Construction of Space Quantum Information System Based on Satellite Recognition

Lingping Tao*
Anhui Sanlian University, Hefei, Anhui 230601, China

*Corresponding author e-mail: taolingping@slu.edu.cn

Abstract. Satellite identification is a form of space quantum information, which refers to the use of artificial earth satellites as the transmitting station between earth communication stations to perform satellite identification to construct a space quantum information system. However, at this stage, a single form of identification cannot meet the needs of various aspects such as the development of the information society. And mobile broadband services. Based on this, this paper has carried out research on the construction of space quantum information system based on satellite recognition. This paper firstly introduces the research significance of space quantum information transmission based on satellite identification, and then analyzes the research status of space information system based on satellite identification and the research status of space quantum information system based on satellite identification at home and abroad. Aiming at the problem of asymmetrical transmission of space information, this paper proposes, a spatial asymmetric transmission scheme based on layered modulation and network coding, and in view of the low communication quality caused by the influence of weather and surrounding environment on the space-based communication channel, this paper proposes an adaptive transmission scheme of spatial information based on satellite cooperation. The survey results show that under the MNC strategy and the traditional zero-padded strategy, the end-to-end bit error rate performance of S2 is not much different. As the signal-to-noise ratio continues to increase to 30dB, the two are basically the same. In the whole range of k value, the access probability of the MNC strategy is equal to a constant 0.67 and remains unchanged. When k=1, under the OUS scheme, it shows that the two source nodes have the same probability of accessing the channel, and the access probability is 50%, which is 16.7% lower than that of the MNC scheme.

Keywords: Satellite Identification, Satellite Collaboration, Space Quantum Information, Information System

1. Introduction
With the continuous development of satellite communication, the form of space communication based on satellite cooperation is a supplement to ground communication, making global communication and future integrated air-to-ground communication possible [1-2]. In space communication, due to the
asymmetry of transmission and the special conditions of the channel, the efficiency of the system is very low. Due to the wide coverage of space communication and many communication nodes located in different geographical locations, asymmetric transmission has occurred [3-4]. The dual influence of environmental factors (such as weather and difficulties) makes space communication channels more unique. Collaborative communication is a new form of spatial diversity. Diversity means that the transmitting end sends the same information to the receiving end through multiple different channels, and the receiving end uses methods such as the combined maximum ratio to effectively use the received information to resist channel attenuation. [5-6] The same communication. The terminal on the network realizes the diversity. Multiple mobile communication terminals are the objects of mutual cooperation. Each mobile terminal not only sends its own information, but also sends the message to the cooperative object [7-8].

In the research on the construction of space quantum information system based on satellite recognition, many researchers have conducted research on this and achieved good results. For example, Mokari N has the problem that the satellite ground channel and the ground connection channel are affected differently. It is recommended that the channels between the source node and the target node and between the source node and the relay node obey the shadow station of the Rice ground cell. Based on satellite attenuation model. The simulation is based on the efficiency of the space information transmission system coordinated by AF satellites [9]. In the transmission system based on AF satellites, Ghrayeb A proposed a new adaptive power allocation strategy to minimize the overall transmission power of the system. Simulation and comparison results show that the proposed adaptive strategy is better than the traditional allocation strategy [10].

In order to conduct research better, this article first briefly introduces satellite-based quantum information methods, and further analyzes the status quo of satellite-based quantum information systems. Aiming at the problem of asymmetrical transmission of spatial information, a spatial asymmetrical transmission system based on hierarchical network configuration and coding is proposed. It also aims to solve the problem of low communication quality caused by the influence of weather and environmental environment on channel space communication. To this end, in order to verify the effectiveness of the measures taken in this article, we conducted an in-depth analysis of the survey data.

2. Construction of Space Quantum Information System Based on Satellite Recognition

2.1 Space Quantum Information Transmission Method Based on Satellite Recognition
(1) Asymmetric transmission of satellite quantum data based on satellite identification. This asymmetry problem is mainly caused by the difference in geographic location between each communication node and the difference in communication channel conditions in spatial communication. First, a spatial communication model using multiple source nodes, a single relay node and a single target node is proposed. Then, the information transmission process of the HMNC scheme is researched and analyzed, and compared with other traditional data transmission methods. Then, according to the data of each network node in the system model, the closed form of the performance of the entire network, the expression of the access probability and the bit error rate are obtained.

(2) Adaptive transmission of spatial quantum information based on satellite recognition. On this basis, an adaptive spatial information transmission system based on satellite KA regional cooperative communication is designed. First, the KA frequency band is affected by the attenuation of rainfall and rice shadows. He created a new model with two and three levels of channels, namely rain shadows and sunlight shadows fading. Among them, according to the degree of shadow effect on the signal, each channel state is divided into three levels.
2.2 Network Topology Structure of Space Quantum Information System Based on Satellite Recognition

The system network topology describes the communication relationship between each earth station in the system. The network topology of satellite communication network is generally divided into the following three categories:

(1) Mesh network structure: In the mesh network, users can communicate at will. For mesh networks, unlike star networks, there is no traditional control and business center. With sufficient resources, each user can perform "single-hop" communication, thereby reducing the transmission delay of the system. At the same time, each user station is completely equivalent in theory, so any user station failure will not cause catastrophic consequences to the entire network, and the reliability of the system is high, but the cost of building the system comes with it.

(2) Star network structure: usually composed of a central station and several remote user stations. Each remote user station is connected to the central station, and there is no connection between the remote user stations. The communication between any two ground stations must be forwarded through the central station in a "two-hop" manner. The central station first packs and multiplies the data, and then transmits it in multi-channel operator mode. The use rate of satellite channels of this network structure is low, the transmission delay is long, especially the influence of the voice service is great. At the same time, the antenna opening and power amplifier of the universal central station are relatively large, and the requirements for the remote user station are relatively small.

(3) Star-shape and grid structure: The above-mentioned star-shape and grid structures are organically integrated, and the advantages between the two are fully utilized to meet the needs of different users for different industries. For this type of Internet, a hybrid control method will be adopted, that is, the allocation of system communication channels, the performance monitoring of device characteristics, and billing. The remote site realizes the control of another site by coordinating with the network management center, while other remote sites realize the control of another site by coordinating with the network management center. If the logical design is carried out, the use efficiency of the satellite communication network can be greatly improved. This structure makes the master station have higher technical requirements, and its realization and maintenance become more complicated.

2.3 Functions and Calculation Formulas of Small-Scale Fading

Small-scale fading is mainly caused by multipath phenomena. There are a large number of scatterers near the mobile terminal, and the signal received from the receiving end affected by the multipath attenuation is represented by the following equation (1):

\[ r(t) = c_0 \cos(\omega_0 t + \phi_c + \Delta \omega_0 t) + \sum_{n=1}^{N} c_n \cos(\omega_n t + \phi_n + \Delta \omega_n t + \phi_n) \]

Among them, the first half of formula (1) represents the direct component of the received signal, and the second half is the multipath component of the signal. Equation (2) shows the probability density function of the received signal under the influence of multiple paths:

\[ f_r(r) = \frac{r}{\sigma^2} \exp\left[-\frac{r^2 + \sigma^2}{2\sigma^2}\right] I_0\left(\frac{r \sigma}{\sigma^2}\right) \]

According to the formula, when there is no direct component, the probability density function is written as formula (3):

\[ f_r(r) = \frac{r}{\sigma^2} \exp\left[-\frac{r^2}{2\sigma^2}\right] \]

3. Experimental Research on the Construction of Space Quantum Information System Based on Satellite Recognition

3.1 Research Materials and Experimental Design

Space communication based on satellite communication expands the communication range, but sometimes due to the wide coverage and mobility of satellites, space communication is vulnerable to
security attacks and disconnects the communication connection. These problems seriously affect the performance of the communication system. In order to solve the above problems, many papers are currently studying the benefits of network coding in improving system performance, security and robustness, and applying network coding to different spatial communication systems.

3.2 Comparison Method and Analysis Content
Combining the previous research on asymmetry in wireless cooperative communication, this article will focus on the asymmetric transmission of spatial information based on satellite cooperation. In the "two sources, one relay and one destination" communication scenario, hierarchical configuration and general network coding technology will be studied. This solution is called the MNC solution. Compared with the traditional zero-investment final position method, the MNC format in this article fills in zeros at specific smaller data positions, and can optimize system performance by adjusting the distance between constellation points without increasing system complexity. First, the source node and the satellite relay node respectively use the 4/16QAM hierarchical configuration method. By analyzing the transmission of each node in the system model, the closed expression of the BER system, the possibility of transportation and entering a specific environment, investment and OUS is generated.

4. Research and Analysis on the Construction of Space Quantum Information System Based on Satellite Recognition

4.1 Bit Error Rate Performance of Space Quantum Information System Based on Satellite Recognition
This article uses MATLAB to simulate and verify the BER, throughput and access probability performance analyzed in the previous section. This paper simulates the end-to-end bit error rate performance of S1. The signal-to-noise ratio and bit error rate data are shown in Table 1:

| Strategy | Traditional zero padding strategy | MNC strategy |
|----------|----------------------------------|--------------|
| 0        | 30                               | 22           |
| 5        | 20                               | 15           |
| 10       | 13                               | 10           |
| 15       | 4                                | 3            |
| 20       | 2                                | 1            |
| 25       | 1                                | 0.8          |
| 30       | 0.5                              | 0.3          |

Figure 1 simulates the end-to-end bit error rate performance of S1. It can be seen from the figure that the actual simulation values under the two strategies are consistent with the theoretical values, and
the BER performance of S1 under the MNC strategy is better than the BER of the traditional zero-padded S1. The reason for this difference is that in order to obtain the original message of S1 under the MNC strategy, the destination node only needs to decode the virtual 4QAM modulation constellation, instead of the traditional zero-padded strategy to decode the 16QAM constellation. And the bit error rate performance of the data from S2 is mostly affected by its high bits and less affected by the low bits. The high bit error rate of S2 is lower than the low bit error rate.

4.2 Access Probability of Space Quantum Information System Based on Satellite Recognition

This paper simulates and compares the access probability of MNC strategy and OUS strategy. The source node S1 uses 4QAM modulation, and the source node S2 uses 4/16QAM layered modulation. The detection results are shown in Table 2:

| OUS Source node | S1 | S2 |
|-----------------|----|----|
| 0.5             | 0.34 | 0.67 |
| 1               | 0.5 | 0.5 |
| 1.5             | 0.6 | 0.4 |
| 2               | 0.67 | 0.33 |
| 2.5             | 0.71 | 0.29 |
| 3               | 0.75 | 0.25 |
| 3.5             | 0.78 | 0.21 |
| 4               | 0.8 | 0.2 |
| 4.5             | 0.81 | 0.19 |
| 5               | 0.83 | 0.17 |

The simulation in Fig. 2 compares the access probability of MNC strategy and OUS strategy. The source node S1 uses 4QAM modulation, and the source node S2 uses 4/16QAM layered modulation. It can be seen from the figure that the access probability of the MNC strategy is equal to a constant of 0.67 and remains unchanged in the entire k value range. For the OUS strategy, when k<1 (that is, the signal-to-noise ratio of the source node S1 is less than S2), the access probability of the source node S1 is less than S2, and the situation is the opposite when k>1. When 0.5<k<2, the access probability of the OUS strategy is less than the MNC strategy proposed in this paper, and when k>2, the access probability of the OUS strategy is higher than the MNC strategy.
probability of the source node S1 is gradually higher than the MNC strategy. When k=1, under the OUS scheme, it shows that the two source nodes have the same probability of accessing the channel, and the access probability is 50%, which is 16.7% lower than that of the MNC scheme.

5. Conclusions
This paper proposes an MNC strategy to solve the asymmetric transmission of spatial information. The experimental results show that the proposed MNC algorithm and the design of the adaptive transmission system can effectively reduce the bit error rate of the system and improve the efficiency of the system. Using the MNC algorithm to solve the asymmetric spatial information model, we assume that the information sent from the source node is forwarded to the target node through satellite relay. However, in actual communication scenarios, if the source node and the target node are far apart and are not within the coverage of the same satellite, two or more satellites are required to send relays in space communication.

Acknowledgments
Anhui Sanlian University Fund Project(KJ2021003,KJ2017001,16zlgc016); Anhui Provincial Quality Engineering Project(2020jyxm0572)

References
[1] Liu F. Research on the Construction of Geographic Information System Based on WebGIS Architecture. Computer measurement and control, 2017, 025(006):264-266,301.
[2] Xie C, He D. Research on the Construction of E-Commerce Precision Poverty Alleviation System Based on Geographic Information. Procedia Computer Science, 2020, 166(001):111-114.
[3] Gao Y. Research on Architecture Construction of Information System of Soil Environment under the Perspective of Big Data. IOP Conference Series: Earth and Environmental Science, 2019, 310(5):41-52.
[4] Lei Y, Guo W. Research on the construction of general practice core skills(GPS-core)database based on Delphi method. Post-graduation medical education in China, 2019, 003(001):27-30.
[5] Wang Y. Research on the Information System of Construction Cost Management Based on BIM. Construction economy, 2017, 038(008):59-62.
[6] Wang A. Research on the Construction of Credit Archives System Based on Online Health Information Sharing. Modern intelligence, 2018, 038(012):109-113.
[7] Bhatnagar M R. Performance Evaluation of Decode-and-Forward Satellite Relaying. IEEE Transactions on Vehicular Technology, 2015,64(10):4827-4833.
[8] Kalantari A, Zheng G. Secrecy analysis on network coding in bidirectional multi beam satellite communications. IEEE Transactions on Information Forensics & Security, 2015,10(9): 1862 - 1874.
[9] Mokari N. Resource allocation for non-delay-sensitive satellite services using adaptive coding and modulation-multiple-input and multiple-output-orthogonal frequency division multiplexing.Iet Communications, 2016,10(3):309-315.
[10] Ghrayeb A. An Adaptive Transmission Scheme for Two-Way Relaying With Asymmetric Data Rates. IEEE Transactions on Vehicular Technology, 2016,65(3):1477-1491.