Interference Coordination Using Cell Cluster for 5G Dynamic TDD System

Junping Liu, Zekai Liu, Nan Liu(✉), Zhiwen Pan, and Xiaohu You

National Mobile Communications Research Laboratory, Southeast University, Nanjing 210096, China
{zkliu,nanliu,pzw,xhyu}@seu.edu.cn

Abstract. The deployment of small cells of dynamic time division duplexing (TDD) using orthogonal frequency division multiple access (OFDMA) is one of the key technologies of 5th-generation (5G). The main problem limiting the performance of dynamic TDD is the existence of cross-link interference in these mobile networks. In order to adapt to the new scenario of 5G, on the basis of the traditional clustering scheme, this paper proposes a new clustering criterion considering both the user equipment to user equipment (UE-UE) interference and base station to base station (BS-BS) interference, and realizes dynamic clustering of the cells. The proposed method can simultaneously solve the uplink and downlink interference problems, and improve the system performance. Compared with the traditional clustering algorithm, the scheme proposed in this paper has certain improvement in the throughput of the system, especially in the downlink.

Keywords: Dynamic TDD · Cross-link interference · Cell cluster · Femtocell · Ultra-dense network

1 Introduction

With the rapid development of mobile Internet, the next generation cellular network, the 5th-generation (5G) mobile communication system will emerge in order to cope with the explosive growth of mobile data traffic. One of the key technologies of 5G is the deployment of small cells of dynamic time division duplexing (TDD) using orthogonal frequency division multiple access (OFDMA). The main goal of dynamic TDD is to realize the flexible utilization of the downlink (DL) and uplink (UL) spectrum of small cells, and to meet the needs of asymmetric and dynamically changing upstream and downstream traffic. However, dynamic TDD mode has high and uncontrollable interference, especially the cross-link interference (CLI) between base stations (BSs) and between user equipments (UEs). BSs in UL receiving state will be interfered by other BSs, while UEs in DL receiving state will be interfered by adjacent UEs [1].

Moreover, low-power nodes is introduced in 5G NR system. By placing high-density low-power nodes, the capacity and the coverage rate of the 5G NR system

H. Gao et al. (Eds.): ChinaCom 2020, LNICST 352, pp. 244–255, 2021.
https://doi.org/10.1007/978-3-030-67720-6_17

can be improved greatly. However, dense deployment of low-power nodes can lead to serious inter cell interference (ICI). Inter cell interference coordination technology (ICIC) is the mainstream technology to suppress interference between cells, through collaboration between cells of wireless resource management [2]. As a solution to interference mitigation and traffic adaption (IMTA) problem, cell cluster is widely accepted [3]. With cell cluster, cells with severe mutual interference are grouped in the same cluster, and the same configuration is adopted in the same cluster to reduce interference. In [4], the paper pointed out that the large scale of cell cluster reduced the flexibility of traffic adaptation, resulting in the low DL performance gain of pico cell. Based on the traditional cell clustering, an optimized reconfiguration algorithm was proposed in [5]. [6] proposed an objective function of the cell cluster based on IMTA, combined with the advantages of threshold value and the heuristic algorithm, respectively as the short-term and long-term planning. The scheme is superior to the traditional cell cluster solution, especially in the uplink, and the performance in the downlink are identical. A cluster classification mechanism was proposed in [7] to divide the sub-regions into different groups according to the degree of interference of each base station. The base station could use adaptive adjustment of TDD uplink and downlink configuration to increase the transmission capacity of the system, thus reduce the downlink to uplink (DL-UL) interference and improve the network throughput.

However, the above studies only consider the interference from base station to base station (BS-BS), but ignore the interference from user equipment to user equipment (UE-UE). The main contributions of this paper are as follows. Firstly, in the dynamic TDD network under the 5G scenario, we propose a dynamic clustering algorithm considering the interference between UEs to carry out interference coordination. Then the algorithm we proposed is simulated with the indoor dual stripe-building model, compared with no interference coordination scenario and traditional cell cluster scheme. The results show the proposed scheme can suppress the CLI caused by the dynamic TDD technology in 5G indoor single-layer ultra-dense network (UDN), and improves the system throughput.

The rest of the paper is organized as follows. In Sect. 2, we introduce the interference problem in the dynamic TDD network. In Sect. 3, we introduce the principle of interference coordination by clustering, and elaborate our proposed scheme. In Sect. 4, the proposed scheme is implemented by system-level simulation. Finally, in Sect. 5, we summarize and discuss our work.

2 Interference Problem in Dynamic TDD Network

In dynamic TDD network, there are two kinds of interferences, i.e. co-direction interference and CLI, while there are only co-direction interference in the static TDD mode.

Compared with the static TDD technology, the information transmission direction of the cell may or may not be consistent due to the dynamic change of TDD configuration in time and space. The asynchronous operation of dynamic TDD causes CLI. There are two forms of CLI, UE-UE interference and BS-BS interference.

In this case, the BS on the UL will experience interference from other DL BSs, while the UE on the DL will experience interference from the UL UE of adjacent cell.

An example is given as shown in Fig. 1. Consider two adjacent BSs, each of which has a severely interfered UE at the edge of its coverage area. It is assumed that BS1 and BS2 select frame structure configuration 2 and configuration 1 respectively according to their current traffic loads. In Fig. 1, BS2 is disturbed by DL signal from BS1 at the third sub-frame, resulting in a decrease in signal quality received by BS2. On the other hand, DL signal from BS1 to UE1 is disturbed by UL data transmission from UE2.

Existing researches are mainly aimed at how to eliminate the interference between BSs. Because in a typical deployment scenario, the transmission power of BSs is far higher than the transmission power of UEs. However, the combination of ultra-dense network (UDN) with dynamic TDD allows for the extensive use of ultra-dense cells and low-power nodes. In this case, the UE-UE interference should be paid close attention to, especially when two UEs are located at the nearest edge of two cells, as shown in Fig. 2. In addition, since the location of public facilities is not known, it is unreasonable to just consider the coupling loss between BSs as the clustering criterion. Therefore, the path loss between the closest UEs in the two cells also needs to be considered.

3 Cell Clustering Interference Mitigation

3.1 The Basic Idea of Clustering

The clustering algorithm allocates cells to clusters according to specific rules. Cells are divided into clusters and each cluster can contain one or more cells. The cells in the same cluster adopt the same UL/DL sub-frame configuration to reduce the BS-BS interference and UE-UE interference. However, the transmission direction

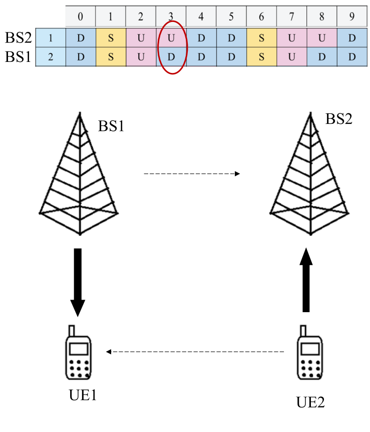

Fig. 1. Dynamic TDD cross-link interference

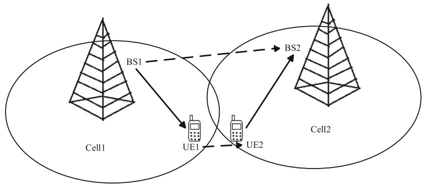

Fig. 2. Serious UE-UE interference scenarios

of cells in different cell clusters can be different. The rules of clustering must take into account the level of interference and asymmetric UL and DL traffic. In different scenarios, there are significant differences in the objectives and criteria of clustering schemes. Figure 3 is an example of an interference coordination scheme using cell cluster, where the femtocells operating at the same frequency. In Fig. 3, the low-power access point network is divided into several clusters, each containing one or more cells. Thus, cells with strong CLI are organized in the same cluster e.g. Cluster1 and Cluster2, and same UL/DL sub-frame configuration is used within a cluster. Therefore, there will be no CLI between cells in the same cluster. And CLI only exists between cells of different clusters with different transmission directions. In 5G ultra-dense network, due to the extensive use and intensive deployment of low-power femtocells, the UE-UE interference must also be considered. Therefore, in the new clustering criterion, the coupling loss between BSs and between UEs should be taken into account at the same time. The goal of the proposed scheme is to improve both the UL and DL throughput of the system.

3.2 New Clustering Scheme

In order to consider both UL and DL performance of the system, we give the formulas for calculating the signal to interference and noise ratio (SINR) of UL and DL respectively. For the j-th UE served by the BS in the i-th cell, SINR in UL is defined as in (1). For the j-th UE connected to the BS in the i-th cell, the DL SINR is defined as in (2).

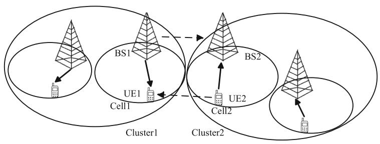

Fig. 3. Dynamic TDD small cluster interference coordination diagram

$$SINR_{i,j}^{UL} = \frac{S_{j,i}^{UL}}{\sum\limits_{k=1,k\neq i}^{K} I_{k,i}^{DL-UL} + \sum\limits_{l=1,l\neq i}^{L} I_{l,i}^{UL-UL} + N_0} \tag{1}$$

$$SINR_{i,j}^{DL} = \frac{S_{i,j}^{DL}}{\sum\limits_{k=1,k\neq i}^{K} I_{k,j}^{DL-DL} + \sum\limits_{l=1,l\neq i}^{L} I_{l,i}^{UL-DL} + N_0} \tag{2}$$

$S_{j,i}^{UL}$ is the power spectral density of the UL signal of the j-th UE received by the i-th BS, $S_{i,j}^{DL}$ is the power spectral density of the DL signal of the i-th BS received by the j-th UE. K is the total number of BSs transmitted in the DL direction, and L is the total number of UEs transmitted in the UL direction. $I_{k,i}^{DL-UL}$ is the power spectral density of the DL interference signal received by the i-th BS from the k-th BS, $I_{l,i}^{UL-UL}$ is the power spectral density of the UL interference signal received by the i-th BS and transmitted by the l-th UE. $I_{k,j}^{DL-DL}$ is the power spectral density of the DL signal transmitted by the k-th BS and received by the equipment of the j-th UE, $I_{l,i}^{UL-DL}$ is the power spectral density of the UL interference signal transmitted by the l-th UE and received by the j-th UE, N_0 is the average power spectral density of AWGN. The BS-BS interference and UE-UE interference can be calculated in (3) (4).

$$I_{k,i}^{DL-UL} = P_k + TAG_k + RAG_i - PL_{k,i}(dB) \tag{3}$$

$$I_{l,j}^{UL-DL} = P_l + TAG_l + RAG_j - PL_{l,k}(dB) \tag{4}$$

P_k and P_l represent the power of the k-th BS and j-th UE respectively, TAG_k and TAG_l represent the transmitting antenna gain of the k-th BS and the l-th UE respectively, RAG_i and RAG_j represent the receiving antenna gain of the i-th BS and j-th UE respectively, $PL_{k,i}$ is the propagation loss from k-th BS to i-th BS. $PL_{l,k}$ is the propagation loss from k-th BS to i-th BS.

$$CL_{k,i}^{BS} = PL_{k,i}^{BS} - TAG_k^{BS} - RAG_i^{BS}(dB) \tag{5}$$

$$CL_{k,i}^{UE} = \frac{\sum\limits_{n_k=1}^{N_k} \sum\limits_{n_i=1}^{N_i} (PL_{n_k,n_i}^{UE} - TAG_{n_k}^{UE} - RAG_{n_i}^{UE})}{N_k \cdot N_i} \tag{6}$$

The coupling loss between the BS of i-th cell and the BS of k-th cell can be calculated in (5). The average coupling loss between UEs in i-th cell and UEs in k-th cell can be calculated in (6). $PL_{k,i}^{BS}$ is the path loss between the BSs in i-th cell and k-th cell. PL_{n_k,n_i}^{UE} represent the path loss between UE n_i in i-th cell and UE n_k in k-th cell. TAG_k^{BS} and $TAG_{n_k}^{UE}$ represent the transmitting antenna gain of the k-th BS and the UE n_k respectively. RAG_i^{BS} and $RAG_{n_i}^{UE}$ represent the receiving antenna gain of the i-th BS and the UE n_i in i-th cell respectively. N_k is the total number of UEs in k-th cell, and N_i is the total number of UEs in i-th cell.

For dynamic cell cluster strategy in dynamic TDD network, we present the definition of different metric in (7). The difference metric (DM) of i-th cell and j-th cells is related to three factors, the coupling loss of BSs between i-th cell and j-th cell, the average path loss of users between i-th cell and j-th cell, and the difference of traffic between i-th cell and j-th cell. The weights of these three factors are δ, β, λ.

$$DM_{i,j} = \delta \frac{CL_{i,j}^{BS}}{\overline{CL^{BS}}} + \beta \frac{CL_{i,j}^{UE}}{\overline{CL^{UE}}} + \lambda \frac{|R_i^{Cell} - R_j^{Cell}|}{\overline{R^{Cdl}}} \tag{7}$$

$CL_{i,j}^{BS}$ represents the coupling loss between the i-th BS and the j-th BS, $\overline{CL^{BS}}$ represents the mean value of coupling loss between BSs, $CL_{i,j}^{UE}$ represents the average coupling loss between users of the i-th cell and the j-th cell, $\overline{CL^{UE}}$ represents the average coupling loss among users of all cells, $|R_i^{Cell} - R_j^{Cell}|$ is the absolute value of the difference between the ratio of DL and UL of i-th cell and j-th cell, $\overline{R^{Cdl}}$ represents the average ratio of DL and UL in all cells.

The process of cell cluster includes the following steps:

1) DM can be calculated as long as the cell obtains coupling loss and traffic buffer information. A clustering matrix $\mathbf{DM} = [DM_{i,j}]$ can be obtained according to the calculation result of DM. When $i = j$, $DM_{i,j} = 0$.
2) Set the threshold DM_0 for clustering. Firstly, randomly select a cell with SINR lower than the set threshold as the master cell of the cluster, and then check the DM of other cells and the master cell. If the DM between a cell and the master i-th cell is greater than the DM_0, the cell and the master cell are grouped into the same cluster. Based on the above initial cluster, all other cells except the master cell loop the above operation, put the cell with the DM greater than the threshold DM_0 into the initial cluster, to form the first cluster.
3) Then, randomly select a cell whose $SINR$ is lower than the set threshold and is not in the cluster as the master cell of the cluster, and conduct the above operation for all remaining cells until all cells whose $SINR$ is lower than the threshold have been grouped into the clusters.
4) After that, the master cell that is not in the cluster is randomly selected as the master cell of the cluster, and the above operation is carried out for all remaining cells until all cells have been divided into disjoint cell clusters. When the SINR of the UL/DL of any i-th cell are below the threshold or the timer starts again, the cells are regrouped.

After clustering, the UL and DL reconfiguration of cells in the cluster is carried out. Seven frame configurations defined in TDD are shown in Fig. 4. Then, before the start of each configuration cycle, the ratio of DL to UL traffic in each cell is calculated for each cluster, and the average ratio of DL to UL traffic in the cluster is calculated. From the TDD configuration table, select the configuration mode in which the ratio of DL to UL sub-frames is closest to this result, as described in (8).

$$i_x = \underset{i=0,1,2,\ldots,6}{\arg\min} |R_i - R_{Cluster}|. \tag{8}$$

Config	Subframe number										Up-Link	Down-Link
	0	1	2	3	4	5	6	7	8	9		
0	D	S	U	U	U	D	S	U	U	U	6	2
1	D	S	U	U	D	D	S	U	U	D	4	4
2	D	S	U	D	D	D	S	U	D	D	2	6
3	D	S	U	U	U	D	D	D	D	D	3	6
4	D	S	U	U	D	D	D	D	D	D	2	7
5	D	S	U	D	D	D	D	D	D	D	1	8
6	D	S	U	U	U	D	S	U	U	D	5	3

10ms

D Downlink subframe S Special subframe U Downlink subframe

Fig. 4. Seven frame configurations for TDD mode.

R_i is the ratio of the DL sub-frames to the upper row subframes of the i-th configuration, R_b is the ratio of the downlink flow to the uplink flow in the actual cache of the cell cluster, R_i is calculated in (9) and $R_{Cluster}$ is calculated in (10). In (10), the ratio of the sum of the DL flow to the sum of the UL flow in the cluster is taken as the ratio of the DL flow to the UL flow of the cluster.

$$R_i = \frac{N_i^{DL} + N_i^S \cdot R_{DwPTS}}{N_i^{UL} + N_i^S \cdot R_{UwPTS}} \tag{9}$$

N_i^{DL} is the number of DL sub-frames in the i-th configuration, N_i^{UL} is the number of UL sub-frames in the i-th configuration, R_{DwPTS} is the ratio of DL pilot time slot (DwPTS) in the special subframe, R_{UwPTS} is the ratio of UL pilot time slot (UwPTS) in a special subframe.

$$R_{Cluster} = \frac{\sum_{n=1}^{N} B_n^{DL}}{\sum_{n=1}^{N} B_n^{UL}} \tag{10}$$

B_n^{DL} and B_n^{UL} represent the DL flow and UL flow of the n-th cell in the cluster respectively.

4 Simulation Results

The first step of simulation is to build the dual strip buildings model. The second step is to decorate femto BSs in combination with UE, and then set the parameters of the simulation according to Table 1. After that, we simulate three schemes in parallel, namely, the original cell without the interference regulation scheme, the IMTA scheme with the traditional clustering method and the scheme we proposed, and finally collected the simulation data and analyzed the results.

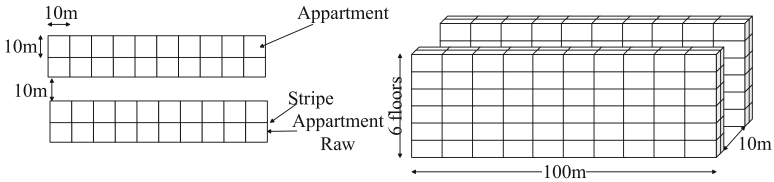

Fig. 5. Dual strip building model

In high-density residential buildings, the deployment of the femtocells is often lack of planning. This is the most complex case, so this article focuses on this case and uses the dual strip model as Fig. 5. Each building has six floors, with two rows of rooms on each floor and 10 rooms in one row. The length, width and height of each room are 10 m, 10 m and 3 m respectively. It is assumed that the femto BS and UE have similar transmitting power. The distribution of femto BS and UE is random. Firstly, the number of i-th cells designated as K, and then K rooms are randomly selected. With each room selected, a femto BS and multiple UEs are randomly scattered.

4.1 System-Level Simulation Model

This paper refers to the path loss models of [8]. In these indoor models, the penetration loss of walls and floors is considered. The penetration loss of signals passing through the walls of buildings as shown in (11).

$$\begin{aligned} PL = {} & 38.46 + 20\log_{10} R + 0.7 d_{2d,indoor} \\ & + 18.3n((n+2)/(n+1) - 0.46) + p \cdot L_{ow} + q \cdot L_{iw}(dB) \end{aligned} \tag{11}$$

R represents the distance between the transmitter and the receiver, $d_{2d,indoor}$ is the distance inside the building. n represents the number of floors between transmitter and receiver. p, q are the number of outer walls and inner walls between the transmitter and receiver respectively, L_{ow} and L_{iw} represents the increased path loss for outer wall and inner wall, and each wall within the building will increase the path loss by 20 dB and 5 dB respectively.

4.2 Metric and Results

The performance metric of this simulation is the throughput of cells. For the convenience of link modelling, the proportional Shannon capacity model proposed in [5] is selected to simulate the influence of different physical layer parameters on link performance. Shannon's theorem can be used to obtain the Shannon capacity as throughput, as shown in (12).

$$U = \begin{cases} 0 & \gamma < \gamma_{min} \\ \alpha \cdot W \cdot \log_2(1 + \beta \cdot \gamma) & \gamma_{min} \le \gamma < \gamma_{max} \\ U_{max} & \gamma \le \gamma_{max} \end{cases} \tag{12}$$

Table 1. Simulation parameters

Parameter	Value
Network deployment	Dual strip model
Carrier frequency	2 GHz
The system bandwidth	10 MHz
Number of single cell users	1
Antenna pattern	Omni antenna
Femto power	23 dBm
Femto noise	13 dB
Antenna gain	0 dBi
Uplink power control	$p_0 = -75$ dBm, $\alpha = 0.8$
UE antenna gain	0 dBi
UE noise	9 dB
UE maximum power	23 dBm
Dynamic configuration cycle	10 ms

Throughput for a given link is denoted by U, and the SINR for such link is expressed by γ. γ_{min} and γ_{max} represent the minimum SINR required for adaptive coding and the SINR when the maximum throughput is reached respectively, U_{max} represents the maximum throughput achieved by adaptive modulation coding, α, β represents the attenuation factors, and W denotes channel bandwidth.

We carried out the simulation for all cases with cells number from 1 to 240 under the carrier frequency of 2 GHz, the values of the UL throughput and DL throughput of all cells in the system with cell number changed were counted. The simulation results are shown in Fig. 6 and Fig. 7.

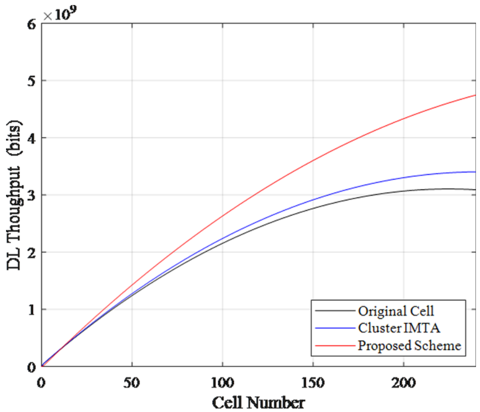

Fig. 6. DL throughput of all cells

Table 2. UL and DL throughput

Scheme	Uplink (Mbits)		Downlink (Mbits)	
	120 cells	240 cells	120 cells	240 cells
Original cell	1739 (baseline)	2854 (baseline)	2437 (baseline)	3091 (baseline)
Cluster IMTA	2029 (16.7%)	3395 (18.9%)	2546 (4.5%)	3405 (10.1%)
Proposed scheme	2039 (17.3%)	3405 (19.3%)	3051 (25.2%)	4740 (53.3%)

Figure 6 shows the change of DL throughput with the number of cells in three schemes. With the increase of the number of cells, the DL throughput of the three simulation schemes increase. However, when the number of cells reached to a certain number, due to serious CLI, the DL throughput of original cells increased slowly or even decreased. The traditional cluster IMTA based on BS-BS coupling loss can slightly improve this situation, and has a certain gain on the DL throughput, but it is unable to solve the interference problem good enough to ensure the throughput continue to increase with the number of cells increasing. The proposed scheme can significantly solve interference problems and greatly improve the system's DL throughput, especially in the case of numerous cells. Figure 7 shows the change of UL throughput with the number of cells in three schemes. Both the traditional cluster IMTA scheme based on BS-BS coupling loss and our scheme can improve the UL throughput of the system largely. Specific data are listed in Table 2. Under the condition of the distribution of 120 cells, original cells without interference coordination have a total UL throughput of 1739 Mbits, traditional cluster IMTA can have a 16.7% gain in UL throughput, and the proposed scheme has a 17.3% gain. For the DL throughput, original cells without interference coordination have a total DL throughput of 2437 Mbits, traditional cluster IMTA can only has about 4.5% gain in DL throughput, while the proposed scheme has a gain of 25.2%. Under the condition of the distribution of 240 cells, original cells without interference have a total UL throughput of 2854 Mbits, cluster IMTA can have

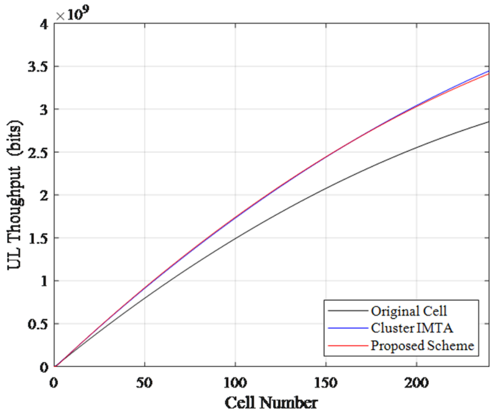

Fig. 7. UL throughput of all cells.

an 18.9% gain in UL throughput, and the proposed scheme has a 19.3% gain. For the DL throughput, original cells without interference coordination have a total DL throughput of 2437 Mbits, and the scheme we proposed have a gain of 53.3%, while cluster IMTA can only has about 10.1% in DL throughput.

5 Conclusion and Discussion

In the 5G UDN scenario, the BS often adopts micro-small BS. In this case, different from the case in LTE, the power of the BS is not significantly different from that of the UE, even in the same order of magnitude. Therefore, the interference between users need to be considered in 5G scenario. Based on the traditional clustering scheme, this paper proposes a new clustering criterion considering both the UE-UE interference and BS-BS interference, and realizes dynamic clustering of the cells. Simulation results show that the proposed method can simultaneously solve the UL and DL interference problems to improve the system performance. Compared with the traditional clustering algorithm, proposed scheme has certain improvement in the SINR and throughput of the system, especially in the DL.

Acknowledgment. This work is partially supported by the National Key Research and Development Project under Grants 2019YFE0123600 and 2020YFB1806800, the National Natural Science Foundation of China under Grants 62071115, and the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 872172 (TESTBED2 project: www.testbed2.org).

References

1. Yun, D.W., Lee, W.C.: LTE-TDD interference analysis in spatial, time and frequency domain. In: 2017 Ninth International Conference on Ubiquitous and Future Networks (ICUFN), pp. 785–787. IEEE (2017)
2. Altabbaa, M.T., Arsan, T., Panayirci, E.: Power control and resource allocation in TDD-OFDM based femtocell networks with interference. In: 2017 IEEE International Black Sea Conference on Communications and Networking (BlackSeaCom), pp. 1–5. IEEE (2017)
3. Zhu, D., Lei, M.: Cluster-based dynamic DL/UL reconfiguration method in centralized ran TDD with trellis exploration algorithm. In: 2013 IEEE Wireless Communications and Networking Conference (WCNC), pp. 3758–3763. IEEE (2013)
4. Sun, F., Zhao, Y., Sun, H.: Centralized cell cluster interference mitigation for dynamic TDD DL/UL configuration with traffic adaptation for HTN networks. In: 2015 IEEE 82nd Vehicular Technology Conference (VTC2015-Fall), pp. 1–5. IEEE (2015)
5. Li, X., Ma, N., Tang, Q., Liu, B.: Buffered DL/UL traffic ratio sensing cell clustering for interference mitigation in LTE TDD system. In: 2018 IEEE Wireless Communications and Networking Conference (WCNC), pp. 1–6. IEEE (2018)
6. Nasreddine, J., Hassan, S.E.H.: Interference mitigation and traffic adaptation using cell clustering for LTE-TDD systems. In: 2016 IEEE International Multidisciplinary Conference on Engineering Technology (IMCET), pp. 155–159. IEEE (2016)

7. Cheng, M.H., Wang, Y.J., Hwang, W.S., Wu, Y.J., Lin, C.H.: Adaptive adjustment of TDD uplink-downlink configuration based on cluster classification in beyond LTE heterogeneous networks. In: 2017 International Conference on Applied System Innovation (ICASI), pp. 1312–1315. IEEE (2017)
8. Jundhare, M.D., Kulkarni, A.: An overview and current development of femtocells in 5G technology. In: 2016 IEEE International Conference on Advances in Electronics, Communication and Computer Technology (ICAECCT), pp. 204–209. IEEE (2016)