Fusion evaluation method of 5G communication and navigation based on DS evidence theory

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***Abstract*—With the development of mobile communication networks, 5G-based high-precision positioning technology has become a reliable way to solve the location service problem. However, 5G networks are unable to allocate adequate resources for positioning due to the limited time-frequency domain resources. This paper suggests a positioning resource evaluation factor and a 5G-based Co-band signal broadcast regime to image the impact of positioning resources on positioning performance and achieve positioning without affecting communication performance. In addition, this paper jointly estimates the localization resource evaluation factor with the bit error rate based on DS evidence theory to evaluate the communication-navigation fusion performance of 5G networks.**

Keywords—5G positioning, DS evidence theory, Communication and navigation integration

I. INTRODUCTION

Currently, the Global Positioning Navigation System (GPS) is the primary method for providing outdoor location services. Its pseudo-range positioning accuracy can reach the meter level. By combining GNSS and cellular networks positioning, such as RTK carrier phase differential technology, the positioning accuracy can reach up to the centimeter level. [1] has proposed GNSS Pseudorange Residual Error Mitigation model, which improved pseudorange positioning accuracy to 3m. J. M. Codol has proposed a new Global Positioning System (GPS) mono-frequency triple difference positioning technique, which can achieve centimeter-level positioning accuracy [2].

However, the performance of GPS services in complex obscured environments such as urban canyons, underground, tunnels and indoors is sharply reduced, and reliable location services cannot be guaranteed, making the ubiquitous application of PNT challenging. In order to compensate for the above positioning blind spots, positioning technologies such as mobile communication network positioning, Wi-Fi, Bluetooth and UWB have come into being. Wi-Fi positioning accuracy can reach the meter level, Bluetooth and UWB positioning accuracy can reach the sub-meter level, and with the development of cellular networks, 5G's large bandwidth, low latency and flexible resource allocation features will improve the positioning accuracy of mobile communication networks from the meter level to the sub-meter level.

The author [3] had implemented AOA-based triangulation using Wi-Fi and obtained a positioning accuracy better than 1.4m, but the Wi-Fi standard is designed for WLAN networks with a signal coverage of the order of ten meters and does not have miniaturized nodes similar to Bluetooth Beacon, resulting in extremely high construction costs for wide-area coverage.

For indoor dynamic positioning, [4] used a low-power Bluetooth iBeacon scheme basing on the received signal strength to estimate the location information, which is simple to obtain data compared to other positioning methods, does not require any dedicated hardware, in addition, it can also achieve meter level positioning accuracy. At this time, although the Bluetooth positioning technology has improved in terms of power consumption and positioning accuracy, the propagation distance is not far enough, resulting in a small coverage area, and the Beacon node coverage is generally only about ten meters, in addition, the communication capacity is also small, resulting in the inability to broadcast fine-grained and high navigation message information.

The paper obtained the round-trip distance between the point to be measured and the base station by bi-directional ranging to obtain the position information of the point to be measured, this method does not require strict clock synchronization between base stations and has the characteristics of low complexity and low latency, and the highest positioning accuracy reaches 40 cm, which achieves sub-meter level positioning[5]. Similar to Bluetooth and Wi-Fi technologies, UWB signal coverage is small, and large-scale coverage requires extremely high network construction costs, and the existing terminals have less support for UWB, and the majority of terminals do not support this technology technique.

However, Wi-Fi, Bluetooth and UWB positioning technologies only cover 6% of the land and can only achieve local positioning, while 2G/3G/4G/5G networks cover about 95% of the population and more than 40% of the land. Using wireless networks to achieve high-precision positioning can make up for blind areas of satellite signal coverage in indoor and underground areas, so that communication and positioning can share a common network, providing ubiquitous and seamless

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spatio-temporal information sensing capability, solving the high cost problem of establishing a separate positioning network, and providing the possibility of integrating communication and navigation.

The 5G signal has a new signal regime, and its large bandwidth and flexible configuration compared to 4G make the ranging accuracy of the 5G positioning reference signal(PRS) significantly improved, giving mobile communication networks the ability to provide high-precision location services. The paper [6] proposed a new multipath suppression method by appropriately modifying the structure of the conventional MEDLL, which solved the multipath problem in 5G localization and improved the multipath suppression performance by 60%. The author in [7] proposes a three-stage timing recovery scheme, using 5GPRS as the pilot symbol to estimate the path time delay and complete the receiver sampling clock synchronization, using a generalized path time delay estimation method that can correct for timing errors larger than one sample, integrating a delay-locked loop (DLL) that tracks the phase of the PRS code when the phase error is within one sample, with a positioning accuracy better than 2m.

In the process of using 5G PRS for location services, it will take up communication resources and reduce the effectiveness of communication. As to how much the use of 5G network for positioning affects communication, few academics have studied it so far.

Based on this, this paper firstly investigates the influence of the percentage of positioning resources on the positioning accuracy, and proposes a signal-to-noise induced embedded 5G positioning signal broadcast system, which annihilates the positioning reference signal under the communication signal in the form of low power, and performs high-precision positioning within the permissible noise range of the communication signal. Secondly, a fusion assessment model for joint communication and positioning is constructed using DS evidence theory, and an integrated communication and navigation assessment threshold for 5G networks is established to realize joint assessment of communication and positioning fusion performance of 5G networks.

II. SYSTEM MODEL

The communication and navigation convergence evaluation system is shown in Figure 1. First, the core network determines the configuration of communication and navigation-related resource parameters based on the data information to be sent, and second, the positioning resource evaluation factor is established by calculating the percentage of positioning resources of the signals sent from the base station to the terminal, while the positioning performance is measured in three dimensions: time-frequency-power, and the bit error rate is estimated a priori based on the modulation mode of the communication system estimation. Finally, the positioning resource evaluation factor and the bit error rate are evaluated comprehensively by DS evidence theory to create a communication-navigation fusion evaluation threshold. If the joint evaluation function is greater than the threshold value, good communication-location function can be achieved at the same time, and if it is less than the threshold value, the positioning performance needs to be increased by changing the configuration of the positioning resources.

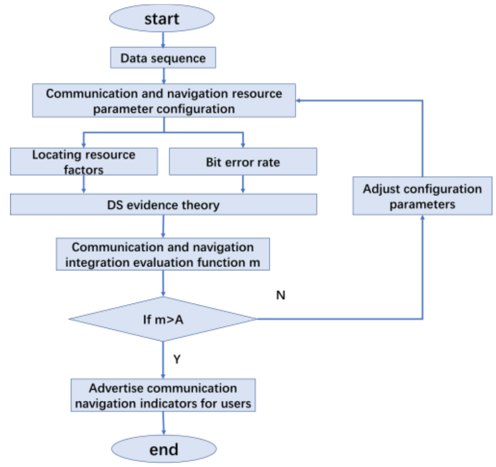

Figure 1. System framework diagram

III. POSITIONING AND COMMUNICATION PERFORMANCE EVALUATION METHODS

A. PRS downlink OTDOA positioning process

When the terminal needs positioning, it sends OTDOA positioning request to the positioning management function(LMF), which sends positioning request to the service base station, the core network sends OTDOA positioning reply to LMF by evaluating the surrounding base stations, LMF sends positioning response to the terminal, and the terminal finally measures the downlink positioning reference signal to calculate its own position information [8].

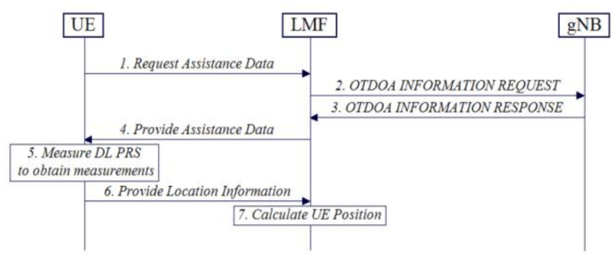

Figure 2. Downlink OTDOA positioning process

The 5G positioning reference signal generation sequence, as specified in 3GPP standard 38.211, is

$$r(m) = \frac{1}{\sqrt{2}}\big(1 - 2c(2m)\big) + j\frac{1}{\sqrt{2}}\big(1 - 2c(2m+1)\big) \tag{1}$$

Generic pseudo-random sequences $c(n)$ are defined by a length-31 Gold sequence.

$$c(n) = \big(x_1(n+N_C) + x_2(n+N_C)\big)mod2 \tag{2}$$

$$x_1(n+31) = \left(x_1(n+3) + x_1(n)\right) mod2 \tag{3}$$

$$x_2(n+31) = \left(x_2(n+3) + x_2(n+2) + x_2(n+1) + x_2(n)\right) mod2 \tag{4}$$

where $N_C = 1600$ and the first m-sequence $x_1(n)$ shall be initialized with $x_1(0) = 1, x_1(n) = 0, n = 1,2,...,30$ .The initialization of the second m-sequence, $x_2(n)$, is denoted by

$$c_{\text{init}} = \left(2^{22}\left\lfloor\frac{n_{\text{ID,seq}}^{\text{PRS}}}{1024}\right\rfloor + 2^{10}\left(N_{\text{symb}}^{\text{slot}} n_{\text{s,f}}^{\mu} + l + 1\right)\left(2\left(n_{\text{ID,seq}}^{\text{PRS}} \bmod 1024\right) + 1\right) + \left(n_{\text{ID,seq}}^{\text{PRS}} \bmod 1024\right)\right) \bmod 2^{31} \tag{5}$$

Where $n_{s,f}^{\mu}$ is the slot number, the downlink PRS sequence ID $n_{\text{ID,seq}}^{\text{PRS}} \in \{0,1,\ldots,4095\}$ is given by the higher-layer parameter, and l is the OFDM symbol within the slot to which the sequence is mapped.

For downlink positioning reference signals, the base station can broadcast positioning reference signal sequences of any amplitude, that is, the sequence $r(m)$ is scaled with a factor β_{PRS} and mapped to resources elements $(k,l)_{p,\mu}$ according to

$$a_{k,l}^{(p,\mu)} = \beta_{\text{PRS}}\, r(m) \tag{6}$$

$$\begin{aligned} m &= 0, 1, \ldots \\ k &= mK_{\text{comb}}^{\text{PRS}} + \left(\left(k_{\text{offset}}^{\text{PRS}} + k'\right) \bmod K_{\text{comb}}^{\text{PRS}}\right) \\ l &= l_{\text{start}}^{\text{PRS}}, l_{\text{start}}^{\text{PRS}} + 1, \ldots, l_{\text{start}}^{\text{PRS}} + L_{\text{PRS}} - 1 \end{aligned}$$

B. Location resource assessment factor construction

When the base station broadcasts data, the positioning accuracy cannot be estimated directly, but the positioning resource allocation can be used to reflect the ranging performance and thus estimate positioning performance.

In 3GPP 38.211 it is stated that the nominal value of PRS time domain period must equal 2^{μ} multiplied by one of the values in the set {4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 160, 320, 640, 1280, 2560, 5120, 10,240}, where μ is the subcarrier spacing configuration with a value of 0, 1, 2, or 3. PRS resource repetition factor must equal the values in the set{1,2,4,8,16,32}, That is, when the PRS time domain period is greater than 32, the PRS sequence cannot be fully spread over the time domain and the localization function is discontinuous.

Based on this, the following parameters are constructed in this paper to measure the impact of positioning resources on positioning accuracy.

$$\gamma = \sum_{j=1}^{TPRS} \frac{\sum_{i=1}^{n} \log_{10} Ap_{ij}}{\sum_{i=1}^{n} \log_{10} Ap_{ij} + \sum_{i=1}^{n} \log_{10} Ac_{ij}} \tag{7}$$

TPRS is the PRS time domain period, which indicates how many time slots there are in a PRS period, n is the number of resource elements in a time slot, A_p is the power of positioning resources, A_c is the power of positioning resources, γ is the positioning resource evaluation factor, whose physical meaning is to measure the proportion of positioning resources in the total resources, and the resources mentioned here integrate the time, frequency, and energy components. In the figure 3, each small grid is a time-frequency resource cell, the colored grid represents the positioning resources broadcasted by different base stations, the white grid represents the communication resources broadcasted by base stations, and the square of the amplitude of the data information contained in each time-frequency resource cell is the power of the data resource.

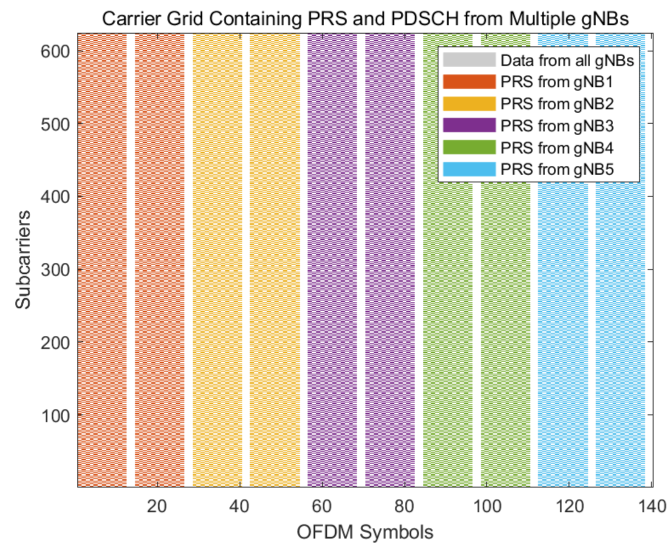

Figure 3. PRS time-frequency resource map

C. Communication Bit Error Rate Analysis

In this paper, the modulations of the communications are all Quadrature Phase Shift Keying(QPSK) with an average bit error rate of

$$p_b = \frac{1}{2} * erfc(\sqrt{\frac{E_b}{N_0}}) \tag{8}$$

where E_b is the signal energy per bit of the communication signal and N_0 is the power spectral density of the noise.

D. 5G Co-band Signal System

When the terminal receives the positioning reference signal, the received signal is correlated with the local sequence to obtain the ranging information and then determine the position. The longer the PRS sequence, the better the autocorrelation performance, which means more time and frequency resources are occupied. In the frame of sending positioning reference signal, usually, in order to avoid co-channel interference, different base stations broadcast the positioning reference signal with staggered time-frequency resources, as shown in the figure 4.

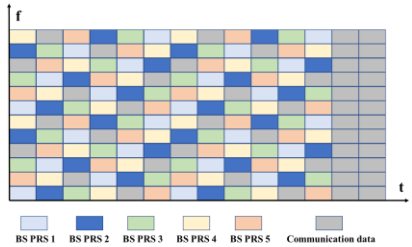

Figure 4. PRS resource allocation under a resource block

In this paper, we propose a signal-noise embedded positioning signal broadcasting method based on 5G system, named Co-band, which broadcast the positioning signal with 20dB lower power than the positioning signal and annihilate it under the communication signal in the form of noise. It can increase location resources and improve location performance without affecting communication performance.

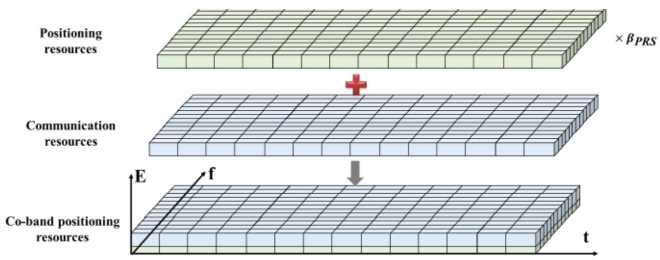

Figure 5. Co-band signal diagram

The Co-band signal is defined as

$$\mathrm{d(t)} = \sum (d_c(t) + d_p(t)) \quad (9)$$

where $d_c(t)$ is complex sequence of modulated communication data bits, $d_p(t)$ is complex sequence of modulated positioning data bits.

The positioning signal is embedded in the communication signal in the form of low power, so that positioning and communication occupy the same time-frequency resources. The positioning resource evaluation factor is shown below, and the parameter can be calculated by considering only the difference between positioning and communication power.

$$\gamma = \frac{\sum_{i=1}^{m} \log_{10} Ap_i}{\sum_{i=1}^{m} \log_{10} A_i} = \frac{\sum_{i=1}^{m} \log_{10} Ap_i}{\sum_{i=1}^{m} (\log_{10} Ap_i + \log_{10} Ac_i)} \quad (10)$$

Previously, communication and positioning resources only considered two dimensions of time and frequency. This paper introduces a new dimension of energy based on 5G communication system on top of time and frequency to realize time-code-frequency division multiplexing and build a new signal regime applicable to the integration of communication and navigation, which significantly increases positioning resources and provides a basis for mobile communication networks to realize high-precision positioning. However, superimposing the location signal on the communication signal in the form of low power may affect the communication performance. How to superimpose the location signal within the communication tolerance to complete high-precision location service needs to be solved urgently. Based on this, this paper proposes a joint decision method between location performance and communication performance using DS evidence theory.

IV. COMMUNICATION NAVIGATION FUSION METHOD BASED ON DS EVIDENCE THEORY

A. DS Evidence Theory

The Dempster-Shafer theory of evidence was first proposed by Dempster to construct a general framework for uncertainty inference, which was later expanded and supplemented by Shafer to form the overall framework of evidence theory. The DS evidence theory can model uncertainty flexibly and effectively without a priori probability, and provides a powerful tool for the representation and combination of uncertainty information. Multi attribute fusion based on DS evidence theory is one of the research focuses of multi-source information fusion. Its attribute fusion has been applied in many fields, such as target state consistency estimation, multi attribute data association, mobile robot multi-sensor data fusion, sequence image recognition for aircraft identification, etc.

DS evidence theory defines the space θ as the discriminative framework, i.e. the combination of possible values of each individual indicator, for any proposition A in the problem domain should be contained in the power set 2^{θ}. If the mapping $\mathrm{m}: 2^{\theta} \rightarrow [0,1]$ is defined as the discriminative framework θ on the basic probability assignment function BPA ,also called mass function, satisfying the following conditions.

(1) $\mathrm{m}(\emptyset) = 0$
(2) $0 \leq \mathrm{m(A)} \leq 1, \forall \mathrm{A} \in \theta$
(3) $\sum_{\mathrm{A}\in\theta} \mathrm{m(A)} = 1$

DS evidence theory provides Dempster synthesis rules that can synthesize evidence from multiple evidence sources defined as follows.

Let two bodies of evidence on the unified discriminative framework be independent, and their corresponding mass functions are m_1 and m_2 , and the focal elements are $A_1, A_2 \cdots A_k$ and $B_1, B_2 \cdots B_n$, then the combined evidence m is

$$\mathrm{m(A)} = \begin{cases} 0, A = \emptyset \\ \dfrac{\sum_{A_i \cap B_j = A} m_1(A_i) * m_2(A_j)}{1-k}, A \neq \emptyset \end{cases} \quad (11)$$

where $\mathrm{k} = \sum_{A_i \cap B_j = \emptyset} m_1(A_i) * m_2(A_j)$ represents the conflict term, which reflects the degree of evidence conflict, k closer to 1 means the more serious conflict between evidence sources, and k closer to 0 means the evidence sources agree with each other; the coefficient $\frac{1}{1-k}$ is the normalization factor, which serves to avoid assigning non-zero probabilities to the empty set during synthesis.

The DS composition rule reflects the joint action of evidence, and gives the reliability function based on different evidences on the same identification framework. If the evidence is not completely conflicting, the DS composition rule can be used to calculate the reliability function under the joint action of evidence.

B. Communication navigation fusion method based on DS evidence theory

In recent years, communication and navigation integration has become a hot topic, but no one has proposed parameters to quantify the fusion index. This paper has DS evidence theory as the core architecture, and jointly evaluates the positioning performance and communication performance, forming a communication and navigation integration mechanism based on DS evidence theory, obtaining comprehensive communication and navigation integration parameters, and evaluating the communication and navigation performance.

The identification framework of communication-navigation joint evaluation parameters is θ_{cp}, which contains five elements A, B, C, D, and E, where A corresponds to comb = 2, B corresponds to comb = 4, C corresponds to comb = 6, D corresponds to comb = 12, and E corresponds to the Co-band broadcast method . The power set of θ_{cp} consists of all subsets of θ_{cp}, θ_{cp} can be expressed as

$$2^{\theta_{cp}} = \{\emptyset, \{A\}, \{B\}, \cdots, \{E\}, \{A, B\}, \cdots, \{A, B, \cdots, E\}\}$$

From the perspective of localization, the localization accuracy is positively correlated with the allocation of localization resources, that is, on the same amount of resources, the more the percentage of localization resources, the better the localization performance, and the higher the basic probability allocation function, the basic probability allocation function of the above identification framework is

$$m_1(i) = \frac{\gamma_i}{\sum_{j=A}^{K} \gamma_j} \tag{12}$$

From the communication point of view, if positioning occupies time and frequency resources alone, that is, on the same amount of resources, the size of the communication bit error rate is only related to the modulation method, when the positioning signal is embedded under the communication signal, the communication bit error rate will be reduced to some extent, the lower the positioning signal power, the lower the communication bit error rate, the basic probability distribution function of the identification framework is

$$\mathrm{p}(A) = p(B) = \cdots = \mathrm{p}(D) = \frac{1}{2} * erfc(\sqrt{\frac{E_b}{N_0}}) \tag{13}$$

$$p(E) = \frac{1}{2} * erfc(\sqrt{\frac{E_b}{N_0 + N_p}}) \tag{14}$$

$$m_2(i) = \frac{\log_{10} \frac{1}{\mathrm{p}_i}}{\sum_{j=A}^{K} \log_{10} \frac{1}{\mathrm{p}_j}} \tag{15}$$

Under DS evidence theory, the probability distribution function considered in terms of both location and communication is

$$\mathrm{m}(\mathrm{A}) = (\mathrm{m}_1 \oplus \mathrm{m}_2)(\mathrm{A}) = \frac{1}{1 - \mathrm{k}} \sum_{\mathrm{B} \cap \mathrm{C} = \mathrm{A}} \mathrm{m}_1(\mathrm{B}) \mathrm{m}_2(\mathrm{C}) \tag{16}$$

After getting the relevant parameter configurations, the core network can calculate the communication and navigation joint evaluation parameters, and then compare them with the threshold. In this paper, the threshold is set to 0.1 according to the simulation. If the joint evaluation parameters are greater than the threshold value, it indicates that the communication and navigation fusion performance is up to standard. Otherwise, the communication and navigation joint evaluation parameters will be optimized by changing the location resource configuration information.

V. EXPERIMENTAL SIMULATION AND DISCUSSION

A. Relationship between positioning accuracy and positioning resource assessment factors

In order to verify the relationship between positioning accuracy and positioning resource evaluation factor, simulations are carried out in this paper.

The simulation conditions are as follows: the subcarrier interval is 30 kHz, the PRS time slot resource is 2, the number of symbols occupied by PRS in a time slot is 12, the number of positioning resource blocks is 54, and the positioning scenario is selected as the 'uma' scenario specified by 3GPP, using COMB = 12 repetition factor = 1,COMB = 12 repetition factor = 2, COMB = 6 repetition factor = 1, COMB = 6 repetition factor = 2, COMB = 4 repetition factor = 2, and Co-band carry out simulation. The simulation results are as follows

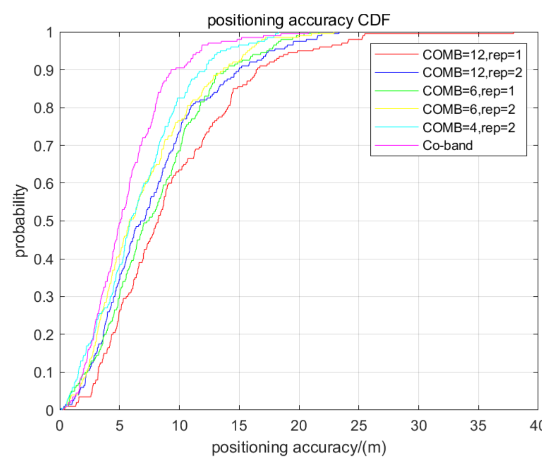

Figure 6. Positioning accuracy under different positioning resource allocation

It can be seen that in the same number of PRS resource blocks and in the same time slot, the more time-frequency resources are used as positioning, the higher location accuracy can be achieve. When the communication resources are occupied, the performance is optimal when the COMB=4, repetition factor = 2. Because the location resources are not fully spread on the time-frequency resource grid, the Co-band location method has better location performance than the location that occupies communication resources, and the location accuracy can be improved by 17%, which shows that the location resource evaluation factor has a positive correlation with the location accuracy.

In addition, the location sequence correlation performance is also simulated for COMB = 4, rep = 2 and Co-band cases, and the results are as follows.

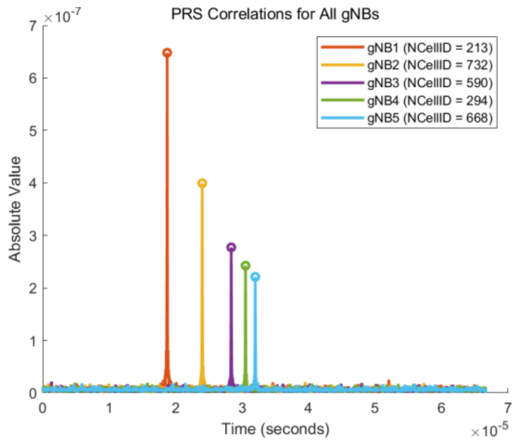

Figure 7. COMB=4 rep=2 location sequence correlation

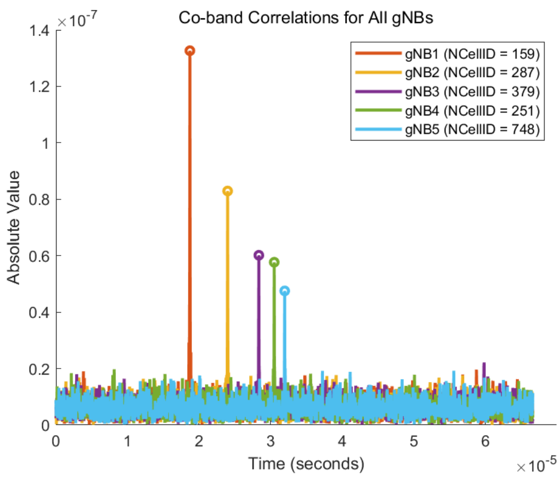

Figure 8. Co-band location sequence correlation

It can be seen that the Co-band positioning method decreases the relevant performance because the positioning signal is superimposed on the communication signal in the form of low power, but it can still clearly identify multiple primary paths for TDOA positioning, which has a small impact on the ranging accuracy but increases the positioning resources. In a comprehensive way, the gain of the Co-band signal broadcasting method on the positioning accuracy by increasing the positioning resources is greater than the impact on the ranging performance.

B. Simulation verification of communication navigation fusion based on DS evidence theory

The commonly used 5G base station power is 320w, assuming that the positioning signal power is 20dB lower than the communication signal power, i.e.

$$\gamma_{Co-band} = \frac{\log_{10} 320 * 0.01}{\log_{10} 320 * 0.01 + \log_{10} 320} = 0.167 \quad (17)$$

In order to visualize the joint estimation of communication navigation based on DS evidence theory, the PRS time slot period of 4 and 32 are used as examples to visualize the joint estimation of communication navigation when PRS is spread and unspread in the time domain. Assuming that the signal-to-noise ratio of 5G communication signal is 20 dB, the subcarrier interval is 30 kHz, and the repetition factor is 32, E_b/N_0 can be calculated according to SNR $= E_b * R_b/N_0 * W$, and $m_2(i)$ can be calculated, the relevant parameters are shown in the following.

$$k = \sum_{A_i \cap B_j = \emptyset} m_1(A_i) * m_2(A_j) = 1 - \sum_{A_i \cap B_j \neq \emptyset} m_1(A_i) * m_2(A_j) = 0.8491 \quad (18)$$

$$m(A) = \begin{cases} 0, A = \emptyset \\ \dfrac{\sum_{A_i \cap B_j = A} m_1(A_i) * m_2(A_j)}{1-k}, A \neq \emptyset \end{cases} \quad (19)$$

$$m_{12}(A_i) = \frac{\sum_{A_i \cap B_j = A} m_1(A_i) * m_2(A_j)}{1-k}, A_i = A, B, C, D, E \quad (20)$$

Table 1. TPRS = 4

	A(comb = 2)	B(comb = 4)	C(comb = 6)	D(comb = 12)	K(Co-band)
γ	0.2569	0.1474	0.1033	0.0545	0.1678
$m_1(i)$	0.352	0.2019	0.1416	0.0746	0.2299
$m_2(i)$	0.221	0.221	0.221	0.221	0.1158
$m_{12}(i)$	0.3952	0.2267	0.159	0.0838	0.1353

Table 2. TPRS = 12

	A(comb = 2)	B(comb = 4)	C(comb = 6)	D(comb = 12)	K(Co-band)
γ	0.0414	0.0211	0.0142	0.0072	0.1678
$m_1(i)$	0.1645	0.084	0.0564	0.0284	0.6666
$m_2(i)$	0.221	0.221	0.221	0.221	0.1158
$m_{12}(i)$	0.241	0.1231	0.0826	0.0416	0.5117

From the above simulation, it can be seen that when the PRS time slot period is less than 32, the communication navigation performance with Co-band positioning method is inferior to that of comb2, similar to that of comb4, and better than that of comb6 and comb12; when the PRS time slot period is greater than 32, the use of Co-band has a great improvement on the communication navigation performance and also enhances the continuity of positioning.

In addition, this paper carries out the simulation of communication navigation fusion evaluation for PRS time slot repetition factor, as shown in the following figure, with the increase of PRS time slot period, the comb-2, 4, 6 and 12 positioning methods that occupy communication resources show the decrease of positioning accuracy performance and the decrease of communication navigation fusion evaluation factor. The Co-band positioning method shows more excellent communication and navigation performance with the increase of PRS time slot repetition sequence, which shows that embedding the positioning signal under the communication signal for broadcasting can effectively improve the communication and navigation fusion evaluation performance, and lay a solid theoretical foundation for realizing a common 5G network for communication and navigation.

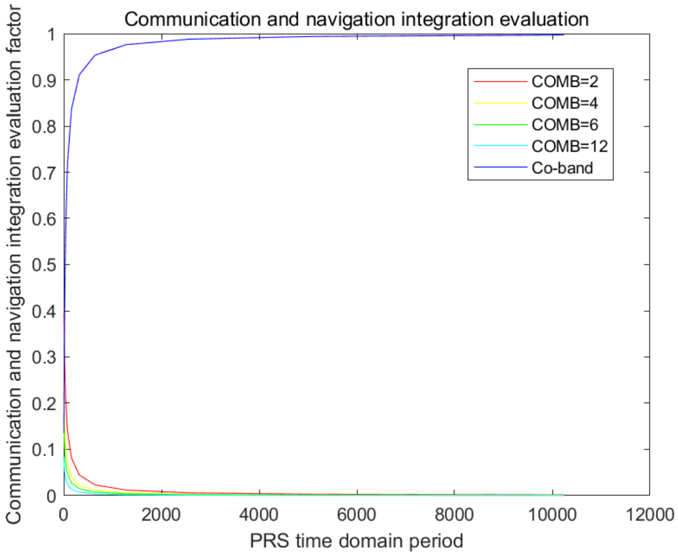

Figure 9. communication and navigation integration evaluation

VI. CONCLUSIONS

In this paper, a positioning resource evaluation factor based on 5G network is proposed, which enables the core network to realize the evaluation of positioning performance by corresponding configuration information. This paper proposes a 5G-based Co-band localization method, which increase the performance of 5G network localization without affecting the communication performance, compared with the location mode that occupies communication resources, Co-band location accuracy increases by more than 17%. This paper also proposes a communication-navigation fusion evaluation method based on DS evidence theory, which realizes the joint evaluation of the positioning function and communication function of 5G networks.

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