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A NOVEL FRAMEWORK FOR BEACON RATE AND POWER ADAPTION USING BACTERIAL FORAGING OPTIMIZATION ALGORITHM IN VANET

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ABSTRACT

Abstract-Vehicular Adhoc Nework (VANET) is emerging & very efficient technology, consisting enabling wireless communication between vehicles for exchanging information like speed, density ,position, safety, accident & handling. Beacon a periodic message used for exchanging these information. The main problem in VANET is the absence of central entity for monitoring and collision due to congestion in highly dynamic environment. In this paper bacterial foraging optimization (BFO) is used to enhance beacon rate and power by node to node reduction in frequency, proving more awareness between vehicle, increasing neighboring nodes and optimize vehicular density to avoid collision**.**

KEYWORDS: ***VANET, BEACON, BFO, FREQUENCY,RATE ,POWER***

I INTRODUCTION

Vehicular Ad Hoc Networks (VANETs) is a developing innovation that has stirred incredible intrigue worldwide in the most recent decade. This basic yet extremely proficient innovation, comprising in empowering wireless communications between vehicles, has pulled in a ton of consideration from both research and industry groups. An expansive arrangement of utilizations has been intended to this end as they guarantee to unravel a large portion of the present road activity issues, such as upholding the security of the road clients, essentially shortening their outing times and upgrading their driving background. Notwithstanding, this specific kind of wireless networks makes them recognize qualities. The principal principle trademark is the nonappearance of a focal substance that screens the condition of the system and monitors vehicles' data like their thickness, paces, positions or their headings. This nonattendance should be remunerated by some intermittent nearness messages, additionally called BSMs or beacons. These short single hop messages, broadcasted by all vehicles, go for furnishing vehicles with data about their neighbours and act like a heartbeat for the encompassing vehicles. It is broadly acknowledged in the vehicular systems administration group that the utilization of beacons is essential for any application whether it is a security or a non-wellbeing one. The second trademark is the exceptionally powerful condition of VANETs. Truth be told, the high versatility of vehicles leads to a fast close of the beacons content, and in this way more updates about the condition of the system are necessary all together for VANET applications to work legitimately. In addition, the more a la mode the beacon is, the more precise the data contained in it and utilized as a part of the application will be. This is the reason it is obligatory for the vehicles shaping the wireless system to trade beacons as regularly as could reasonably be expected. As indicated by the National Highway Traffic Safety Administration and the Crash Avoidance Metrics Partnership, most wellbeing applications can't ensure exact outcomes with a beaconing frequency lower than 10Hz, while some of them require a beaconing frequency up to 50 Hz to run easily and productively. One essential thing which merits specifying is the constrained radio asset that is required to convey this information. VANETs ordinarily work around the 5.9GHz frequency band which is separated in 10MHz channels. The IEEE 802.11p WAVE Standard characterizes six administration channels (SCH) in the US while four diverts has been dispensed in Europe by ETSI TS. Then again, both guidelines conceded to crediting a solitary control channel (CCH) that will serve for conveying security related data, setting mindful data and administration declarations. There is most likely these three sorts of messages are somewhat massive to be conveyed by a solitary CCH channel, particularly the second sort since these beacons ought to be broadcasted with a high periodicity at times. Besides being vital for all security and non-wellbeing applications, beacons are the primary wellspring of clog in the CCH channel. Such clog may have pulverizing outcomes on the execution of security applications and may significantly imperil the wellbeing of the road clients [1]. Vehicular networks have been considered as the key innovation of cooperative driving wellbeing applications that can altogether diminish an enormous measure of monetary and social misfortune beginning from road mischances. With these applications, a driver ends up noticeably mindful of road episodes in advance by uprightness of multi-hop delivery of the data about road conditions. Vehicular security applications keep running on the premise of message scattering among adjacent vehicles, either a wellbeing message or a beacon message. A vehicle broadcasts a wellbeing message to help different vehicles to maintain a strategic distance from hazardous circumstance in advance. Then again, a beacon message is occasionally dispersed to neighbour vehicles keeping in mind the end goal to report the status data, e.g. position, speed, heading, and so forth. This data is fundamental for neighbour vehicles to foresee the activity circumstance. In any case, visit beacon spread may altogether degrade the execution of a very thick vehicular system. In such a circumstance, system may experience the ill effects of an extreme misfortune because of many edge impacts [2].

II LITERATURE REVIEW

Sofiane Zemouri et. al. [1] this work is keen on intermittent beacons transmission, the primary driver of the Control Channel (CCH) blockage and the real snag deferring the advance of security messages spread in VANETs. In this paper, proposed to together adjust both transmit rate and power in another savvy way that ensures a strict beaconing frequency and also a decent level of mindfulness in nearer goes, while keeping up a negligible beacons crash rate and a decent level of channel use. To begin with, the transmit rate is adjusted to meet the channel necessities as far as crash rate and channel stack; at that point, once the base beacon transmit rate, set by ETSI, has been come to, transmit power is adjusted in a way that ensures a decent level of mindfulness for nearer neighbours. The reproduction comes about demonstrate a noteworthy upgrade as far as the quality and additionally the level of mindfulness.

Hoa-Hung Nguyen et. al. [2] it examined the effect of the accompanying three key parameters of the beacon scattering on the execution of vehicular networks: beacon period, beacon transmit power, and contention window (CW) measure. They initially determine a beacon period which is contrarily relative to the vehicle speed. Next, we scientifically detail the greatest beacon load to show the need of the transmit power control. It at last introduced an inexact shut frame arrangement of the ideal CW estimate that prompts the greatest throughput of beacon messages in vehicular networks.

Nader Chaabouni et.al. [3] Wellbeing applications in VANET utilize two sorts of messages (a)periodical messages/beacons: they are communicate a few times each second to trade data with neighbours; and (b) cautioning (occasion driven) messages: they are produced when an occasion happens (e.g., an auto crash) and are dispersed in the system to tell hubs of intrigue. Albeit cautioning messages have higher need, beacons are similarly as vital since a decent dispersal technique for the most part depends on data given by beacons to pick sending hubs. In any case, in thick networks, beacons may cause arrange congestion prompting execution debasement of wellbeing applications. In this paper, proposed CBA: a congestion control approach that uses the quantity of identified crashes as a metric to control the beacon era recurrence and subsequently decrease the impact of congestion. Reproduction comes about demonstrate that our proposed plot accomplishes an adjusted exchange off between beacon data accuracy and beacon related overhead.

Miguel Sepulcre et.al. [4] This paper has proposed and assessed INTERN, an integrated congestion and mindfulness control convention that powerfully adjusts the transmission parameters of reference points considering every vehicle's application's necessities and the channel stack. The outcomes got exhibit that INTERN can keep up the channel stack under control while guaranteeing that the application's prerequisites of every vehicle are fulfilled. The channel load and application's adequacy experienced with INTERN are appeared to be steady. Also, INTERN can progressively adjust to movement thickness changes and varieties of the application's necessities. Facilitate examinations will be expected to unravel situations in which the most extreme channel stack level permitted is surpassed notwithstanding when all vehicles are designed to utilize the base transmission parameters required.

Matthias Sander Frigau et. al. [5] In this paper, the thought is to consider the powerfully changing topology of a VANET (nearby activity thickness) and have every vehicle ready to progressively adjust its PHY QoS parameter (Transmit Power) as indicated by its quick changing channel conditions, organize load, and connection amounts of upper-layers. The proposed component, called Transmit Power Adaptation (TPA) depends on channel assess at PHY layer and uses criticism from an adaptive beaconing system (likewise displayed) which constructs the nearby perspective of a vehicle at the system layer. It has assessed the execution of TPA through reproduction with ns-3 test system. Results demonstrate that TPA plainly outflanks the default 802.11 telecom component regarding system limit. TPA likewise beats a comparable adaptive strategy not in view of divert assess as far as system limit with respect to three situations.

Muhammad A. Javed et. al. [6] In this paper, introduced the idea of a wellbeing zone to adaptively control the transmit power of CAMs to limit the system stack without trading off the security components of VANET applications. Besides, we additionally present another agreeable data sharing procedure to expand the vehicle's mindfulness past the transmission run. The re-enactment comes about demonstrate that the proposed system could essentially lessen the parcel misfortunes and channel usage for a scope of vehicle densities.

Danda B. Rawat et.al. [7] In this paper, exhibited another plan for dynamic adaptation of transmission power and contention window (CW) size to improve execution of data scattering in Vehicular Ad-hoc Networks (VANETs). The proposed plot consolidates the Enhanced Distributed Channel Access (EDCA) instrument of 802.11e and utilizations a joint way to deal with adapt transmission power at the physical (PHY) layer and quality-of-service (QoS) parameters at the medium access control (MAC) layer. In this plan, transmission power is adapted in view of the evaluated neighbourhood vehicle thickness to change the transmission run progressively, while the CW measure is adapted by the momentary crash rate to empower service separation. In light of a legitimate concern for advancing auspicious proliferation of data, VANET advisories are organized by their earnestness and the EDCA system is utilized for their spread. The execution of the proposed joint adaptation conspire was assessed utilizing the ns-2 test system with added EDCA bolster. Broad recreations have shown that our plan highlights altogether better throughput and lower normal end-to-end postpone contrasted and a comparable plan with static parameters.

Tang Lun et. al. [8] In vehicular Ad-hoc networks (VANETs), guide message is intended with the end goal of occasionally broadcasting the status data (speed, course, and so on.), which empower neighbour mindfulness and bolster some security applications. Notwithstanding, under high thickness situations, settled rate beaconing can cause extreme clog and lower the convey rate of reference points and different sorts of messages. In this paper, depicted the beaconing rate control approach with an one-dimensional Markov display, and in view of this, an upgraded guide rate control conspire is proposed which expects to moderate the clog and augment the convey efficiency of beaconing. Logical and recreation comes about demonstrate that proposed plan can accomplish higher adaptability and beaconing efficiency contrasted and different plans in different conditions.

Esteban Egea-Lopez et.al. [9]In this paper the model for the first run through, to the best of our insight, the issue of beaconing rate control in vehicular systems as a NUM rate allocation issue. This demonstrating opens the way to formally characterize and apply the fairness idea in beaconing rate allocation to vehicles. What's more, it gives a scientific system to create decentralized and straightforward calculations with demonstrated merging assurances to a fair allocation arrangement. In this regard, it has exhibited a group of calculations in light of the angle improvement of the double of the rate allocation issue. Inside this family, it has concentrated on relative fairness and it has proposed the Fair Adaptive Beaconing Rate for Inter vehicular Communications (FABRIC) calculation.

Bernhard Kloiber et.al. [10] In this paper, propose to use repeating interferences by haphazardly choosing every TX control following a given likelihood dispersion. Such randomization decreases the odds of repeating interferences, and the likelihood dissemination gives control to the applications with respect to the required Awareness Quality, specifically by giving a higher Awareness Quality at short proximity. This idea likewise decreases congestions by transmitting less at high separations. It is straightforward to the applications, and figures out how to enhance the Awareness Quality in a thick interstate by a component 2 to 20, yet at a variable 2 to 3 bring down channel stack

III METHODOLOGY & PROPOSED ALGORITHM:-

Bacterial Foraging Optimization

The Bacterial Foraging Optimization Algorithm is awakened by the social occasion rummaging behaviour of microscopic organisms, for instance, E.coli the BFOA is excited by the chemo taxis direct of microbes that will see substance inclinations in the environment, and push toward or a long way from specific signs. Microorganisms see the heading to sustenance in perspective of the inclinations of chemicals in their condition. Microorganisms emit pulling in and repelling chemicals into the environment and can see each other relatively. Using velocity instruments, (for instance, flagella) microscopic organisms can move around in their condition, now and again moving glamorously (tumbling and turning), and different circumstances moving in a coordinated way that may be insinuated as swimming. Bacterial cells are dealt with like operators in a domain, using their view of sustenance and different cells as inspiration to move, and stochastic tumbling and swimming like development to re-find. Dependent upon the cell-cell communications, cells may swarm a sustenance source, and additionally may commandingly rebuff or negligence each other. The data get ready procedure of the calculation is for empowering cells stochastically and on the whole swarm toward optima. This is expert through a movement of three systems on a populace of recreated cells:

1) "Chemo taxis" where the cost of cells is rerated by the nearness of different cells and cells move along the controlled cost surface each one in turn (most of the work of the calculation),

2) "Propagation" where just those cells that performed well over their lifetime may a contribution for the next generation, and

3) 'End dispersal' where cells are disposed of and new irregular specimens are embedded with a low likelihood.

Foraging theory is based on the assumption that animals search for and obtain nutrients in a way that maximizes their energy intake E per unit time T spent foraging. Hence, they try to maximize a function like (or they maximize their long-term average rate of energy intake). Maximization of such a function provides nutrient sources to survive and additional time for other important activities (e.g., fighting, fleeing, mating, reproducing, sleeping, or shelter building). Optimal foraging theory formulates the foraging problem as an optimization problem and via computational or analytical methods. Some animals are “cruise” or “ambush” searchers. For the cruise approach to searching, the forager moves continuously through the environment, constantly searching for prey at the boundary of the volume being searched (tuna fish and hawks are cruise searchers). In ambush search, the forager (e.g., a rattlesnake) remains stationary and waits for prey to cross into its strike range. The search strategies of many species are actually between the cruise and ambush extremes. BFO include following main stages

1) **Chemo taxis**

Chemo taxis is achieved through swimming and tumbling via Flagella. Depending upon the rotation of Flagella, it decides whether it should move in a predefined direction (swimming) or altogether in different directions (tumbling). To represent a tumble, a unit length random direction, say φ, is generated; this will be used to define the direction of movement after a tumble in a tumble, the position of the i bacterium is updated as

$$\theta^i(j+1,k,l)=\theta^i(j,k,l)+C\times\angle\phi$$

Where $\theta^i(j,k,l)$ is the position of the i_{th} bacterium at the j_{th} chemotactic step of the k_{th} reproduction loop in the $_{lth}$ elimination-dispersal event, C is the size of the step taken in the random direction specified by the tumble.E-coli bacterium has a specific sensing, actuation and decision-making mechanism. As each bacterium moves, it releases attractant to signal other bacteria to swarm towards it. Meanwhile, each bacterium releases repellent to warn other bacteria to keep a safe distance from it. BFA simulates this social behavior by representing the combined cell-to-cell attraction and repelling effect as:

$$J_{cc}(\theta^i(j,k,l),\theta(j,k,l))=\sum_{t=1}^{s}J^t{}_{cc}(\theta^i,\theta\theta)$$
$$=\sum_{t=1}^{s}\left[-d_{attract}\exp(-\omega_{attract}\sum_{m=1}^{p}(\theta^i{}_m-\theta^t{}_m)^2)\right]$$
$$+\sum_{t=1}^{s}\left[-d_{repellant}\exp(-\omega_{repellant}\sum_{m=1}^{p}(\theta^i{}_m-\theta^t{}_m)^2)\right]$$

Where is the cost function value to be added to the actual cost function to be minimized to present a time varying cost function. 'S' is the total number of bacteria and 'P' the number of parameters to be optimized which are present in each bacterium. $d_{attract,}$ $\omega_{attract}$,$d_{repellant}$,$\omega_{repellant}$ are different coefficients that are to be chosen properly.

2) ***Reproduction***

In BFA, a fixed total number of reproduction steps, N_{re} is given. Only the first half of populations survive in each reproduce step a surviving bacterium splits into two identical ones, which occupy the same position in the environment as the one in previous step. Thus the population of bacteria keeps constant in each chemotactic step. After Nc chemotactic steps, the fitness values for the ith bacterium in the chemotactic loop are accumulated and calculated by:

$$j^i{}_{health}=\sum_{j=1}^{Nc+1}j^j(j,k,l)$$

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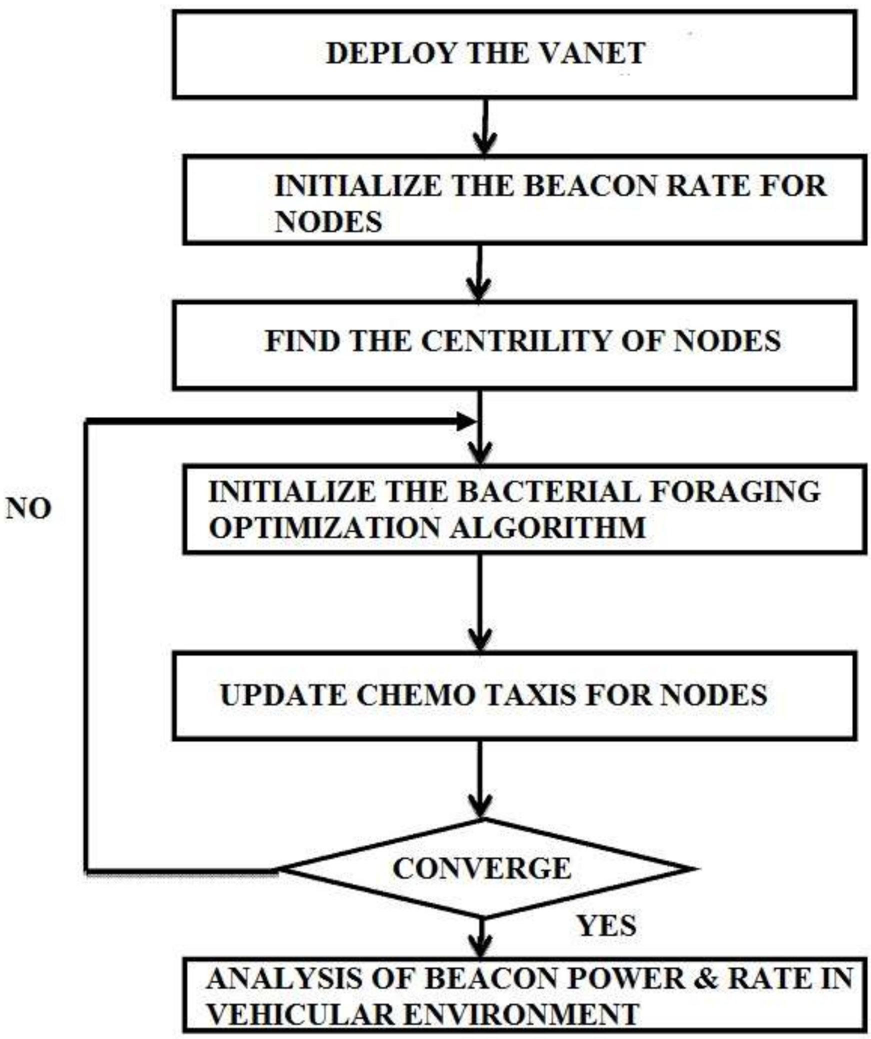
Where j^i_{health} presents the health of the ith bacterium, the smaller the j^i_{health} is, the healthier the bacterium is.

3) **Elimination-dispersal**

For the purpose of improving the global search ability, elimination-dispersal event is defined after N_{re} steps of reproduction. The bacteria is eliminated and dispersed to random positions in the optimization domain according to the probability P_{ed}. This elimination dispersal event helps the bacterium avoid being trapped into local optima. The number of the event is denoted as Ned

Flowchart for implementing BFO is given below



(FLOW CHART)

Basic Steps in Flowchart

Step1: In this step, the VANET network is deployed.
Step2: When network is deployed then Beacon rate is initialized.
Step3: When beacon rate is initialized then the centrality of the node is finding.
Step4: After finds the node centrality BFO (Bacterial Foraging Optimization) is initialized.
Step5: In this step Chemo taxis are updated for nodes
Step6: In this step updated Chemo taxis are converge.
Step7: If Chemo taxis is converge then analysed the Beacon power rate otherwise go to the step4.

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Calculation gives a pseudo code posting of the Bacterial Foraging Optimization Algorithm for limiting a cost work. Calculation gives the pseudo code leaning to the chemo taxis and swing conduct of the BFOA calculation. A microscopic organisms cost is dreaded by its collaboration with different cells. This communication work (B( )) is figured as takes after:

B(Cell$_n$)(j,k,l)=

$$\sum_{i-1}^{s}[-_{A_{att}} \times \exp(_{B_{att}} \times \sum_{k=1}^{p}(Cell_k^n - other_k^i)^2)] + \sum_{i-1}^{s}[_{Y_{rep}} \times \exp(-_{Z_{rep}} \times \sum_{k=1}^{p}(Ce$$
$$other_k^i)^2)]$$

Where

Cell$_n$← Given cell , A_{att} and B_{att} ← Attractive coefficient ,Y_{rep} and Z_{rep}←Repulsion Coefficient

s←No. of cells in population , p← No. of dimensions (position vector of a given cell)

The algorithm remaining parameters are as follows:

cells$_n$←maintained no. of cells in the population

n_{ed}← number of elimination and dispersal steps

n_{rep}← no. of reproduction steps

n_{chemo}←no. of chemo taxis steps

n_{swim}←no. of swim steps

rt_{size}←random direction vector

p_{del}←cell probability subjected to dispersal and elimination

Pseudo code for the BFOA
Input: $prob_{size}$, $cells_n$, n_{ed}, n_{rep}, n_{chemo}, n_{swim}, rt_{size}, A_{att}, B_{att}, Y_{rep}, Z_{rep}, p_{del}
Output: $cell_b$
Vehicular Population←initialize vehicles ($cells_n$, $prob_{size}$)
Chemo taxis loop j=j+1
Elimination-dispersal loop: k=k+1
Reproduction loop l=l+1
For (L=$0_{to}n_e$)
For (N=$0_{to}n_{rep}$)
For (j=$0_{to}n_{chemo}$)
Chemo taxis and Swim (vehicular *population*, $prob_{size}$, $cells_n$, n_{swim}, rt_{size}, A_{att}, B_{att}, Y_{rep}, Z_{rep})
For *(cell*∈ vehicular *population)*
If (*cost(cell)*≤*cost($cell_b$)*)
End
Select←by $cell_{health}$ *(vehicular population,*$\frac{cells_n}{2}$*)*
Vehicular Population←select
Compute fitness function, J (I,j,k,l)
End
For (*cell*∈vehicular *population*)
If (*random()*≤p_{de})
cell←create cell at *random location ()*
End
Return (*$cell_b$)*

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Pseudo code for the Chemot axis And Swim
Input: $prob_{size}$, $cells_n$, n_{swim}, rt_{size}, A_{att}, B_{att}, Y_{rep}, Z_{rep}
Output: *(cell*∈vehicular *population)*
Chemo taxis loop j=j+1
Elimination-dispersal loop: k=k+1
Reproduction loop l=l+1
$cell_{fit} \leftarrow$ cost(cell)+interaction(vehicular *population*, *cell*, A_{att}, B_{att}, Y_{rep}, Z_{rep})
$cell_{health} \leftarrow cell_{fit}$
$cell' \leftarrow \emptyset$
generate a random vector
For $(i=0_{to} nswim)$
step random direction ← create step($prob_{size}$)
cell´←take step (*step random direction*, rt_{size})
$cell'_{fit} \leftarrow$ cost(cell´)+interaction(*cell', vehicular population,* A_{att}, B_{att}, Y_{rep}, Z_{rep})
If $(cell'_{fit} > cell_{fit})$
$i \leftarrow n_{swim}$
Else
$cell \leftarrow cell'$
$cell_{health} \leftarrow cell'_{fit} + cell'_{health}$
If $k < Nrep$, $j < Nc$, $l < Ned$
else
End

ALGORITHM FOR RATE & POWER OPTIMIZATION

G_{IR}: Gradual Increase Rate
C_L: Confidence_ level
C_{ocr}: Acceptable_ collision_ rate
B_{or}: optimal_ busy_ ratio
C_{cr}: current_ collision_ rate
B_{cr}: current_ busy_ ratio
1: At the End of each control channel do:
2: if (1 C_{cr} - C_{acr} 1) < CL) then
3: Apply equation 1
4: Define TR_{max} and TP_{max}
5: Apply Algorithm BFOA
6: Define TR_{min} and TP_{min}
7: Exit
8: end if
9: if ($C_{cr} < C_{acr}$ && $B_{cr} < B_{or}$) then
10: if ($TP==TP_{max}$ && $TR \leq TR_{max}$)
11: then
12: create random location ( )
13: TR_{min}=TR
14: end if
15: TR←Apply BFOA
16: TP←Chemo taxis changes
17:if ($TR= TR_{min}$ && $TP> TP_{min}$) then
18: Apply eq (1)
19: End

IV RESULT

Optimization -The proposed method include the analysis of beacon rate reduction and beacon frequency should be optimize according vehicle frequency for that use bacterial foraging method for reducing the beacon analysis which depend on previous beacon frequency parameter then take decision by node to node and reduce the frequency. The simulation parameters used for optimization is

Number of bacteria (nodes)	100
Step size for each bacterium	0.05
Initial energy	0.5
Centroid	5
Dimension of optimization process	2
Probability	0.1
Number of swimming, chemo taxis & reproduction step	50

Simulation parameters

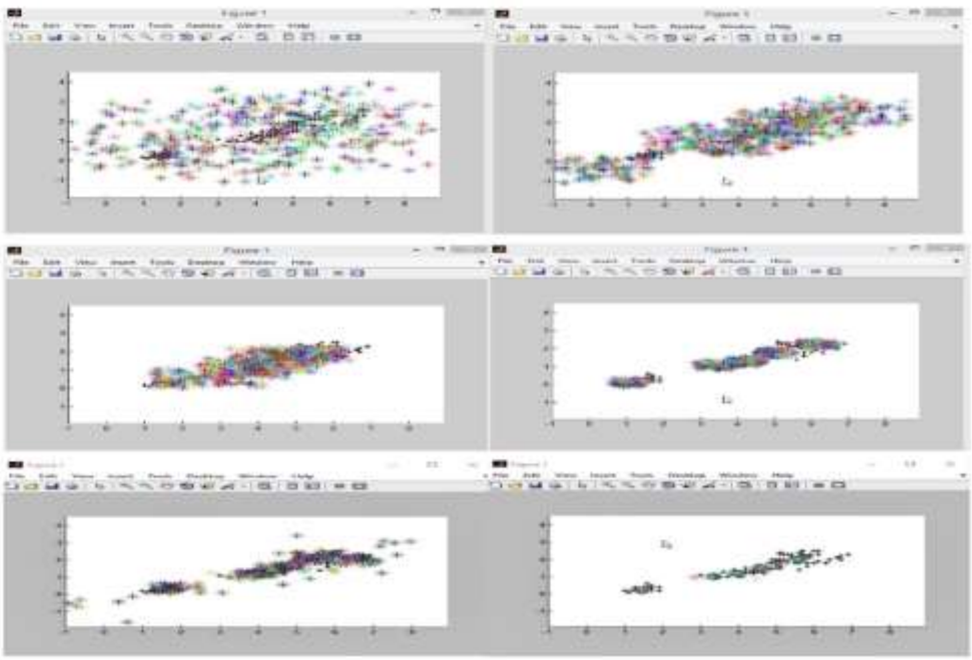

Figure 1 Optimization

The basic beacon rate is calculated by

$$Beacon\ Rate = \beta \times Beacon\ Size \times Channel\ Capacity \times Neighbouring\ Nodes$$

Where β is constant

Channel load is calculated by

$$CL = \frac{vehicles}{common\ distance} \times Beacon\ Rate \times Beacon\ size$$

Where $\frac{vehicles}{common\ distance}$ is the number of vehicles within the communication range

Power adaption

$$PAmin/max = \frac{\text{Min/Max}\, adjusted\ load}{2 \times CSRmin/max \times Vehicular\ load\ \times Vehicular\ density}$$

Type equation here.

CSR is certified signaling request, vehicle density is traffic flow density vehicle load is periodic beacon generation rate min/max adjusted load is channel load.

Throughput is amount of data transferred over a given period of time. if more data transferred ,higher throughput. Fitness function is used to define the performance of bacterial foraging. The fitness function simply defined is a function which takes a candidate solution to the problem as input and produces as output how "fit" our how "good" the solution is with respect to the problem in consideration.Total distance is 16.4692 in simulation & Global fitness is 0.2721

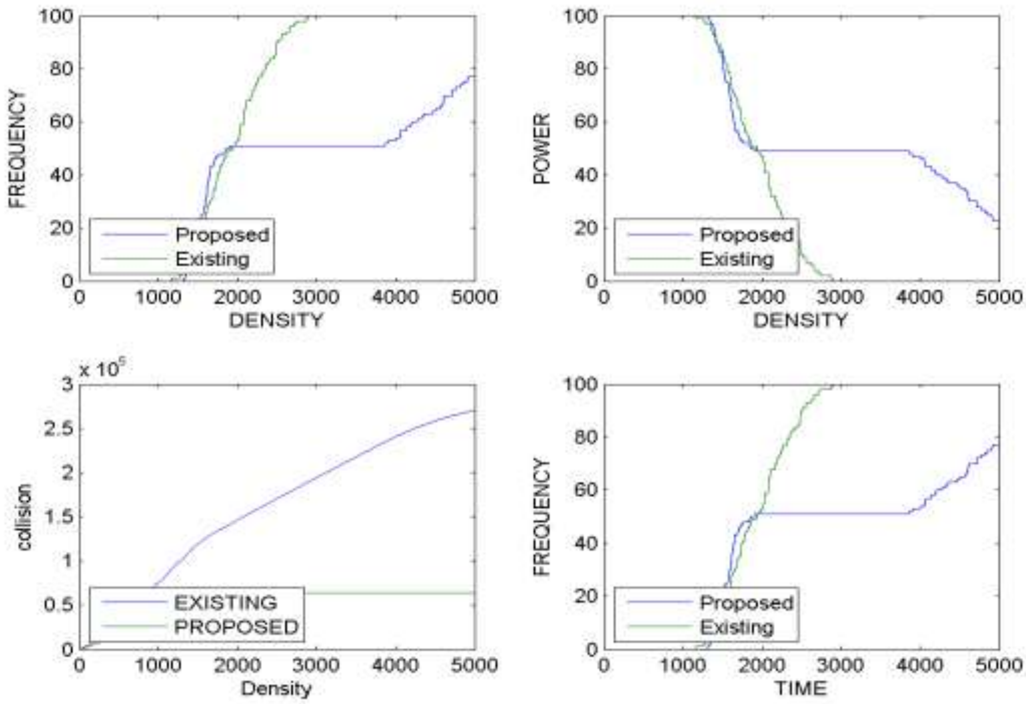

Figure 2 Comparison of proposed method BFOA with existing SuRPA
[Frequency in Khz, Density in (n/cm^3) power in w]

Graph plotted between frequency and density show that the proposed method (BFOA) consume 50% less beacon frequency then existing method (SuRPA) and density is also higher than the existing method. In case of power vs. density graph BFOA technique is much better than SuRPA method, it shows 18% efficient than existing SuRPA technique. Collision is almost constant. In BFOA we get better beacon transmission rate and enhancement in power and negligible collision.

V CONCLUSION & FUTURE SCOPE

To avoid collision a better level of awareness must be there between vehicles. We are achieved this goal by applying bacterial foraging optimization algorithm which increases the neighbouring nodes, optimize the vehicular density to avoid the collision enhancing beacon rate and power.in experiment we compare the result of bacterial foraging optimization algorithm with existing method which shows better result in collision ,frequency, rate and power. In proposed work bacterial foraging optimization technique is used for optimize beacon power and rate, in future adaptive bacterial foraging algorithm can be used with firefly and PSO to optimize traffic .SuRPA method can also be modified by combining with genetic algorithms.

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VI REFERNCES

1. Zemouri, Sofiane, Soufiene Djahel, and John Murphy. "Smart adaptation of beacons transmission rate and power for enhanced vehicular awareness in vanets." *Intelligent Transportation Systems (ITSC), 2014 IEEE 17th International Conference on*. IEEE, 2014.
2. Nguyen, Hoa-Hung, Adhitya Bhawiyuga, and Han-You Jeong. "A comprehensive analysis of beacon dissemination in vehicular networks." *Vehicular Technology Conference (VTC Spring), 2012 IEEE 75th*. IEEE, 2012.
3. Chaabouni, Nader, Abdelhakim Hafid, and Pratap Kumar Sahu. "A collision-based beacon rate adaptation scheme (CBA) for VANETs." *Advanced Networks and Telecommuncations Systems (ANTS), 2013 IEEE International Conference on*. IEEE, 2013.
4. Sepulcre, Miguel, et al. "Adaptive beaconing for congestion and awareness control in vehicular networks." *Vehicular Networking Conference (VNC), 2014 IEEE*. IEEE, 2014.
5. Sander Frigau, Matthias. "Cross-layer transmit power and beacon rate adaptation for VANETs." *Proceedings of the third ACM international symposium on Design and analysis of intelligent vehicular networks and applications*. ACM, 2013.
6. Javed, Muhammad A., and Jamil Y. Khan. "A cooperative safety zone approach to enhance the performance of VANET applications." *Vehicular Technology Conference (VTC Spring), 2013 IEEE 77th*. IEEE, 2013
7. Rawat, Danda B., et al. "Enhancing VANET performance by joint adaptation of transmission power and contention window size." *IEEE Transactions on Parallel and Distributed Systems* 22.9 (2011): 1528-1535.
8. Lun, Tang, Liu Yifu, and Chen Qianbin. "Optimized beaconing rate control for vehicular Ad-hoc networks." *The Journal of China Universities of Posts and Telecommunications* 22.6 (2015): 1050-17.
9. Egea-Lopez, Esteban, and Pablo Pavon-Mariño. "Distributed and fair beaconing congestion control schemes for vehicular networks." *arXiv preprint arXiv* 1407 (2014).
10. Kloiber, Bernhard, Jerome Harri, and Thomas Strang. "Dice the TX power—Improving Awareness Quality in VANETs by random transmit power selection." *Vehicular Networking Conference (VNC), 2012 IEEE*. IEEE, 2012.

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