Research on Information System of Communication Engineering Information Transmission Based on 5G Technology

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Abstract: Ultra-wideband (UWB) pulsed wireless transmission technology based on 5G technology is a revolutionary transmission technology for wireless communication that is booming in the world in the last two or three decades. UWB technology has the advantages of high transmission rate, large system capacity, strong anti-multipath interference ability, low power consumption and low cost. one. In order to ensure the validity and reliability of UWB signal transmission in complex indoor environment, we must be required to accurately grasp its channel characteristics. This paper mainly discusses and simulates the UWB indoor channel model. In the introduction of the basic theory of the channel, the time domain measurement technology and the later data processing method in the modeling process, the CLEAN algorithm, are introduced in order to facilitate the simulation analysis of the channel modeling.

1. Introduction

In recent years, with the development of wireless communication technology, various wireless communication systems have appeared one after another, which makes the available spectrum resources increasingly saturated. However, people's requirements for wireless communication systems are still increasing, and they are expected to provide higher data transmission rates, lower costs, and lower power consumption. In this context, ultra-wideband (UWB) technology has attracted people's attention, and has gradually become a hot spot in the field of wireless communication research and development, and is regarded as one of the key technologies of next-generation wireless communication [1]. Due to various advantages of UWB technology, UWB technology communication system has gained great attention from the industry, media and academia, making it one of the main technologies of wireless personal area network (WPAN). The traditional narrowband and wideband bandwidth is less than 20MHz, and its small-scale fading distribution obeys Rayleigh distribution or Rician distribution. In the UWB system, the propagation of UWB signals has unique characteristics: the bandwidth of the transmitted signal must be at least greater than 500MHz, the system has high multipath resolution, and the number of multipaths is relatively reduced. The research and development of UWB wireless technology in my country is still in its infancy, and it is even blanker in channel measurement and model establishment. The National Natural Science Foundation of China and the "863" program have begun to support research and development in this area, and have made initial progress. My country should put forward the theory and technical achievements of UWB technology with independent intellectual property rights, and use this as the support to formulate independent relevant standards and norms to promote the development of UWB industrialization in my country, so as to obtain its due position in the fierce international market competition.

2. The basic theory of UWB channel

2.1 Propagation characteristics of UWB signals

In the traditional CW-based narrowband or wideband system (the signal bandwidth is usually less than 20MHz), due to the random modulation characteristics of the channel during transmission, the receiving multipath signal changes randomly in amplitude and phase, and the receiving end signal is coherently superimposed. This superposition can be constructive or destructive, resulting in dramatic fluctuations in the amplitude of the signal, known as multipath fading [2]. Due to the strong ability of UWB signal to penetrate obstacles, it is more suitable for indoor environment, penetrating multiple walls and obstacles, and realizing high-speed wireless communication in a limited space with closed and multiple partitions. Form.

2.2 Measurement technology

The transmitter of the measurement system transmits narrow pulses (nanosecond or sub-nanosecond level), and the sampling oscilloscope samples the received signal in the time domain at the receiver, and the channel impulse response can be obtained through certain post-processing. The transmitter transmits narrow pulses (nanosecond or sub-nanosecond level) by the pulse generator [3]. The pulse signal enters the channel after passing through the power amplifier and the transmitting antenna, and the received signal is directly sent to the digital sampling oscilloscope after passing through the receiving antenna and low noise amplifier. Transfer to the computer. Both the pulse generator and the digital sampling oscilloscope are triggered by the signal from the trigger generator. The Matlab software used in the post-processing uses the clean algorithm to deconvolve the received signal, and then the channel impulse response $h(t)$ can be obtained by processing the data format. The specific process of the time domain measurement system and later data processing is shown in Figure 1.

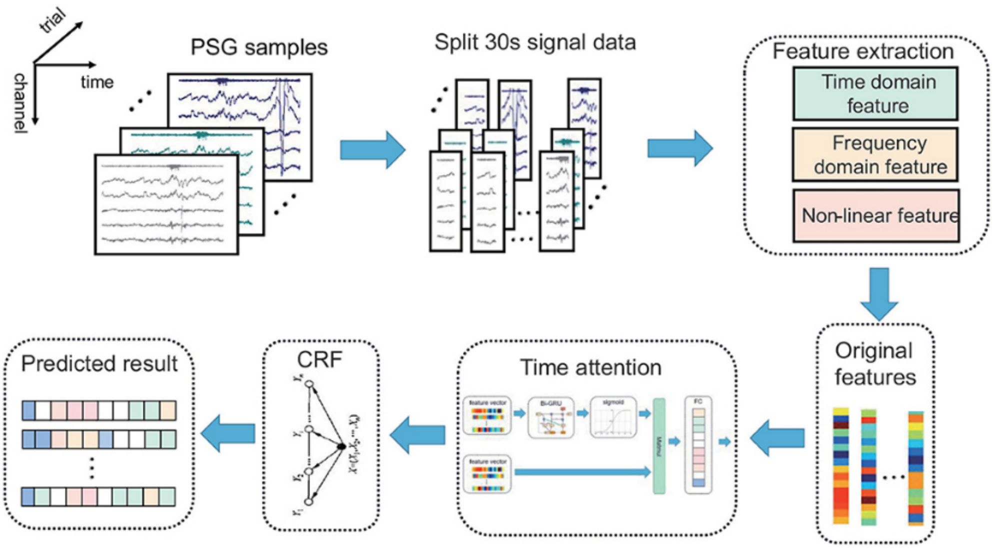

Fig 1. The specific process of the time domain measurement system and later data processing.

2.3 Data Processing Algorithms

Assume that the pulse signal waveform sent by the pulse generator is $p(t)$, and the received signal waveform $r(t)$ obtained by sampling the oscilloscope is

$$r(t) = p(t) * T_x(t) * h(t) * R_x(t) + n(t) \tag{1}$$

Where $*$ represents the convolution operation, $T_x(t)$ and $R_x(t)$ are the time domain impulse responses of the transmit and receive antennas, respectively, $h(t)$ is the channel impulse response, and $n(t)$ is additive white Gaussian noise. The main task of the later data processing of the time domain channel measurement is to extract the channel impulse response $h(t)$ from the received signal $r(t)$. The Clean algorithm first obtains the template signal $s(t)$ through the actual measurement method as

$$s(t) = T_x(t) * h(t) * R_x(t) + n(t) \tag{2}$$

Where $n(t)$ is the additive white Gaussian noise in the template measurement? Then, the influence of $T_x(t)$, $R_x(t)$ and $n(t)$ is removed from the received signal $r(t)$ by using the template signal through an iterative algorithm, and an approximate value of the channel impulse response $n(t)$ is calculated. The method of obtaining the template signal $s(t)$ is as follows: align the transceiver antennas in the dark room, measure at a distance that meets the far-field requirements, and directly separate the complete strongest pulse signal from the received signal as the template signal $s(t)$. The relationship between the acquisition of the template signal and the actual measurement is shown in Figure 2.

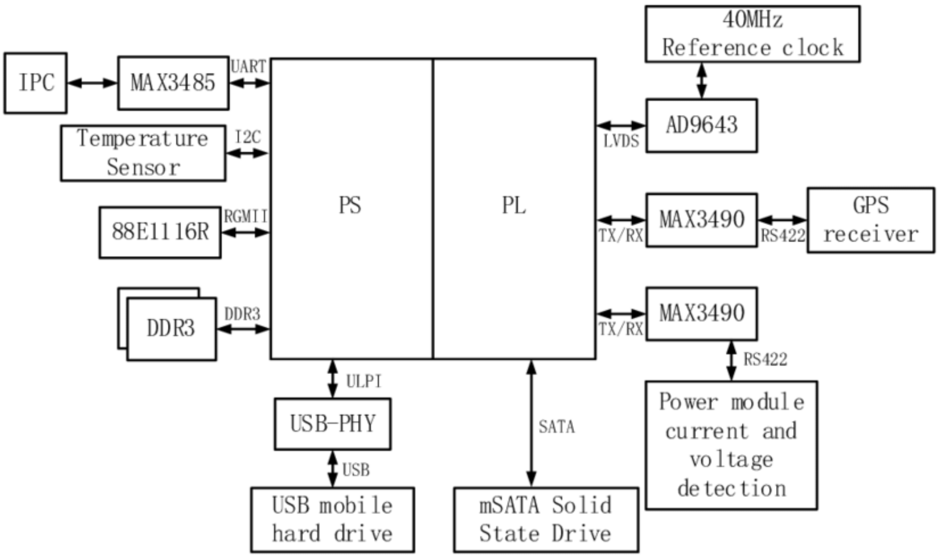

Fig 2. Interception and actual measurement of the board signal.

3. System Simulation

The simulation environment of this paper is NS-2. The simulation parameters are: the initial energy Ej,a (j=1,2,3...) of each sensor node is 50J; the maximum transmission distance of the sensor node is 50m-60m; each sensor node generates and transmits every second The data size is 100bits; the energy consumption parameter is 5×10-8J/bit The node distribution area is 500m×500m. The sink node is located at the far right of the network. See Table 1 for detailed parameters:

Table 1. Experimental parameters.

Parameter	value	parameter	value
Area size	500m×500m	Node maximum transmission distance	50-60m
Number of nodes N	300	Transmit energy/receive energy	5.0×10^{-8}J/bit
Node initial energy	50J	Data fusion consumes energy	5.0×10^{-9}J/bit
Base station location	-250,250	circuit consumes energy	5.0×10^{-8}J/bit

In order to verify the effect of the improved CLEAN algorithm in this paper, the paper analyzes the protocol from multiple perspectives and compares it with other protocols. First, compare the impact of CLEAN, traditional CLEAN algorithm, and EEABR algorithm on the network life cycle; second, compare the impact of the above three algorithms on network throughput; third, realize route tracking, by tracking a certain route from the source node to the network The route of the destination node, and the dynamic change process of the route is obtained [4]. Through the analysis of the experimental results, it can be concluded that the performance of the CLEAN algorithm is better, it consumes a small amount of communication and computing costs but brings a longer life cycle and network throughput.

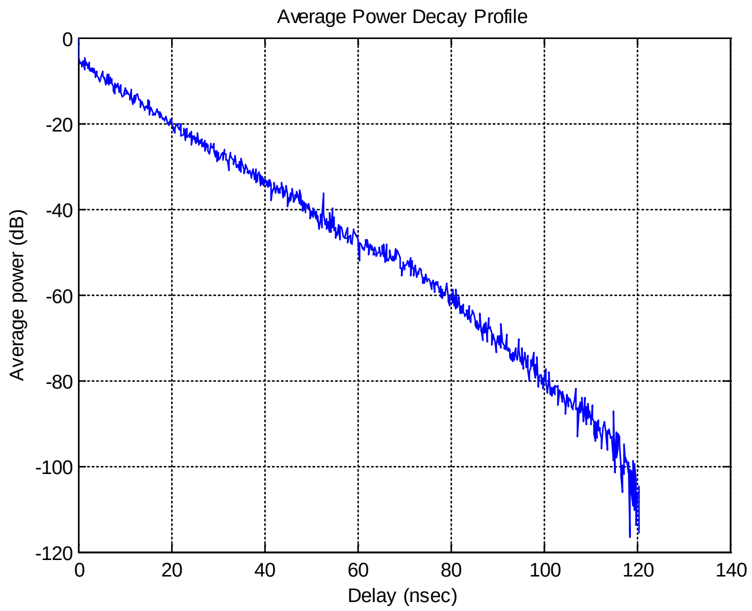

Fig 3. Life cycle comparison.

From Figure 3, it can be seen that after using the CLEAN algorithm, the network life is significantly prolonged, and the life cycle is increased by about 24%. The most critical point of this is that the algorithm comprehensively considers the two reference factors of Pheromones and energy, and balances the load of nodes in the network, making energy consumption more uniform.

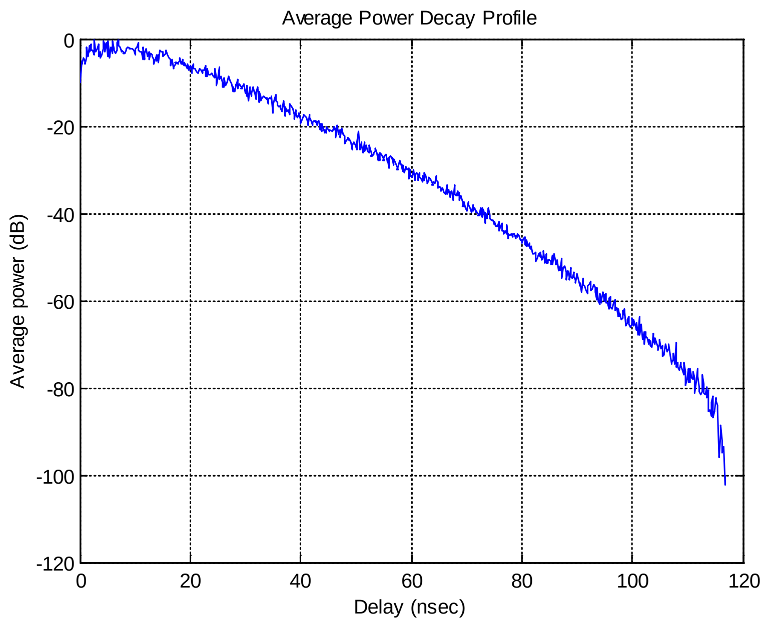

Fig 4. Comparison of total network throughput.

As shown in Figure 4, after repeated experiments, we found that in the network cable sensor network with 300 nodes, the maximum length of the traditional CLEAN route or many previous routes improved by the CLEAN algorithm is about 6 hops on average, while the RE-ANT proposed by us The length of the route in the algorithm will change dynamically and gradually increase, and the maximum length can reach 11 hops, because it reasonably avoids some nodes that are on the edge of death [5]. Although the increase in the length of the route will bring about the delay of data transmission in the network, this is tolerable for the wireless network with unreliable data communication, and it can make full use of the energy in the network and increase the number of data packets in the network. , which increases the throughput of the network.

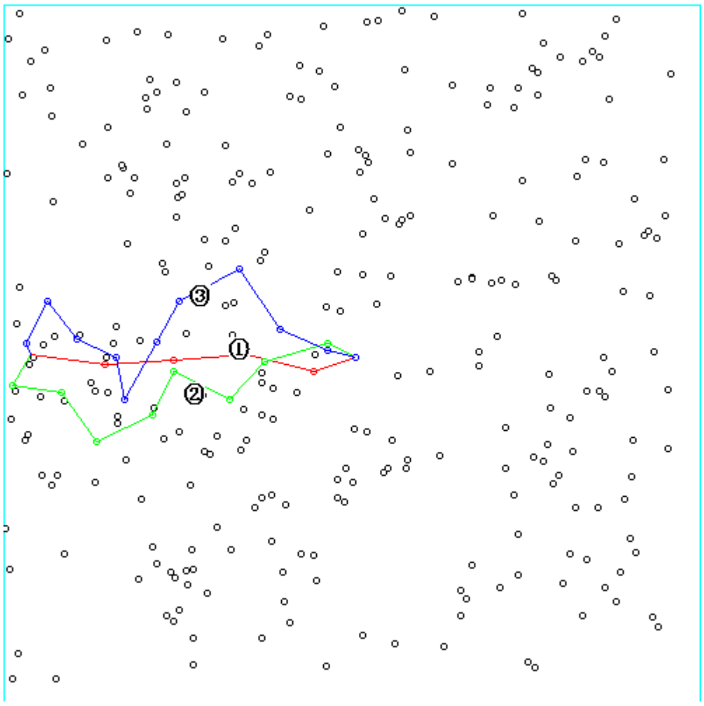

Fig 5. Example of dynamic routing change.

Figure 5 shows an example of the change in routing length in data transmission. The left side is a source node, and the middle is a destination node. During the initial route selection process, route 1) (5 hops) was selected. Obviously, this is the route with the least initial cost. However, as time goes by, the energy of some nodes in this route is rapidly exhausted. Therefore, It also integrates the energy and the distance to the sink node, and dynamically adjusts the routing, which is the second path 2) (9 hops). As time goes on, there will also be nodes in this path whose energy is rapidly exhausted. At this time, the routing will be dynamically adjusted again and become path 3) (11 hops). Although the delay of data packet transmission increases, it still sends the packet to the destination node accurately. Of course, the route will not grow all the time. The typical dynamic change process is that it sometimes grows and sometimes shortens, and the length of the path fluctuates.

Table 2. Parameter value impact.

Parameter	λ=0.2	λ=0.2	λ=0.7	λ=0.7	λ=0.9
	η=0.2	η=0.9	η=0.5	η=0.2	η=0.9
The life cycle	1157	1092	938	915	809
Throughput	353334	375000	495000	455000	275000

Experiments have shown that when the values of λ and η are very small, such as 0.1, it may cause data packets to linger at some nodes and cannot continue to advance to the destination node, resulting in a large amount of packet loss rate. After repeated experiments, we got It can be seen that when λ=0.7 and η=0.5, the packet loss rate is almost the smallest, and the network delay is basically the smallest, so we set λ and η to be 0.7 and 0.5 respectively. At this point, the wireless sensor network model we built has the best overall performance.

4. Conclusion

Based on the CLEAN optimization method, this paper proposes a new CLEAN routing algorithm based on residual energy: CLEAN. The main feature of this algorithm is that the residual energy is referred to in the process of selecting the next hop node and updating the Pheromones. By weighing the Pheromones and the remaining energy, and the distance of each node to the destination node (here is the number of hops), we give an optimal packet transmission path. The algorithm has many advantages, and it improves the performance of the network in several ways. First, it prolongs the life cycle of the network and effectively solves the problem of energy holes at individual nodes in the sensor network; secondly, it balances the load of the network so that some nodes are not overloaded; thirdly, through the reference energy, avoid sending data packets to nodes with little remaining energy, thereby reducing the packet loss rate; finally, it improves the overall throughput of the network.

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