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# Research on Power Control of D2D Communication System in 5G Network

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**Abstract**. Although D2D (device-to-device) communication can improve the spectrum utilization rate by multiplexing uplink resources in a 5G cellular network, it also brings interference to the 5G cellular network. So, the power of the D2D communication system should be controlled to reduce interference to cellular network effectively. Aiming at the above interference problem, a MPP-PPP (Matern Hard-core Point Processes-Poissonon Point Process) model is established to make it closer to the actual system situation, according to the randomness of the distribution of mobile terminals. Based on the model, an optimized power control method is proposed to achieve the optimization goal, according to the principle of system throughput maximization. The simulation shows that compared with the traditional scheme, the proposed algorithm can effectively improve system throughput with the QoS being satisfied.

**Keywords**: 5G network, D2D communication, interference coordination, power control

## 1 Introduction

In recent years, with the development of 5G, 5G mobile communication is mainly used in enhanced mobile broadband, large-scale machine communication, ultra-reliable and low-latency communication. 5G mobile communication will increase the technical indicators in terms of user experience rate, spectrum efficiency, mobility, delay, and network energy efficiency by one or more orders of magnitude compared to 4G systems. Taking the peak transmission rate and system energy efficiency as an example, the peak transmission rate of SG mobile communication is expected to reach 10 Gb/s, which is 100 times higher than the 100Mb/s of 4G mobile communication, and the system energy efficiency needs to be increased by 10 compared with 4G mobile communication. This makes the intelligent terminal show explosive growth. However, the cellular network has limited spectrum resources and it is difficult to handle these huge data flows. The existing wireless transmission key technologies supporting 4G mobile communication will not be able to meet the needs of 5G mobile communication. Therefore, it is extremely urgent to develop new wireless transmission key technologies. The D2D (device-to-device) communication technology [1], which is one of the key technologies of the 5G network, can multiplex the resources of cellular users with the assistance of the base station and improve the utilization of spectrum resources [2]. D2D communication is a short-distance direct communication technology, which can be used as a communication relay without a base station. Because the distance is short, it will not bring a large system overhead to the system. Therefore, it is mainly applied in the 5G network scenarios such as car networking, emergency communication and network capacity expansion. As an important part of 5G network, D2D communication technology plays an irreplaceable role in the formation of 5G complex cellular network architecture in the future.

While multiplexing the spectrum resources of the cellular link to improve the spectrum utilization, the D2D users will also bring the same-frequency interference to the cellular users of the 5G network, and the interference coordination can reduce the interference to a certain extent [3]. Therefore, this topic mainly aimed at modeling and simulating the interference of D2D scenes in the future 5G network,

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establishing a more realistic and more accurate interference model, and analyzing the average user signal-to-noise ratio SINK and user average throughput performance of the wireless system through simulation. Compared with the traditional hexagonal interference model, the accuracy of the model is verified. Based on the principle of system throughput maximization, the optimization goal is established and an optimized power control method is proposed. The subject has very important research significance and application value.

## 1.1 D2D Communication Application Scenario

Although D2D communication technology is currently only applicable to small-scale communication services, with the popularity of mobile devices, the explosive growth of information and the rise of users based on geographic location information services, D2D communication has gradually entered our lives, and its application scenarios mainly include :

**Local business.** A local service is a service in which data is directly generated between terminals without passing through a base station. The most typical of local businesses is social applications based on proximity characteristics. For example, increase spectrum utilization and reduce transmission pressure. For example, in places with large data traffic, such as large concert venues, users can request data and obtain data from a server that stores data provided by an operator or a content provider through D2D communication. In order to alleviate network overload and reduce network pressure.

**Emergency communication.** Under the destruction of some natural disasters such as earthquakes and mudslides, the traditional cellular communication network will be paralyzed. Users in the disaster areas cannot transmit information to the outside world, and the outside world cannot understand the situation of the disaster area. This will bring great relief to the rescue. Big difficulty. The amount of property and personnel lost. We can use D2D communication to transmit data in this case. Even if the communication network infrastructure is destroyed, the mobile device can still establish D2D communication transmission data to ensure the effective transmission of information under any circumstances, which can reduce loss and rescue timely.

**Internet of things enhancement.** The most typical application for IoT enhancement is the Internet of Vehicles. For example, during the driving process, if deceleration, overtaking, lane change, etc. are to be performed, the driver can make a prompt to nearby vehicles through D2D communication, and other vehicles receive an early warning and feed back to the driver, so that the driver You can make the right judgment.

**Multiplex cellular communication resources.** This is a major reason for the development of D2D technology, which aims to improve spectrum utilization and reduce base station load.

## 1.2 Advantages and Challenges of D2D Communication

**Advantages.** After the D2D communication is introduced on the 5G network, a large number of terminal devices access the neighboring terminals through the D2D mode, which can improve the spectrum efficiency by multiplexing the resources of the cellular network. The D2D users can directly perform the terminal communication connection without passing through the base station, thereby alleviating the pressure on the base station. Improve data transmission rate; because D2D transfers data directly between terminals, thereby reducing end-to-end transmission delay and reducing terminal transmission power; since D2D utilizes widely distributed terminals, it can improve coverage and expand coverage when wireless communication Infrastructure damage, or in the coverage area of wireless networks, terminals can use D2D to achieve end-to-end communication and even access to cellular networks, improving link flexibility and network reliability.

**Challenges.** The adoption of D2D in 5G also faces some challenges. First of all, the switching between D2D and cellular communication becomes a prominent problem. When the terminal distance is insufficient to maintain short-range communication, or the D2D communication condition is satisfied, how to perform optimal selection switching of the D2D communication mode and the cellular communication mode needs to be solved; secondly, D2D cell interference needs to be considered. When D2D communication is performed in a cell or between cells, it will inevitably cause interference to other users and cell base stations. How to perform interference coordination is a problem that D2D needs to solve.

### 1.3 Research Status of D2D Communication

At present, the research on interference coordination mainly focuses on the power control strategy [4]. Specifically, the power setting of the D2D communication terminal can be mainly divided into two modes: the first one is a static setting, that is, the interference received by the CU that multiplexes the same resource is within the tolerable range and D2D communication can proceed smoothly. When the D2D communication session is initiated, the BS sets the maximum transmit power of the D2D terminal through a series of data analysis and calculation, and the setting continues until the end of the D2D communication. Obviously, the static setting method is simple and easy, but the real-time changes of the channel and user state are not considered, so it is difficult to achieve the best system performance. The second is dynamic setting, that is, the D2D user can dynamically adjust the power according to the target SINR and the actual SINR returned. Since the power can be adjusted in real time according to the channel and user state changes, the system performance can be greatly improved, but the signaling overhead in this case will be much larger than the static setting mode.

The 5G network is an ultra-dense heterogeneous network, but for the selection of models, most of the literature adopts a simple traditional hexagonal cell model. The literature [5] uses the traditional hexagonal cell model for D2D users. And cellular users take a simple even distribution [5], without considering the randomness of users in actual communication. [6-7] considers the process of spatial Poissonon Point, but the basic homogeneous Poissonon Point Process model [6-7] is adopted for both the base station and the user. In the actual situation, the distribution of base station should have more aggregation characteristics than the basic second Poissonon Point Process. In terms of power control, [8] proposes a simple power control scheme, In this strategy, D2D users will set a transmission power at the beginning of communication, and then keep this transmission power unchanged throughout the communication, so the transmission power cannot be timely adjusted according to the real-time situation of the channel [8]. [9] divides users into two groups of high and low interference, and then compensates for different path losses, but the scheme only takes into account the situation of a single cell, and does not take into account the interference brought by adjacent cells in actual communication.

In this paper, combined with the randomness of mobile terminal distribution, the MPP-PPP (Matern Hard-core Point Processes-Poissonon Point Process) model is established, which solves the problem that the traditional regular hexagonal model is relatively fixed and does not conform to the actual situation of 5g network. Based on this model, an optimized power control method is proposed, which is based on the maximization of system throughput. Under the premise of QoS requirement, the system performance can be improved effectively.

## 2 System Model and Interference Analysis

The current research model for D2D communication technology mainly focuses on the traditional regular hexagon. In the model of the regular hexagon, the distance between the base station and the base station is fixed, and the users are evenly distributed around the base station. Such model is not suitable for 5G hyperdense network with multi-layer isomerization in the future [10]. Therefore, MPP-PPP interference model is adopted in this paper.

### 2.1 General Model

**PPP model.** The PPP (Poissonon Point Process) model refers to the homogeneous Poisson point process model, which is the earliest type of spatial point process to be applied, and is the simplest and most common point process model. In the point process theory and application, the homogeneous Poisson point process occupies a very important position. Poisson point process is a very suitable model for many phenomena in real life. Based on homogeneous Poisson point process, a variety of more complex spatial point processes can be constructed through various point process processing operations. Some complex point processes can usually be simplified into homogeneous Poisson point processes by means of random comparison or some specific transformation. Therefore, the homogeneous point process lays the foundation for stochastic point process theory.

The generation steps of the homogeneous Poisson point process algorithm can be summarized as follows:

(1) Generate a random number N, obeying a Poisson distribution with a mean of $\lambda_1$;

(2) N points are randomly generated in the plane, and these N points constitute a homogeneous Poisson point process model with a density of $\lambda_1$.

The PPP model is the most basic and simplest point process model, which can vividly describe the point random distribution process of D2D users and cellular users in the communication system.

**MPP model.** The MPP (Matern Hard-core Point Processes) model refers to the Matern hard-core process, which is improved on the basis of the PPP model. The main idea is that it is based on a point process without any restrictions (PPP). If the distance between any two points is less than a given minimum distance threshold, then those points that do not conform to the rule are deleted according to certain rules, and the final result is the hard core point process. First, it is also necessary to generate a homogeneous Poisson point process $\Phi_p$ with a density of $\lambda_p$ and then randomly assign a value to these points. This value is taken from the interval (0, 1). For example, the value assigned to point $x$ is $m_x$, and finally deleted. In the circular area $B(x,R)$ where the point $x$ is the center and R is the radius, all the points larger than the value $m_x$ are present.

The density of the process is $\lambda = p\lambda_p$, where $p$ is the probability that a point will not be deleted. The formula is:

$$p = \int_0^1 \exp(-\lambda_P ct)dt = \frac{1-\exp(-\lambda_P c)}{-\lambda_P c},\ c = \pi R^2\ . \tag{1}$$

So the density of the point process can be obtained as $\lambda = 1-\exp(-\lambda_P c)/c$

The software implementation steps of MPP are as follows:

(1) Generate a Poisson point process called $\Phi_p$ with a density of $\lambda_2$;

(2) Add a mark to the point generated in step 1, that is, $m_x \in U\left[0,1\right]$, the marks between each point are independent of each other;

(3) For each point in the circle $B\left(x,R\right)$, if the mark $m_x$ of the point $x$ is the smallest, the point is retained and the remaining points are all deleted.

Where $\left[0,1\right]$ is the uniform distribution in the 0~1 interval and R is the given minimum distance. The method of generating points can be summarized as:

$$\Psi = \left\{x: x \in \Phi_p, m_x \le m_y, \forall \in B\left(x,R\right) \cap \Phi_p\right\}\ . \tag{2}$$

In the formula, $\Psi$ represents the point retained in circle $B(x,R)$. According to this method, all the points selected to be retained can be obtained, and the remaining points constitute the MPP model.

In the MPP model, any two points are repulsive, that is, the distance between the two points is not allowed to be too close, and such characteristics just meet the needs of the base station distribution.

### 2.2 MPP-PPP System Model

According to the distribution of base stations and users, this paper establishes the MPP-PPP model, and combines the MPP model with the PPP model to better reflect the randomness of users and the irregularities of the cells in the actual communication system.

MPP-PPP model consists of Base Station (Base Station), traditional cellular user equipment (CUE) and D2D user equipment (D2D user equipment) pairs, as shown in Fig. 1. The red star is BS, the black dot represents the cellular user, the blue + is the transmitting end of the D2D pair, and the red dot is the D2D receiving end.

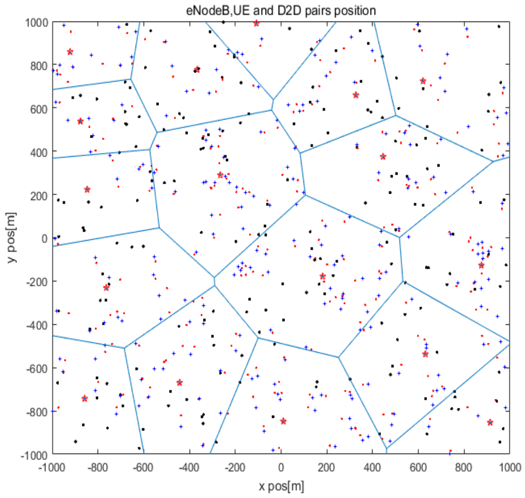

**Fig. 1.** MPP-PPP system model in D2D scenario

For the base station (BS) of the first layer, the location is built into an MPP model, and the base station density is set to $\lambda_B$ ( $\lambda_B$ =17 square kilometers) according to the actual situation, which fits the distribution density of the base station in reality, and the base station is The minimum distance between the two is limited to R (R = 500 m), which is in line with the distance between the base station and the base station in actual situations, so that the distribution of the base station can divide the entire plane into multiple Thiessen polygons, wherein each Tyson polygon represents a base station. The coverage, as can be clearly seen from the figure, the coverage size of each cell is not fixed but random, and the shape is also irregular, which is more in line with the deployment of real-time base stations.

According to the actual situation, the position of the D2D transmitting end is set to a density of $\lambda_D$ ( $\lambda_D$ = 90 square kilometers) to obey the independent PPP model. Compared with the density of the base station, the density of the D2D terminal equipment is slightly larger. The distance between the transmitter and the receiver of each D2D pair is $\gamma_D$ ( $\gamma_D$ = 30 meters). The position of each D2D pair is randomly distributed on a circle or within a circle $\gamma_D$ meters from its transmitter.

The distance $\gamma_D$ between the D2D pairs has a certain influence on the systemicity of the MPP-PPP model. As the distance $\gamma_D$ between the D2D pairs increases, the system performance will deteriorate, but within a certain range (10m-50m) Not big. Because under the simulation conditions given in this paper, as $\gamma_D$ increases, the path loss between D2D pairs increases, resulting in the D2D receiving signal from the receiving end is smaller, which leads to the SINK of the D2D user. So choose the most intermediate distance in the range, 30m, which is more suitable.

At the same time, for ordinary cellular users, the location distribution is also subject to another independent PPP model with a density of $\lambda_{CU}$ ( $\lambda_{CU}$ = 180 square kilometers). The number of cellular users is twice as large as that of D2D users, because the cellular network is the basis of communication, and the cellular users are the basic users, so that D2D users can be provided with the opportunity to reuse resources.

As shown in Fig. 1, the base station and the base station are not too close to each other, and the cells are all irregular polygons, and the distribution is more in line with the randomness of the mobile terminal.

### 2.3 Interference Analysis

In the D2D communication system, when the *i*-th D2D user pair ( $DUE_i$ ) multiplexes the uplink sub-channel resources of the *j*-th cellular user ( $CUE_j$ ), interference occurs, as shown in Fig. 2.

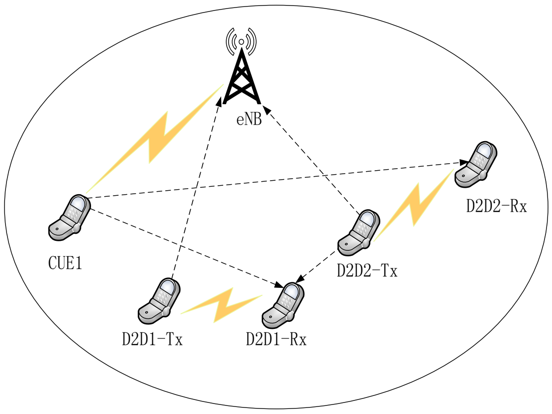

**Fig. 2.** Interference analysis of D2D for multiplexing uplink channel resources

As can be seen from Fig. 2, the transmitting end of the D2D pair will cause interference to the BS, and at the same time, the transmission of the CUE will cause interference to the receiving end of the D2D. When there are multiple pairs of D2Ds multiplexing the same $CUE_j$ resource at the same time, there will also be interference between the D2D pairs.

**System interference with BS.** It is assumed that there are M pairs of D2D users multiplex the resource block RB (Resource Block) of the $CUE_x$, so the eNB will be interfered by the two parts of the D2D transmitting end. Then, the signal to interference and noise ratio ($\beta_{B,n}$) received by the BS in the serving cell ($Cell_i$) on the nth RB is expressed as:

$$\beta_{B,n} = \frac{P_x^C * G_{C_x,BS}}{N_0 + I_{inter} + \sum_{j=1}^{M} P_j^D * G_{D_j,BS}}. \tag{3}$$

Among them, $P_x^C$ is the transmitting power of $CUE_x$, $P_j^D$ is the transmitting power of D2D pair to the $j$ node, $G_{C_x,BS}$ is the channel gain between $CUE_x$ and base station, $G_{D_j,BS}$ is the channel gain between $j$ node and base station of D2D, $N_0$ is the thermal noise received by the receiver, $I_{inter}$ is the interference between adjacent cells, and is obtained by interference measurement in reference [11].

**System interference with D2D users.** In the uplink, the resource blocks of each D2D pair of multiplexed cellular users are determined according to a certain resource reuse strategy. If $DUE_x$ and $DUE_j$ are multiplexed with the same cellular user's RB, then $DUE_x$ will interfere with $DUE_j$, There are M pairs of $DUE_x$ and $DUE_j$ multiplexed with the same RB. Therefore, $DUE_x$ will be subject to interference of two parts, namely, interference of cellular users and interference of M D2D sender that multiplex the same cellular resources. Then, the signal to interference and noise ratio $\beta_{D,n}$ on the nth RB at the receiving end of the $DUE_x$ is expressed as:

$$\beta_{D,n} = \frac{P_x^D * G_D}{N_0 + \sum_{k=1}^{N} P_k^C * G_{C_k,D_x} + \sum_{j=1}^{M} P_j^D * G_D}. \tag{4}$$

Where $P_x^D$ is the transmit power of $DUE_x$, $P_j^D$ is the transmit power of D2D to the $j$-th node, $P_k^C$ is the transmit power of $CUE_k$, $G_D$ is the channel gain of the D2D link, and $G_{C_{k,D_x}}$ is the channel between $CUE_k$ and the $x$ node of D2D Gain, $N_0$ is the thermal noise received by the receiver.

## 3 Power Control

D2D can bring interference while multiplexing the uplink resources. The appropriate power control method can reduce the interference appropriately, which can make full use of spectrum resources. First, when the system is set to transmit power, it should meet the QoS requirements in the network. Secondly, the energy consumption of mobile devices is also very critical, so power control should consider the balance between communication service quality and energy consumption.

The SINR values obtained from each uplink data correspond to different QoS requirements. Suppose $\beta_j^C$ is the threshold of $CUE_j$. In order to ensure normal data transmission between devices, it is necessary to make the target SINR value of each uplink not less than the threshold value, there are :

$$\beta_{B,n} \geq \beta_j^C , \tag{5}$$

$$\beta_{B,n} = \frac{P_x^C * G_{C_x,BS}}{N_0 + I_{inter} + \Sigma_{j=1}^M P_j^D * G_{D_j,BS}} , \tag{6}$$

$$\frac{P_x^C * G_{C_x,BS}}{N_0 + I_{inter} + \Sigma_{j=1}^M P_j^D * G_{D_j,BS}} \geq \beta_j^C . \tag{7}$$

Then there are:

$$P_j^D * G_{D_j,BS} \leq \frac{P_x^C * G_{C_x,BS}}{\beta_j^C} - N_0 - I_{inter} . \tag{8}$$

Suppose that $P_{jmax}^D$ is the maximum power the D2D transmitting device can transmit in physics. There are:

$$P_j^D \leq min\left\{ P_{jmax}^D , \frac{P_x^C * G_{C_x,BS}}{\beta_j^C * G_{D_j,BS}} \right\} . \tag{9}$$

Similarly, when the SINR value received by the D2D link is smaller than the threshold, the D2D link becomes unreliable. In this case, the D2D link cannot be used for communication. Therefore, the threshold of the SINR ( $\beta_0^D$ ) is set to be To make the D2D link reliable, there are:

$$\beta_{D,n} \geq \beta_0^D , \tag{10}$$

$$\frac{P_x^D * G_D}{N_0 + \Sigma_{k=1}^N P_k^C * G_{C_k,D_x} + \Sigma_{j=1}^M P_j^D * G_D} \geq \beta_0^D . \tag{11}$$

Then there are:

$$P_j^D \geq \frac{\left( N_0 + \Sigma_{k=1}^N P_k^C * G_{C_{k,D_x}} \right) * \beta_0^D}{\left( 1 - \beta_0^D \right) * G_D} . \tag{12}$$

So by combining equations (9)and (10)you can get:

$$P_j^D = \{ P \mid \frac{\left( N_0 + \Sigma_{k=1}^N P_k^C * G_{C_{k,D_x}} \right) * \beta_0^D}{\left( 1 - \beta_0^D \right) * G_D} \leq P \leq min\left\{ P_{jmax}^D , \frac{P_x^C * G_{C_x,BS}}{\beta_j^C * G_{D_j,BS}} \right\} \} . \tag{13}$$

Therefore, the transmit power of D2D should satisfy the formula (13).

## 4 Performance Simulation and Analysis

Based on the analysis above, the power control of D2D communication system is simulated and analyzed in this paper. The MPP-PPP model is based on the irregular polygonal multi cell model established in 2.2. In which, the realization of the base station obeys the MPP model, and the D2D users and cellular users adopt the PPP model. The simulation parameters are set as shown in Table 1.

**Table 1.** Simulation parameter setting

| parameter | numerical value |
|---|---|
| Resource block bandwidth /KHz | 180 |
| Distance of D2D pair transmission and reception/m | 30 |
| Number of base stations | 16 |
| Base station transmit power /dBm | 43 |
| CUE transmit power /dBm | 23 |
| D2D user maximum transmit power /dBm | 24 |
| Number of D2D pair | 10 |
| Minimum spacing between base stations/m | 500 |
| Number of cellular users | 50 |
| Noise power density /(dBm• $H_z^{-1}$ ) | -174 |
| Shadow fading ( $\mu = 0$ )/dB | $\sigma = 8$ |
| Path loss eNB-user | 33.65+23.47lg10(d) |
| Path loss user-user | 36.67+19.54lg10(d) |

### 4.2 Comparison of User Performance Under Different Models

Considering the accuracy of MPP-PPP model, this paper compares the model with the traditional hexagon model. The user average SINR accumulation distribution function is shown in Fig. 3.

It can be seen from Fig. 3 that the curve on the left represents the traditional hexagonal model, and the curve on the right represents the MPP-PPP model constructed in this paper. Under the same conditions of CDF (Cumulative Distribution Function), the MPP-PPP constructed in this paper. The model SINR is better than the traditional regular hexagon model, because the number of users distributed around each base station is fixed and evenly distributed, which is not in line with the actual situation; and the cell established by the MPP-PPP model They are random and irregular polygons, which are more realistic. Fig. 4 shows the cumulative probability density curve for the average throughput of the user.

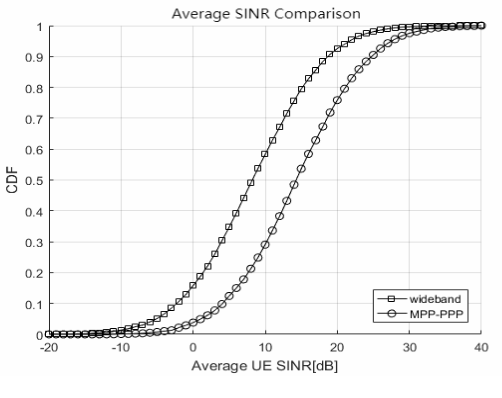

**Fig. 3.** User average SINR cumulative distribution function

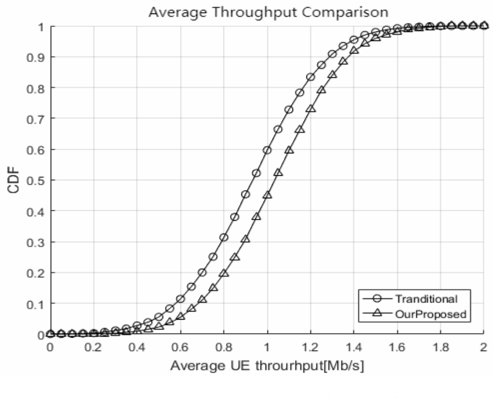

**Fig. 4.** User average throughput cumulative distribution function

As can be seen from Fig. 4, the throughput of the MPP-PPP model is improved relative to the conventional regular hexagon and corresponds to the SINR curve of Fig. 3, since the distribution of the actual base stations is not evenly distributed in the regular hexagon. Adopting a model that is divided according to irregularities increases throughput. Therefore, the performance of the MPP-PPP model constructed in this paper is better than that of the traditional hexagonal model, and it is more suitable for the interference model in the future 5G ultra-dense heterogeneous network.

### 4.2 Performance Comparison of Different Power Control Strategies Under MPP-PPP Model

Fig. 5 shows the total throughput of all users. The left curve in the figure represents a simple D2D power control scheme proposed in [8]. In this strategy, the D2D user sets a transmit power at the beginning of the communication and then maintains this throughout the communication. The transmission power does not change, so the transmission power cannot be adjusted in time according to the real-time situation of the channel. The curve on the right represents the power control scheme of this paper. It can be seen from the figure that the power control method proposed in this paper is better, and [8] only considers In the case of a single cell, this paper also considers the interference problem between adjacent cells, and then designs the algorithm with threshold power control to obtain the optimal solution under the premise of guaranteeing the service quality of the communication system.

Fig. 6 is a comparison diagram. The figure contains four curves. It can be seen from the figure that after using the power control algorithm of this paper, the throughput of cellular users is significantly improved, because in the 5G network D2D communication system, D2D users multiplex cellular spectrum resources and are interfered. The largest is the cellular user, so the power control scheme proposed in this paper is effective, improving the communication quality of cellular users and conforming to the actual situation. However, since the D2D user also receives the interference of the cellular user and the interference of the D2D transmitting end that multiplexes the same cellular resource during the communication process, the throughput is also improved correspondingly after the power control algorithm is adopted.

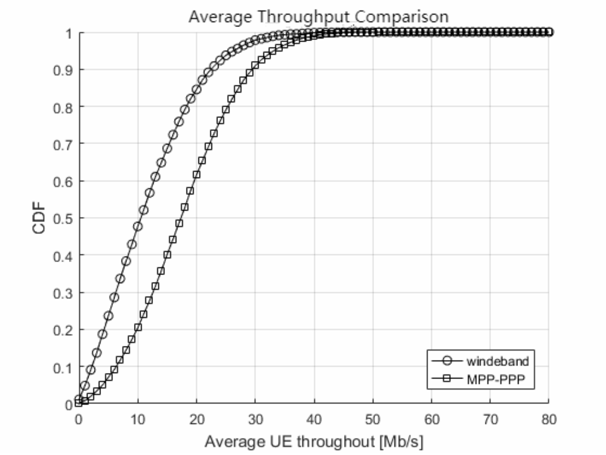

**Fig. 5.** Cell User Throughput

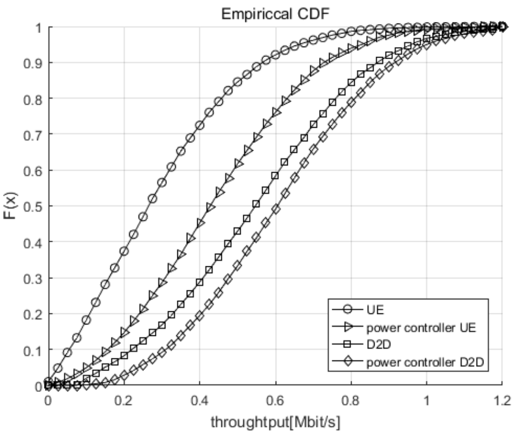

**Fig. 6.** Throughput of D2D users and cellular users

## 5 Conclusion

Since the deployment of 5G ultra-dense heterogeneous networks in the future makes inter-cell interference more serious and complicated, how to establish an effective model to simulate the distribution of interference is very important for the verification analysis of D2D communication system technology under 5G networks. D2D communication technology can alleviate the current situation of spectrum resource shortage to a certain extent, but due to the reuse of D2D users, it will bring some new interference problems. This paper mainly studies the power control simulation analysis of D2D communication system under 5G network. In this paper, a two-layer MPP-PPP model is established to ensure the randomness of the mobile terminal. On this basis, a power control scheme for setting the threshold of the transmit power of the D2D user is proposed, which ensures the communication quality of the cellular user. To reduce interference, the algorithm proposed in this paper has a better effect than the traditional scheme to a certain extent, but there are still some insufficiencies. For example, in terms of models, users are relatively simple and have no spatial correlation. The simplest PPP model of sex, in the next study, should consider more accurate models. In terms of interference coordination, this paper only considers power control, and the D2D interference coordination method also includes mode selection [12] and resource allocation [13]. In future research, it should also consider whether these three methods can be combined to obtain a more perfect Interference coordination strategy.

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