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Novel Approach of Energy efficient Massive MIMO Communication by optimized Clustering in 5G

Sweety Sharma
sweety.sharma5678@gmail.com
Baddi University of Emerging Sciences and Technology, Baddi, Himachal Pradesh

Abstract- In general, network plays a vital role in tranferring the information from one node to other. Various techniques are developing to convey the data efficiently. Additionally, in today's era; less energy utilization, high throughput and serving numerous users at a time are the essential requirements of wireless communication system. So, these requirements can be fulfilled with the help of Massive multiple-input multiple-output (MIMO) technology to some extent where in the same time-frequency resources; many users can be served with a base station (BS) equipped with very large number of antennas. Hence, it is a favourable technology for next generations of wireless systems such as in 5th generation. To communicate inside the large network, it is divided into clusters in which cluster head to be chosen and energy is optimized to some extent using Bacterium forging optimization technique.

Keywords-*5th Generation (5G), Massive MIMO, Bacterial foraging optimization (BFO)*

1. INTRODUCTION

In general terms, Network is defined as the assemblage of nodes which are conversing through wireless or wired mechanism. Information is conveyed from one node to other nodes through electromagnetic waves in wireless communication. A well-defined topology is required to supply wireless services with high received signals energy over wide coverage area. To accelerate wireless communication between a device and the network, a piece of network equipment that is fixed- location base station is required to operate in coverage area which is divided into cells. A set of User Equipment (UEs) and a set of Base Stations (BSs) combine to form a cellular network. Utilities are provided to each UE which is connected to one of the BSs. Signals sent from the BSs to their respective UEs is called the downlink (DL), while transmissions from the UEs to their respective BSs refers as a uplink (UL)[1].

Presently to meet the presumptions and challenges of the near future, technology like high-speed packet access (HSPA) and long-term evolution (LTE) will be launched which are wireless based networks. However, in early days, mobile wireless communication provides only analogue voice calls which are now a days developed to modern technologies with all facilities voice and video call, image so on. They are giving peak quality mobile broadband utilities with end-user data rates of several megabits per second. Due to this numerous numbers of communication devices (mobile phones and tablets) and mobile networks are required [2].

In the process of communication, digitization has played an echo role as a greater number of advancements is going on from 1G to 2.5G and from 3G to 5G. 5G is in demand presently due to its high bandwidth such that broadband is available with their handsets. Most of the users are waiting to access their handsets as it provides large amounts of features for instance: better coverage area and high data rate at the edge of the cell, low battery consumption, Availability of multiple data transfer path, Around one giga per second data rate is easily possible, security is more and also Energy efficiency and spectral efficiency are good (Research is going on to limit the energy consumption) Additionally 5G has more number of advantages like People can feel her kid's stroke in her mother's womb, know about sugar level with the help of mobile, able to view if unauthorised person enters in organisation or residence and can know the information about tsunami/earthquake before it occurs etcetera [3].

In 5G networks, Massive MIMO is a recent technology which has been developed from the already used MIMO technology. Massive MIMO utilizes arrays of antenna accommodating few hundred antennas which are at the same time in one time, frequency slot helping many tens of user terminals. To the greater extent this technique is robust, secure and energy efficient [6].

Moreover, Bacterium forging optimization algorithm (BFOA) is a probabilistic technique which is used to solve numeric optimization problem with the help of food-seeking & reproductive behaviour of common bacteria such as E-coli. It is developed by Kevin M. Passino in 2000 to solve distributed optimization problems. Behaviour of Escherichia coli (E. coli) bacteria living in human intestine is used to build BFOA which is also known as bio-inspired technique. Logical selection contributes to pull out animals with low foraging strategies and favours the transmission of genes of those animals that have outstanding foraging strategies, as they are more prone to have reproductive success. Later frequent, generations, low foraging strategies are either detached or constructed into positive ones. In optimization process this technique of foraging is used [4].

In this paper, we describe the introduction related to evolution of 5G technology, its features and application which are briefly discussed. Additionally, how to optimize energy efficiency is covered in the purposed work of this paper. Bacterium forging optimization technique is applied to improve the energy parameter [5]. Energy efficiency is defined as to complete a certain amount of work, how much energy is evolved. Moving further, the next section comprises of Results that are obtained by simulation performed on Matlab software. In the last section conclusion determines how much energy is optimized with the help of optimization algorithm.

2. PURPOSED WORK

In large networks in which number of nodes are more, to share the information source node have to find the destination node which is quite difficult in first attempt, therefore to share the information, first step is to find the path through which data to be send. For that purpose many routing algorithm are designed, with the help of these algorithms path can be established and nodes are capable of sharing the data. In that process energy factor plays an important role. So to save the energy, network is divided into clusters (group of nodes). Each cluster will have the cluster head which have all the information (like energy consumption, throughput etc.) related to its area or nodes comes under that cluster. Choosing the cluster head is also a task, basically cluster has to take the decision which node to make a cluster head, sometimes the new node entered the network work as cluster head, on the other hand random node is chosen to behave as a cluster head. In the present network or in the cluster formation, the energy consumption is optimized with the help of Bacterial foraging optimization [7][8]. In Figure 1.1 flowchart shows the method to optimize the energy.

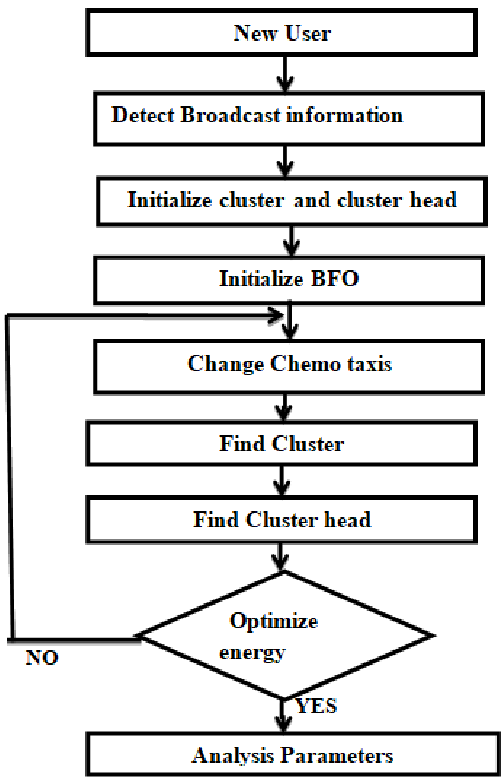

Figure 1.1: Flowchart to show the methodology used to optimize energy

If we elaborate further each bacterium can only modify the search behaviour of itself by using the current status of its own. In this way, not only the position solution vector, but also the run-length unit of each bacterium undergoes evolution, respectively. This individual-level self-adaptation may provide us with more accurate information about the search because it is the separate individuals that engaged in searching the solution space not just the whole colony. In the foraging process, each bacterium displays alternatively two distinct search states. First is exploration state, during which the bacterium employs a large run-length unit to explore the previously un scanned regions in the search space as fast as possible and second is exploitation state, during which the bacterium uses a small run-length unit to exploit the promising regions slowly in its immediate vicinity. Each bacterium in the colony has to permanently maintain an appropriate balance between exploration and exploitation states by varying its own run-length unit adaptively. The adaptation of the individual run-length unit is done by taking into account two decision indicators: a fitness improvement finding a promising domain and no improvement registered lately current domain is food exhausted.

The criteria that determine the adjustment of individual run-length unit and the entrance into one of the states i.e., exploitation and exploration are the following. Criterion-1: if the bacterium discovers a new, promising domain, the run-length unit of this bacterium is adapted to another smaller one. Here, "discovers a new promising domain" means this bacterium registers a fitness improvement beyond a certain precision from the last generation to the current. Following Criterion-1, the bacterium's behaviour will self-adapt into exploitation state. Criterion-2: if the bacterium's current fitness is unchanged for a number Ku user defined of consecutive generations, then augment this bacterium's run-length unit and this bacterium enters exploration state. This situation means that the bacterium searches an unpromising domain or the domain where this bacterium focuses its search has nothing new to offer. This self-adaptive strategy is given in Pseudocode 2, where t is the current generation number, Ci t is the current run-length unit of the ith bacterium, εi t is the required precision in the current generation of the ith bacterium, α and β are user-defined constants, and Initial and initial are the initialized run-length unit and precision goal, respectively. The flowchart of the ABFO1 algorithm can be illustrated by Figure 4b, where S is the colony size, t is the chemotactic generation counter from 1 to max-generation, i is the bacterium's ID counter from 1 to S, Xi is the ith bacterium's position of the bacteria colony, Ns is the maximum number of steps for a single activity of Swim, and flag is the number of generations the ith bacterium has not improved its own fitness.

3. RESULT ANALYSIS

The purposed work is simulated using matlab software from where the results came and they are shown in this section. Base stations comprises of arrays of more number of antennas, each radiates or transmits with low power, this thing happened in massive MIMO. Mathematically, Electrical efficiency is defined as the ratio of throughput (bits/cell) to power consumption.

In figure 1.2, the energy conserved by proposed approach and existing approach using different number of users. its represented by the first term of the denominator, which also has a similar strDL-EEture to the preferred signal. This term is amplified at the same rate with the preferred signal; this fact is due to the limitation of the base stations to separate reused pilot sequences. The energy conversation will be degraded by adding interference signals .[11].

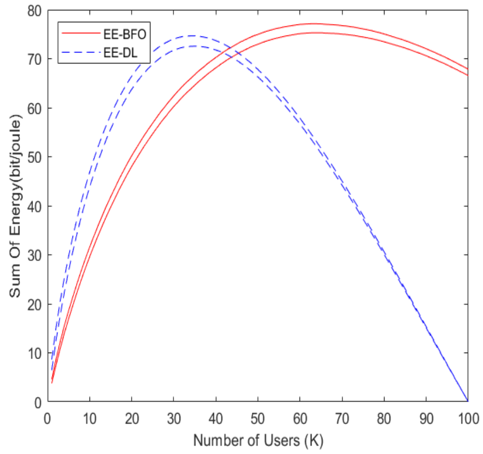

Figure 1.2: Comparison Sum of energy conservation in massive MIMO in different number of users

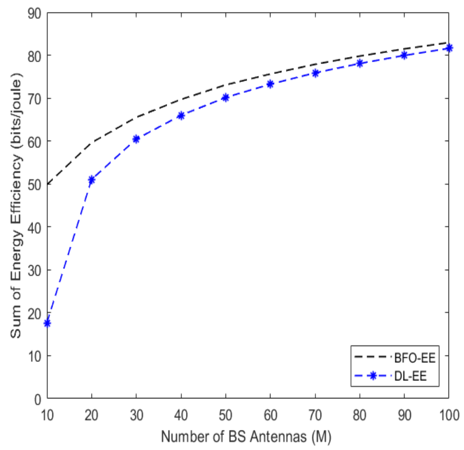

Figure 1.3: Sum of energy conservation in massive MIMO in different number of Base Stations

In fig 1.3 comparison of BFO-EE and DL-EE interference signals represent practically interference but dealing with all these signals is technically oppressive. Thus, only interference signals that are beyond the noise level and at the edge of the preferred signal are considered. Consequently, dealing with only dominant interference signals is sufficient to reach sub-optimal receivers. As previously mentioned, part of the interference signal should be known at the receiver. For instance, interference channel information should be known at the receiver to detect and decode the signal. Also, control signalling between network base stations should afford a comfort sharing media to transfer resources allocation, coding, and modulation schemes. Other extra information about the interference signal can be blindly estimated to avoid backhaul signalling overhead.

Table 1.1 Proposed approach spectral and energy efficiency in different number of users and Base station

Number BS	SE(BFO-EE)	EE(BFO-EE)	Number of user(K)
1	0	0	1
10	5.31452209	5.337198128	5
20	11.87663533	12.01788876	9
50	29.61551296	30.42061981	19
80	44.19620961	45.99977993	27
110	56.27922403	59.3120207	32
140	66.28107789	70.53209325	37
170	74.73037216	80.33554305	40
200	82.02000569	88.86232038	43
230	88.41296993	96.34861413	44
260	94.07829602	103.0400116	47
290	99.20926193	109.0584572	48
320	103.8394127	114.53423	48
350	108.0673968	119.5255878	49
380	111.9280659	124.1442047	49
410	115.4991731	128.4248769	50
440	118.8279174	132.3845721	51
470	121.9409946	136.0999079	51
500	124.8646004	139.5973712	52

In table 1.1 analysis the BFO-EE from the training session during upload, BS can use the estimated BFO-EE to pre coder data to each user. However, if the BFO-EE is imperfect, the preceded signal quality can be degraded. This is due to many factors, where we are interested in presenting the pilot contamination effect as a key challenge. Based on the received signal expression at the k-th user terminal, a lower bound on the capacity between the k-th user terminal in the l-th cell and its serving base station (BS) is presented in the following theorem; detection vector is replaced with the preceding one. Considering the interference term, it also has a similar strDL-EEture unless the indices between the channel vector and the processing vector are swapped.

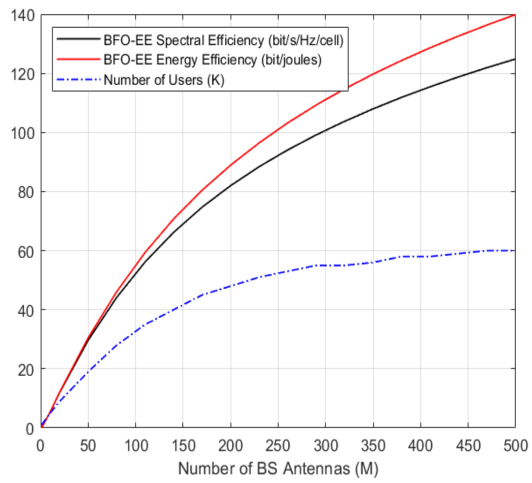

Figure 1.4: Proposed approach spectral and energy efficiency in different number of users and Base station

In fig 1.4 analysis number of users and BS station with spectral efficiency and energy efficient using frequency band is shared among all cells, the intra-cell interference is considered negligible due to the orthogonality of pilots within the same cell. However, since adjacent cells may encounter the same pilot sequences, inter-cell interference may occur. The reuse factor will directly scale up the contamination effect leading to severe performance degradation. This is starts in the uplink session, while BS is trying to separate pilot signals. However, due to the lack of pilot sequence orthogonality between several users, the BS will fail to separate user signals. Hence, an inaccurate BFO-EE estimation will be trained.

4. CONCLUSION

Among the discussed differences, the most disruptive one was the fact that MIMO systems may be doubly massive at mm-Waves. In this paper, it has been shown that the use of large-scale antenna arrays has not an as beneficial impact on the system multiplexing capabilities as it has at µ-Wave frequencies. Additionally, the availability of doubly massive MIMO wireless links enables the generation of very narrow beams, resulting in red DL-EEed co-channel interference to other users using the same time-frequency resources. Another key advantage of doubly massive MIMO system at mm-Waves is the fact that the computational complexity of channel estimation weakly depends on the number of antennas, especially for the case in which analog (beam-steering) beam forming strategies are used. While massive MIMO at µ-Wave frequencies is gradually entering 3GPP standards, mm-Waves and in particular massive mm-Wave MIMO systems are still under heavy investigation, both in academia and industry. In the result section of this paper, effect on energy efficiency by increasing the number of base stations and users has been discussed.

5. REFERENCES

[1] R.Baldemair, "Evolving wireless communications: Addressing the challenges and expectations of the future," IEEE Veh. Technol. Mag., vol. 8, no. 1, pp. 24–30, Mar. 2013.

[2] T. Rappaport, Wireless Communications: Principles and Practice, Prentice-Hall, Englewood Cliffs, NJ, 1996.

[3] Arun Agarwal, Gourav Misra, Kabita Agarwal, The 5th Generation Mobile Wireless Networks- Key Concepts, Network Architecture and Challenges, American Journal of Electrical and Electronic Engineering, 2015, Vol. 3, No. 2, 22-28.

[4] Ms. Kiran, Dr. Sunita Choudary, "Bacterial Foraging Optimization: Review", International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 7, July - 2013 IJERT ISSN: 2278-0181.

[5] Amali, C., & Ramachandran, B. (2018). Enabling Key Technologies and Emerging Research Challenges Ahead of 5G Networks: An Extensive Survey. JOIV: International Journal on Informatics Visualization, 2(3), 133-146.

[6] Zhu, Kun, and Ekram Hossain. "Virtualization of 5g cellular networks as a hierarchical combinatorial aDL-EEtion." IEEE Transactions on Mobile Computing 15.10 (2016): 2640-2654.

[7] Kevin M. Passino. "Biomimicry of bacterial foraging for distributed Optimization and control", IEEE Control Systems Magazine, 22(3):52-67, 2002.

[8] Kevin M. Passino, "Bacterial Foraging optimization", International Journal of Swarm Intelligence Research, pp. 1-16, Jan-Mar 2010

[9] Rebato, M., Mezzavilla, M., Rangan, S., &Zorzi, M. (2016, April). Resource sharing in 5G mmWave cellular networks. In 2016 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS) (pp. 271-276). IEEE.

[10] Panwar, N., Sharma, S., & Singh, A. K. (2016). A survey on 5G: The next generation of mobile communication. Physical Communication, 18, 64-84.

[11] Sulyman, A. I., Nassar, A. T., Samimi, M. K., MacCartney, G. R., Rappaport, T. S., &Alsanie, A. (2014). Radio propagation path loss models for 5G cellular networks in the 28 GHz and 38 GHz millimeter-wave bands. IEEE Communications Magazine, 52(9), 78-86.

[12] Sciancalepore, V., Mancuso, V., Banchs, A., Zaks, S., & Capone, A. (2016). Enhanced content update dissemination through D2D in 5G cellular networks. IEEE Transactions on Wireless Communications, 15(11), 7517-7530.

[13] Liu, G., Yu, F. R., Ji, H., Leung, V. C., & Li, X. (2015). In-band full-duplex relaying for 5G cellular networks with wireless virtualization. IEEE Network, 29(6), 54-61.

[14] Qiao, J., Shen, X. S., Mark, J. W., Shen, Q., He, Y., & Lei, L. (2015). Enabling device-to-device communications in millimeter-wave 5G cellular networks. IEEE Communications Magazine, 53(1), 209-215.

[15] Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", Foundations and Trends R in Signal Processing: Vol. 11, No. 3-4, pp 154–655. DOI: 10.1561/2000000093.

