Mobility Management [10]. CNNs have outperformed than traditional machine learning paradigm. The network extracts differential and important features of the image. Transfer-based learning paradigms have been successfully incorporated in various areas; CNN utilizes feature extraction to the small datasets [9].

Table. 1 Comparison of the best network for the TB classification using CXR images for different enhancement techniques

S no.	Year	Name	Topic	Objective	Benefits	Limitations
1	2019	S. L. Su, T. H. Chih, and S. B. Wu	Proposed a brand-new distribution methodology, makes distribution of burden in LTE networks highly flexible	Load balancing in LTE	Useful for heterogeneous network	Ignores handover failure reduction
2	2018	M. T. Nguyen	Improve the strength of adaptability for decreasing the malfunctioning of distribution in long term evolution (LTE) Small-Cell Networks	Handover Failure Reduction inside a long-term evolution	Robust and optimized system	Ignores load balancing
3	2018	A. Alhammadi	Considered vibrant factors for the management of transmission in support of LTE-A/5G Mobile Communications	Performing Handover Control Parameters in case of LTE-A/5G	Dynamic and flexible approach has been used.	Complex to implement in real life.
4	2018	Z. Alireza and H. Sara	Consider and examine the procedure of distribution in long term evolution System and make it better.	To improve of Handover Process in LTE System	Suitable to enhance handover process	Research lack the technical implementation.
5	2010	A. Ulvan	On the basis of Femtocell networks put situation of renounce and its method inside a long-term evolution	To put handover method inside a long-term evolution	System becomes suitable for long term evolution-based femtocell networks	There is lack of dynamic approach
6	2019	T. Coqueiro	stated a Fuzzy Logic System in support of Vertical Handover for maximize the duration of battery in various Wireless Multimedia Networks.	To maximize battery lifetime in heterogeneous networks.	Research played significant role to perform handover in Wireless Multimedia Networks	Neuro fuzzy logic could play better role as compare to fuzzy logic.
7	2019	A. Abdelmohsen, M. Abdelwahab, M. Adel, M. Saeed	Considered The manner in which long term evolution renounce factors were improved by means of Q-learning technique	Performing parameter optimization.	Q-learning technique has played significant role in optimization.	Hybrid optimization could introduce more dynamic approach.

		Darweesh, and H. Mostafa			
8	2016	L. Aparna and A. Martin	On the basis of reference signals recei ved power put a superior method in support of transmission in LTE Scenario	Using RSRP to implement Handover	Approach used has enhanced performance during handover	Research has not considered load balancing.
9	2016	K. L. Tsai	Used fuzzy logic for the reduction of ping-pong handover impact inside a long-term evolution network	Reducing ping-pong handover	Fuzzy logic played significant role to achieve objective.	Neural network system could be used to provide flexible approach.
10	2015	D. Gupta and S. Deswal	Discussed valuable system transmission rate using fuzzy Inference in favour of various mobility management	To provide Network Handovers for heterogeneous mobility management.	Model is proven effective.	Need to use optimization techniques for best solutions.

3. PROPOSED MODEL

Experiments were performed on Google Collaboratory Pro with Tensorflow, Keras, Pandas, and Numpy, etc libraries to support the work. Python is used as a script.

3.1 Overview

Handover procedures are the main operation of LTE nodes where Long-Term Evolution (LTE) has been considered the standard for wireless broadband communication that is utilized in mobile devices and data terminals. Handover margin (HOM) is constant variable that shows threshold of difference in captured strength of signal among serving as well as target cells. Handover is performed it the conditions of time to trigger (TTT) are found accomplished [21-23]. On other hand the Dropped call rate (DCR) has been considered as fraction of telephonic calls which get cut off due to technical reasons. Reference Signal Received Power (RSRP) is the power of LTE Reference Signals spread in full bandwidth and narrowband. Proposed work is focusing to retrieve the optimized HOM and DCR solution. To fulfil this objective, the PSO mechanism has been used considering that it will provide optimized result. Moreover, it would be capable of providing a more accurate optimal solution. Implementation of PSO in proposed work can improve accuracy as well as performance.

3.2 System Model

The proposed system has HOM and DCR calculation module as well as PSO optimization module. Initially the HOM and DCR have been calculated considering Handover margin, Time to trigger, Radius of cell, Over lapping area, Handover time, Speed of user, Mean call duration. Proposed work is checking the time to get the optimum solution using PSO in case of HOM as well in case of DCR. It is concluded that PSO is taking less time. Research is providing more accurate optimal solution using PSO. Utilization of such optimization mechanism is given more accuracy with enhanced performance. PSO becomes a method of assessment. It exists in the form of method which is quite simple in use and implemented on regular basis. It was already assessed that such type of assessment methods discovers best possible solution in a very efficient manner. In the field of information technology, one can define this technique as a method that can optimize any considered problem. It is observed that in PSO based model, the efforts are put one by one for enhancing the performance of candidate solution. It deals with any issue of population related to candidate solutions. Here around in search-space, the dubbed particles move. This technique performs because of arithmetical rule above position and velocity of particle [24,25]. Its domestic well-known location makes a huge impact on its movement. Exactly, moved in the direction of its well acknowledged arrangement across domain. This location is refreshed in the form of better positions. With the help of additional fragments, the thesis's location can be easily identified. In other words, relocate swarm in the direction of optimized resolutions. PSO becomes met heuristic because it fails to establish any theory in relation to concerns if it becomes ideal. On the other hand, Meta heuristics like PSO never provide the best possible answer. In the present scenario, it becomes most important and useful met heuristics because it showed success of various optimization problems after applied on [26]. It is a self-organized model. It specified the activeness of this complicated systems. For keeping an eye on ideal issue, not only in combined but also in smart structure it uses a skillful design related to protocol. In equation PX is presenting the position of particles with a uniformly distributed random vector PXi whereas the particles best known position to its initial position is presented by POSi. VEi presents the velocity [27]. Here i is presenting the index of each particle. Q is the cost function that should be minimized. n is presenting the dimension of each particle. Personal best is presented by personal best whereas global best has been presented by global best, here g is presenting the global best index.

Swarm: a set of particles (SOP)

$$PX_i = (PX_{i1}, PX_{i2}, \dots\dots, PX_{in}) \in Q^n$$
$$VE_i = (VE_{i1}, VE_{i2}, \dots\dots, VE_{in}) \in VE^n$$

Each particle maintains

Individual best position: $POS_i = (POS_{i1}, POS_{i2}, \ldots \ldots, POS_{in}) \in Q^n$

$$\text{personal\_best}_i = f(POS_i)$$

Swarm maintains its global best: $POS_g \in Q^n$

$$\text{global\_best}_i = f(POS_g)$$

a. Calculation of RSRP, RSSI, RSRQ

In equation RSRP is presenting average received power of a single resource element (RE).

Received Signal Strength Indicator (RSSI) is the power measured over entire bandwidth of occupied Resource blocks (RBs)

N is Number of RBs as per Channel Bandwidth

RSRP=RSSI - 10 log(12xN)

where RSSI is wideband power calculated by sum of noise, serving cell power,interference power.

Reference Signal Received Quality (RSRQ) is calculated after obtaining RSRP

RSRQ= N X (RSRP/RSSI)

Or

RSRQ= 10 Log(N) + RSRP (dBm)- RSSI (dBm)

Proposed work is checking the time to get the optimum solution using PSO in case of HOM as well in case of DCR. It is concluded that PSO is taking less time. Research is providing more accurate optimal solution using PSO. Utilization of such optimization mechanism presents more accuracy with enhanced performance. Figure 1 describes the flow chart for the proposed work. In proposed work the HOM and DCR have been calculated considering equation of HOM and DCR from existing research paper. After getting array of the HOM and DCR at different user speed the particle swam optimization mechanism has been applied to get the optimized value from HOM and DCR. Time for optimization operation is calculated. The GUI simulation has been made considering the filtered HOM value on the bases of PSO and given TTT. Optimized value in case of PSO in case of HOM and DCR is calculated. The figure 1 is presenting the flowchart of proposed work. The calculation of HOM has been made using equation whereas DCR has been calculated using equation 2, 3, 4, 5, 6 in simulation section and presented in figure 2 and 3. After getting the calculation of HOM and DCR with different user speed the PSO has been applied to get the optimized result. The GUI simulation considers only optimized data during presentation. Moreover, the optimization using PSO for HOM and DCR has been made at different iteration levels in order to get more accurate results. The time consumption at different level in case of HOM and DCR has been simulated in figure 4 and 6.

b. ALGORITHM

Step 1 Get parameter to calculate HOM considering r_new is coverage radius of base station, Vi_new is speed of user, s_new is overlap radius of two base stations, t_new is representing the handover time.

Step 2 Find HOM for different user speed using formula K_NEW LOG ((r_new – Vi_new X t_new)/(r_new+Vi_new X t_new –s_new))

Step 3 Get parameters to calculate DCR *r_new as* cell radius, *tm as* mean call duration, *v_new as* user speed *Pc_new a*s dropped calls probability.

Step 4 Find the dropped call probability formula Pc_new =((1−e $^{-\alpha}$ [1−α])/2α) -(α/2) $\int_{\alpha}^{\infty} \frac{e^{-x}}{x} dx$

Step 5 Apply PSO for HOM and DCR solution considering different iteration

- Get optimized solution of for HOM and DCR and plot simulate result in GUI
- Simulate for time consumption of optimized value using PSO in for HOM and DCR at different iteration counts.

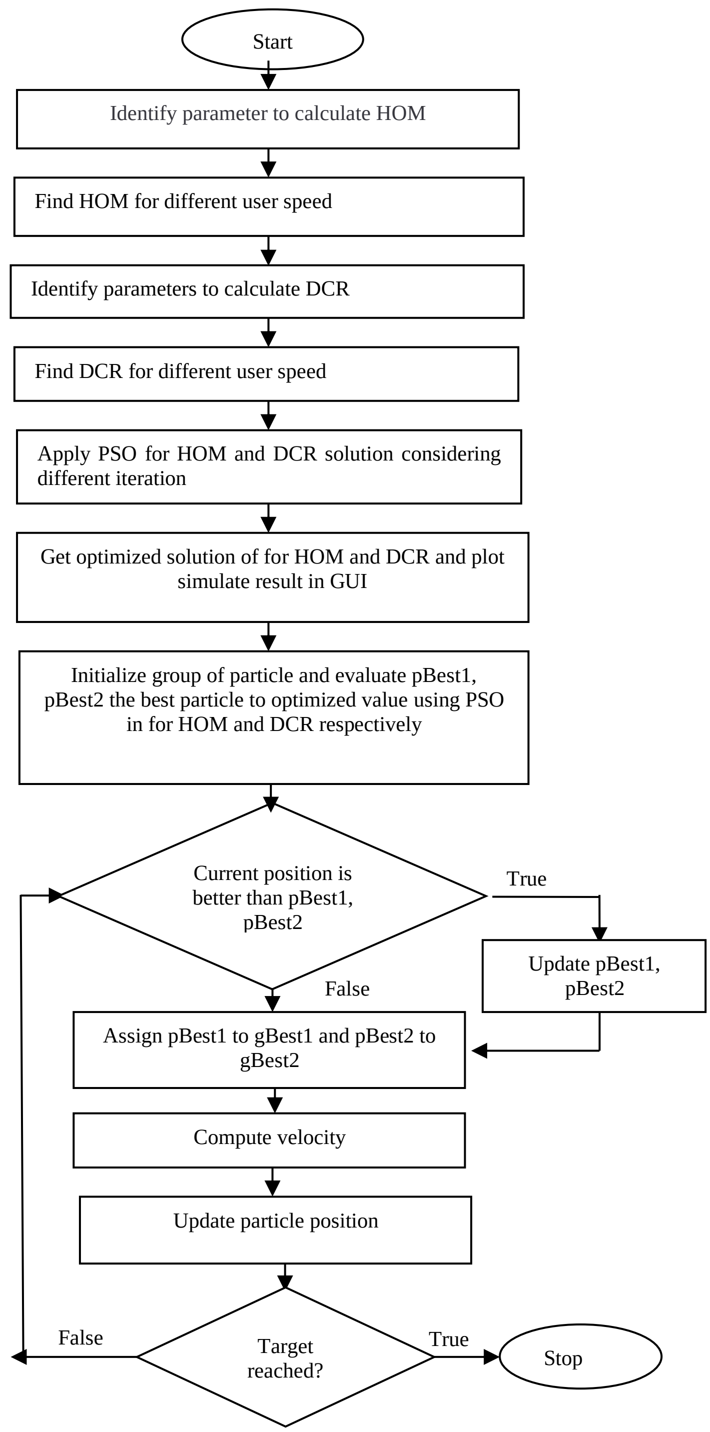

Fig. 1 Flow diagram for proposed work

4. SIMULATION

In this section the value of HOM and CDR has been calculated and optimized using PSO. User agents and their position in various cells have been presented in MATLAB simulation before optimization. The user position is also presented in case of PSO based optimization. Moreover, the time comparison of PSO mechanism has been performed considering different iterations in order to perform comparative analysis of performance in both cases.

Table. 2 Simulation Performance Parameters

S.No.	Parameters	Abbreviation Value
1.	Handover margin HOM	0:0.5:10 (dB)
2.	Time to trigger TTT	0, 40, 64, 80, 100, 128, 160, 256, 320, 480, 512, 640, 1024, 1280, 2560, and 5120 ms
3.	Radius of cell R 2 km	2000m
4.	Over lapping area S	500 m
5.	Handover time T	0.04:2:6 s
6.	Speed of user V	0 up to 140 m/s
7.	Mean call duration	tm 2 s

Arithmetic connection in the middle of transimission margin and user speed is expressed in equation (1)[12]

HOM_NEW=K_NEW LOG ((r_new - Vi_new * t_new)/(r_new+Vi_new*t_new-s_new)) (1)

r_new is coverage radius of base station

Vi_new is speed of user

s_new is overlap radius of two base stations

t_new is representing the handover time.

K_NEW is constant

Arthimathical connection in support of call drop rate because user speed changes [12]

Call which has been done on the speed of user equipment strategy drops in situation where breakdowm of radio link takes place. It happens because of too early handover or too late handover. It becomes possible to say that this is opposite to transimission breakdown because call drops even in the absence of transimission breakdown. It means target cell works under crowded load, while the handover is performed at the right time and right place (having adaptive TTT and HOM) for the users moving at different speeds. It becomes possible to express mathematical relationship of call drop rate and user speed in the form which is presented in equation 2 and 3:

$$P_c = ((1-e^{-\alpha}[1-\alpha])/2\alpha) - (\alpha/2)\int_{\alpha}^{\infty}\frac{e^{-x}}{x}dx \ \ldots.. \quad (2)$$

$$\alpha = 2*r/v*t_m \quad (3)$$

r represents cell radius, *tm represents* the mean call duration, *v represents* user speed, and *Pc represents* dropped calls probability.

Mathematical relationship of call drop rate and traffic loads [12]

In practical terms larger transmission balance reduce those cells which are crowded and increase the broadcast region of those neighbouring cell which are less crowded. By adjusting the parameters, the It becomes possible to modify cell coverage region. It can be done by making some adjustment in the parameters. As a result of this, the coverage of those cell which are crowded and increase the broadcast region of those neighbouring cell which are less crowded. It becomes possible to express dropped calls probability in the form, which is presented in equation 4,5,6

$$P_{DC} = AC/C!\ X\ P(0) \quad (4)$$

$$P(0) = \sum_{k=0}^{C} (A^K/K!)^{-1} \quad (5)$$

4 and 5 equation leads to equation 6

$$P_{DC}=AC/C!XP(0)\ /\ (\sum_{k=0}^{C} (A^K/K!)) \quad (6)$$

C represents channels number, *A represents* offered traffic, and P_{DC} *represents* dropped calls probability. Table 3 is presenting the HOM in case of different user speeds considering equation 4, 5, 6.

Table. 3 HOM for different user speeds

R	s	t	vt	HOM
2000	500	2	0	124.9387366
2000	500	2	20	104.7353505
2000	500	2	40	84.64414175
2000	500	2	60	64.64283472
2000	500	2	80	44.70973497
2000	500	2	100	24.82358373
2000	500	2	120	4.963419532
2000	500	2	140	-14.8915554

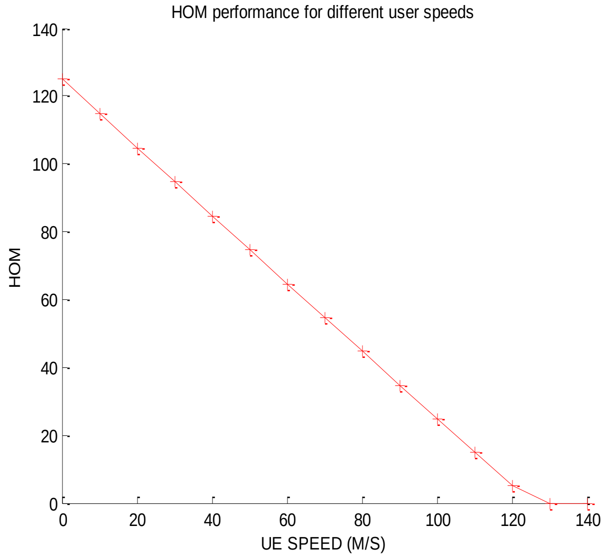

Fig. 2 HOM performance of different user speeds

Table. 4 Call drop rate for different user speeds

r	tm	Speed of user	α	Call drop rate (((1−e −α [1−α])/2α))	Final call drop rate
2000	2	1	2000	0.00025	0.00025
2000	2	20	100	0.005	0.005
2000	2	40	50	0.01	0.01
2000	2	60	33.3333	0.015	0.015
2000	2	80	25	0.02	0.02
2000	2	100	20	0.025000001	0.025000001
2000	2	120	16.6666	0.030000027	0.030000027

2000	2	140	14.2857	0.035000291	0.035000291

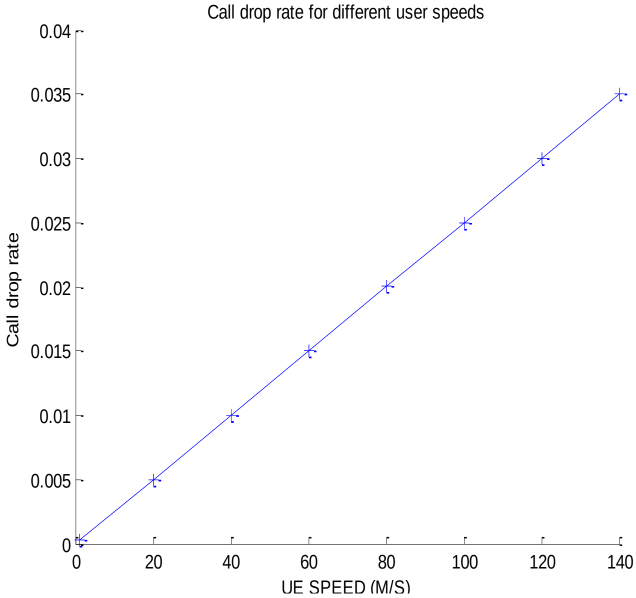

Fig. 3 Call drop rate for different user speed

a. *SIMULATION OF PSO BASED OPTIMIZATION*

Optimization technique has been used in order to improve the performance and accuracy during finding optimal solution from HOM and CDR values. The optimal solution, best objective value and elapsed time have been considered in order to compare the accuracy and performance of PSO. The best solution is depending on best objective value.

Table 5 Results obtained by PSO considering 5000 iteration for HOM is as follow

Optimal solution found in case of PSO	0
Best objective value	0.3532
Elapsed time	22.437904 seconds.

Table 6 Results obtained by PSO considering 5000 iteration for CDR is as follow

Optimal solution found	0.0102
Best objective value	0.3012
Elapsed time	11.116989 seconds.

b. *PSO based HOM considering various iterations*

Time in case of PSO based HOM has been made in following chart. Results are presenting if the iterations are growing then the difference in time consumption is also increasing. Simulation of table 7 has been plotted as graph in figure 4. Figure 4 is presenting the time consumption in case of iteration from 2000 to 10000 for PSO based HOM.

Table7 Time for PSO in case of HOM considering different iterations

ITERATION	PSO BASED HOM
2000	11.413036
3000	16.886031
4000	21.597743
5000	27.626491
6000	36.378653
7000	38.607782
8000	43.96504
9000	52.73117
10000	78.413082

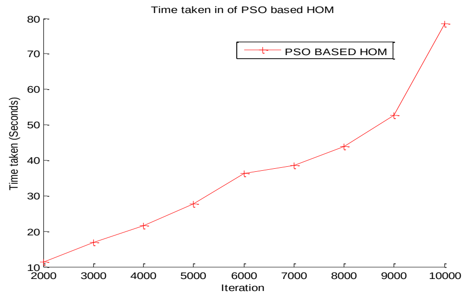

Fig. 4 Time consumption in case of PSO based HOM

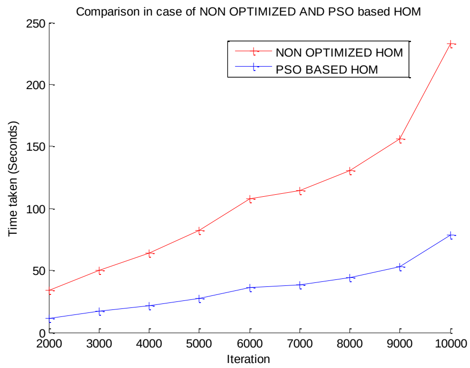

Fig. 5 Comparison for non-optimized and optimized HOM

c. *PSO based DCR considering various iterations*

Time in case of PSO based DCR has been made in following chart. Results are presenting if the iterations are growing then the difference in time consumption is also increasing. Table 8 is showing the time consumption in case of optimization of DCR using PSO. It is observed that the time consumption is increasing as number of iteration increases. Simulation of table 8 has been plotted as graph in figure 6. Figure 6 is presenting the time consumption in case of iteration from 2000 to 10000 for PSO based DCR.

Table 8 Time for PSO in case of DCR considering different iterations

ITERATION	PSO BASED DCR
2000	5.800938
3000	8.324576
4000	10.799137
5000	13.315974
6000	15.920454
7000	18.550651
8000	21.18125
9000	23.830014
10000	26.661346

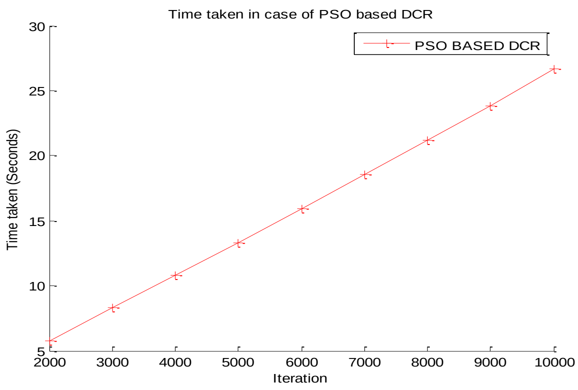

Fig. 6 Time consumption case of PSO based DCR simulation

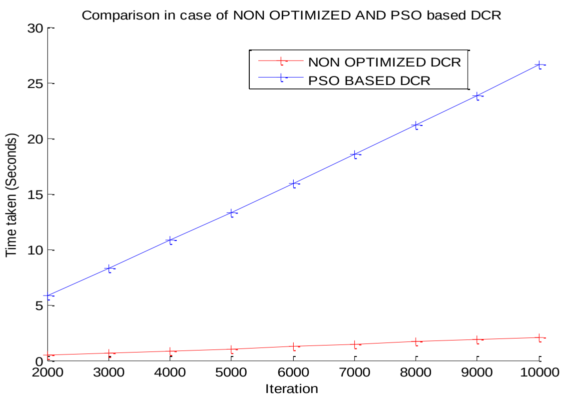

Fig. 7 Comparison of optimized and non-optimized DCR

5. CONCLUSION

Long-Term Evolution (LTE) that is standard in case of wireless broadband communication and utilized for mobile devices and data terminals considers handover procedure as its major function. Handover margin (HOM) that is constant variable, shows threshold of difference in captured strength of signal among serving as well as target cells. It is observed that HOM is implemented after fulfillment of TTT condition. On other hand DCR that has been considered as fraction of telephonic calls which gets cut off due to technical issue. The limitations of previous research have been resolved in the proposed work. The HOM and DCR influencing parameters such TTT, RSRP, DCR have been considered in this research and the optimized result are extracted by making use of PSO optimizer. Moreover, research has also considered the performance of optimizer considering different iteration scenarios to improve the accuracy of optimized result. The research has optimized HOM and DCR solutions. It has been observed from the results that PSO is providing efficient solution for HOM and DCR simulation. Moreover, it also provides a more accurate optimal solution using PSO. Thus, the use of PSO has given more accuracy with enhanced performance. Similarly in the case of PSO the optimal solution is 0.0102 for DCR Moreover the PSO based implementation of DCR takes 11.116989 seconds. Results confirm that if the number of iterations gets increased the time consumption also increases. Moreover, the comparison of time consumption in case of PSO based and non-optimized for different iteration has been performed where the optimized HOM and DCR takes less time as compared to non-optimized HOM and DCR. But the limitation of research is that there is need to introduce optimization mechanisms that should perform better than PSO. In future MVO could be used in order to improve performance and accuracy.

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