Research Article

Interbank Offered Interest Rate Risk Measurement Based on Embedded Sensor Network

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Interbank lending rate is the main benchmark interest rate in the domestic currency market, looking for an appropriate financial time series model to describe its stochastic fluctuation process, and choosing an appropriate risk measurement method to measure the domestic interbank lending interest rate risk. The risk management of the interest rate market has great theoretical and practical significance. This article is aimed at studying the interbank interest rate risk measurement based on the embedded sensor network and proposes the key technology of sensor network, sensor network MAC layer protocol, LEACH energy model, and other methods in the article. Related experiments have been carried out on the interbank interest rate risk measurement. The experimental results show that the interbank interest rate risk measurement model based on the embedded sensor network is much more efficient than the traditional interest rate risk measurement model. This has reduced the bank’s loss of interest rate by at least 7%.

1. Introduction

Interest rate risk is a type of financial risk. In essence, it is the change in the price and income of financial products caused by changes in interest. From a superficial point of view, the causes and effects of interest risk are diverse. In recent years, with the continuous acceleration of the domestic interest rate marketization process, domestic interest rate tools for macro control have become more frequent, and the interest rate environment for commercial bank operations has continued to change, and interest rate risks have become more obvious. Since interest rate risk is “bilateral,” that is, the uncertainty of the two directions of loss and benefit, commercial banks can easily assume excessive risks in order to increase their benefits. Analyzing and measuring the risk of interbank loan interest rates is very important to the risk management of commercial banks. At the same time, it is extremely effective to find a suitable financial time series model to describe its stochastic fluctuation process and to choose a suitable risk measurement method to measure the domestic interbank lending rate risk.

The core task of the financial market is risk management and risk price setting. When setting the risk price of financial products related to interest rate risk management, it is particularly important to accurately predict the changes and tendencies of interest rates provided by banks. In the case of changes in the economic environment, it is important for the central bank to carry out more effective financial supervision by scientifically using interest rate prediction methods and exploring the establishment of an interbank loan interest rate risk prediction model, and it can also encourage commercial banks.

The innovation of this article lies in the research of embedded sensor networks and a full understanding of the characteristics of sensor networks such as strong compactness, high sensitivity, and strong interoperability. Secondly, in the simulation experiment, it is proposed to conduct experiments on the changes of interbank lending rates from the perspective of technical forecasting, etc., to verify the feasibility of the risk measurement model.

2. Related Work

With the continuous development of science and technology, wireless sensor networks have attracted the research interest of a large number of researchers. Wireless sensor
network is one of the most popular IoT network technologies. The efficiency of the trust evaluation process largely depends on the trust derivation, because it dominates the overhead in the process, and the performance of WSN is particularly sensitive to overhead due to limited bandwidth and power. So Duan et al. proposed an energy-aware trust derivation scheme using game theory methods in his research, which manages overhead while maintaining sufficient security of WSN [1]. Also, in the research on the security of WSN, Seo et al. proposed a certificateless effective key management (CL-EKM) protocol in the research, which is used for secure communication in dynamic WSN characterized by node mobility [2]. Structural health monitoring (SHM) using wireless sensor networks (WSN) has aroused research interest because of its ability to reduce the costs associated with the installation and maintenance of SHM systems. In his research, Adam et al. conducted a comprehensive investigation of SHM using WSN and outlined algorithms for damage detection and location, network design challenges, and future research directions. At the same time, he also compared and discussed solutions to network design problems [3]. Location is one of the key technologies in wireless sensor networks (WSN), because it provides basic support for many location-aware protocols and applications. Cost and power consumption constraints make it impossible to equip each sensor node in the network with a global positioning system (GPS) unit, especially for large WSNs. In a survey, Han et al. reviewed the most successful MANAL algorithm, focusing on the achievements in the past ten years, striving to conduct a comprehensive review of the
latest breakthroughs in this field and provide links to the most interesting and successful progress in this research field [4]. It is also in the research on energy-saving optimization of sensors. In Luo et al.’s research, he focused on minimizing energy consumption and maximizing the network life of data relay in a one-dimensional (1D) queue network [5]. Underwater wireless sensor network (UWSN) technology is widely used in various underwater monitoring and exploration applications and has proven its high status. Goyal et al. proposed a paper based on the UWSN survey, which contains data aggregation to highlight its advantages and limitations [6]. In the era of big data, sensor networks have become pervasive, generating large amounts of data for various applications. Yang et al. mainly focus on the reliability of data storage in heterogeneous wireless sensor networks, in which robust storage nodes are deployed in the sensor network, and data redundancy is utilized through coding techniques [7]. In the research of these researchers, most of them are researches on wireless sensor networks, but not on the further development of sensor networks.

3. Sensor Networks and Interbank Lending Rates

3.1. Embedded Sensor Network

3.1.1. Wireless Sensor Network. The wireless sensor network is composed of a large number of wireless sensor nodes. These wireless sensor nodes generally have signal acquisition and simple processing functions and have simple wireless communication capabilities [8–11]. These sensors self-organize into a certain network topology according to the needs of the network and complete information transmission and interaction in one or more hops. One-hop forms are mostly star links. There is a node with strong processing and communication capabilities in the center. The central node is responsible for gathering, organizing, and processing the collected data and sending it to a higher-level center. Multihop methods are generally networks with self-organizing functions. Because sensor nodes have weak communication capabilities and short communication distances, they need to send information through multihops. In multihops, all nodes are equal, which constitutes a network with self-organization ability [12, 13]. Figure 1 shows the sensor network structure.

The hierarchical network structure is divided into two parts, the upper layer and the lower layer. The central backbone node and general sensor nodes are scattered in these two layers. A flat network structure is used between backbone nodes or general sensor nodes, while a hierarchical network structure is used between backbone nodes and general nodes. Generally, sensor nodes do not have functions such as routing, management, and aggregation processing. The network is divided into clusters according to the needs of application types and geographic locations, and each cluster is divided into cluster heads and member nodes [15]. This structure increases the capacity of the entire network, but the algorithm requirements for cluster head selection are more stringent. Figure 3 shows the wireless sensor hierarchical network structure diagram.

Mesh network structure is the focus of recent network research, which is mainly used in the network structure of AP access nodes in large-scale networking [16]. Mesh network nodes are generally static, and the network structure is relatively stable and only changes when the nodes are connected and exited. Mesh network supports many users, high stability, and throughput and is generally used in the construction of backbone networks. Simple installation and
automatic networking the installation and layout of the wireless mesh network is not difficult, and there are not too many complicated settings.

In the mesh network structure, there are usually multiple routing paths between network nodes. If any node fails, the nodes can intelligently find a new routing path through the routing algorithm without affecting the network communication capabilities of other nodes. Figure 4 shows the mesh network structure diagram.

(2) Key Technologies of Wireless Sensor Networks. As a cutting-edge research field that has attracted much attention in the world today, WSN has had an increasing impact on people’s production and life. On the basis of traditional communication network theory, researchers have thoroughly studied the inherent theoretical laws of WSNs and concluded a new theoretical system [17, 18]. The main technologies related to WSN can be summarized as network communication protocol, time synchronization, and so on. The application of wireless sensor network is shown in Figure 5.

3.1.2. MAC Layer Protocol of Wireless Sensor Network. In WSN, the MAC layer has the right to govern the use of wireless channels to promote effective data communication. Its main function is to allow multiple users to effectively share wireless channel resources, avoid conflicts, and improve channel utilization [19]. Disadvantages of wireless sensor network are as follows: (1) for physical layer, the main attack methods are congestion attack and physical damage; (2) for link layer, the main attack methods are collision attack, exhaustion attack, and unfair competition.
Table 1: Bank transactions in the interbank market over the years.

| The first season | Second quarter | The third quarter | Fourth quarter |
|------------------|----------------|-------------------|----------------|
| 2015             | 5600           | 6400              | 7100           |
|                  | 2016           | 7620              | 7860           |
|                  | 2017           | 8621              | 7560           |
|                  | 2018           | 9630              | 9800           |

Table 2: Changes in interbank offered rates.

| June | December | Average interest rate ranking |
|------|----------|-----------------------------|
| 2014 | 3.01     | 3.22                        |
| 2015 | 3.06     | 3.31                        |
| 2016 | 3.00     | 3.18                        |
| 2017 | 3.28     | 3.22                        |
| 2018 | 3.22     | 3.34                        |
| 2019 | 3.28     | 3.29                        |

S-MAC protocol is a typical MAC protocol based on competition. This protocol is proposed to improve the limited energy of node batteries in WSN. It assumes that the network allows some delay and allows nodes to sleep periodically, so achieved a better energy-saving effect.

As a classic contention-based protocol, S-MAC uses a periodic listening/sleeping mechanism that enables nodes to sleep for a long time, reducing the time the node is in the idle listening state, so it reduces idle listening energy consumption generated, where HN is the initial energy. Compared with the MAC protocol without sleep state, the energy saved by S-MAC is approximately:

\[
I_0 = U_{\text{frame}} * I_0 = I_0 (1 - HN),
\]

\[
U_{\text{frame}} = U_{\text{Listen}} + U_{\text{Sleep}}.
\]

Among them, \(I_s\) is the remaining energy for idle listening, \(I_0\) is the energy consumed by the wireless receiving module while listening, \(U_{\text{Sleep}}\) and \(U_{\text{Listen}}\) are the sleep time and listening time of the node, respectively, and the sum is the duration of a listening sleep period, that is \(U_{\text{frame}}\).

Due to the random backoff algorithm adopted by the S-MAC protocol, every time a node conflicts, the energy consumed is

\[
I_{\text{col}} = 1 * NR_{\text{new}} * I_{\text{id}}.
\]

Due to the periodic sleep mechanism of the S-MAC protocol, when a node wants to transmit a data packet, it must wait for the receiving node to end its sleep before transmitting, which means that an additional delay will be generated, that is, the sleep delay [20]. When analyzing the delay performance, we only need to analyze the delay caused by carrier sensing, transmission, and sleep. When the sensor node receives the data packet, it will immediately start carrier sensing and transmit the data to the next hop node. The average delay at \(m\) hops is

\[
H(m) = s_{\text{pc,m}} + s_{\text{yr}}.
\]

In the MAC protocol without sleep, the delay caused by \(m\) hops is

\[
L(m) = \sum_{m=1}^{M} (s_{\text{pc,m}} + s_{\text{yr}}).
\]

Then, the average delay is

\[
P[L(m)] = m (s_{\text{pc,m}} + s_{\text{yr}}).
\]

It can be seen that the multihop delay is proportional to the number of hops, and the linear slope is the sum of the carrier sensing time and the transmission time.

Suppose node \(x\) wants to send data to node \(y\). We denote the sleep delay caused by \(m\) hops in the process as \(s_{\text{sc,m}}\). The length of a listening sleep cycle is recorded as \(Z_{\text{C}}\). Then, the time delay after passing the \(m\)-th hop is

\[
L(m) = s_{\text{sc,m}} + s_{\text{dr,m}} + s_{\text{sx}}.
\]

When nodes \(y\) and \(n\) exchange RTS/CTS, the next hop node \(j\) of \(n\) is still listening, so \(j\) knows when the information transmission from \(y\) to \(n\) ends. The adaptive listening mechanism will immediately wake up node \(j\) when the previous hop transmission is completed. Similarly, when \(n\) transmits data packets to \(j\), \(n\) will also perform adaptive listening. Therefore, the delay of the \(m+1\)th hop is

\[
L(m + 1) = s_{\text{sc,m+1}} + s_{\text{sx}}.
\]

Because the distance between nodes \(n\) and \(y\) is two hops, when \(n\) transmits the CTS control packet, \(y\) cannot overload the monitoring of the CTS packet like \(j\) and cannot wake up when the message transmission between \(x\) and \(n\) ends. Therefore, when \(n\) sends a message to \(j\) during the dormant period, \(y\) cannot receive the CTS packet sent by \(j\) because it
A hop network is a model where the delay of a hop node obeys the uniform distribution on the interval \([0, U_f]\). Therefore, the delay of the \(m\)th hop is:

\[
L(m) = s_{c,m+2} + s_{d,m+2} + s_{xx}.
\] (9)

From the above analysis, the delay of the \(m\)th hop node is:

\[
L(m) = s_{c,1} + s_{d,1} + s_{xx} + s_{d,2} + s_{xx} + \cdots + s_{c,m-1} + s_{d,m} + s_{xx}.
\] (10)

According to the S-MAC protocol adaptive listening process, it can be known that:

\[
U_f = s_{d,m} + s_{xx} + s_{d,m+1} + s_{xx} + s_{c,m+2}.
\] (11)

Therefore, formula (10) can be simplified to obtain:

\[
L(m) = s_{c,1} + \left(\frac{m}{2} - 1\right)U_f + s_{d,m-1} + s_{d,m} + 2s_{xx}.
\] (12)

Since the source node can generate data packets at any time in an \(U_f\) cycle, it is assumed that the \(s_{c,1}\) of the first hop node obeys the uniform distribution on the \((0, U_f)\), so its average value is \(U_f/2\). Therefore, the average delay of an \(m\) hop network is

\[
P[L(m)] = \frac{mU_f}{2} + 2s_{dc} + 2s_{xx} - \frac{U_f}{2}.
\] (13)

It can be seen from formula (13) that if you want to reduce idle listening and save energy, you need to increase the sleep time in \(U_f\), but the increase in \(U_f\) will increase the delay. What is described above is the contradiction between node energy consumption and time delay.

3.1.3. Improved Topology Control Algorithm Based on LEACH Algorithm. LEACH is a classic hierarchical clustering topology control algorithm. The algorithm first proposed a strategy for clustering the network. The cluster heads are randomly selected according to the requirements to achieve the purpose of network clustering [21].

(1) LEACH Energy Model. LEACH’s radio energy consumption model is shown in Figure 6. The spatial model used varies with the distance between nodes.

In this model, the energy consumed by the sensor node sending bits data to another node at distance \(f\), \(N_{Em}(b, f)\), consists of two parts, the transmitting module and the amplifying module. The expression of \(N_{Em}(b, f)\) is

\[
N_{Em}(b, f) = \begin{cases} 
bn_{elec} + b\delta_{zx}f^2, & f < f_0 \\
bn_{elec} + b\delta_{pl}f^4, & f \geq f_0 
\end{cases}
\] (14)

Among them, \(n_{elec}\) is the energy consumption of the wireless circuit to send and receive unit data, \(f_0 = \sqrt{\delta_{zx}/\delta_{pl}}\) is the transmission distance threshold, \(\delta_{zx}\) and \(\delta_{pl}\) are the amplifier’s energy consumption and attenuation parameters for unit data amplification, and its value is determined by the amplifier.

When a node receives bits data, the energy consumption is mainly circuit consumption, and \(N_{Tz}(b)\) is used to represent it.

\[
N_{Tz}(b) = bn_{elec}.
\] (15)

(2) Optimal Number of Cluster Heads and Optimal Communication Radius Model. LEACH uses the cluster head algorithm to generate the expected number of cluster heads \(x\). Assuming that \(I\) nodes are uniformly deployed in an \(X \times X\) square area, the network structure model is shown in Figure 7. After the algorithm runs, \(x\) cluster
areas will be generated. The average number of nodes in each cluster is \( I_x \).

Each cluster member node transmits data only once during a data frame. Assuming that the distance to the cluster head is relatively short, the free space fading model \( \delta_{zx} f^2 \) is used. Therefore, the energy consumption of each frame of data transmitted by the cluster head and member nodes can be expressed as follows:

\[
N_{kl} = \left( \frac{x}{I} - 1 \right) b N_{elec} + b N_{url} I_x + b N_{elec} + b \delta_{zx} f^4 \text{toBS}. \tag{16}
\]

\[
N_{non-kl} = b N_{elec} + b \delta_{pl} f^2 \text{tokl}. \tag{17}
\]

Among them, \( f_{\text{toBS}} \) and \( f_{\text{tokl}} \) are the distance between the cluster head and the base station and the distance between the cluster head and the member nodes, respectively.

Assuming that each cluster area is a circle with a radius of \( r \), then \( r = X/\sqrt{\pi x} \) can obtain the expected \( N[f^2_{\text{tokl}}] \) of the square of the distance from the member node to the cluster head. The expression is as follows:

\[
N[f^2_{\text{tokl}}] = \int \int (m^2 + n^2) \rho(m + n) dm dn = \frac{1}{2\pi} X^2, \tag{18}
\]

\[
N_{non-kl} = b N_{elec} + b \delta_{pl} \frac{1}{2\pi} X^2. \tag{19}
\]

The energy consumption of transmitting data frames in each cluster area is

\[
N_{\text{cluster}} = N_{kl} + \left( \frac{x}{I} - 1 \right) N_{non-kl}. \tag{20}
\]

In a network with large-scale deployment of nodes, the cluster head is usually far away from the base station, so the multipath attenuation model is adopted; while the member nodes in the cluster only communicate with the cluster head and the distance is relatively short, so the free space model is adopted. Finally, the total energy consumption of \( x \) cluster regions can be obtained as follows:

\[
N_{\text{Total}} = x N_{\text{cluster}} = b \left( 2N_{\text{elec}} Y + N_{\text{url}} Y + b \delta_{zx} f^4 \text{toBS} + Y \delta_{pl} \frac{1}{2\pi} X^2 \right). \tag{21}
\]

Taking the derivative of \( x \) in formula (21) and making the derivative equal to 0, the optimal number of clusters \( x_{opt} \) can be obtained:

\[
x_{opt} = \frac{\sqrt{I}}{\sqrt{2\pi} \sqrt{\delta_{ZX} X}}. \tag{22}
\]

### 3.1.4. Embedded System

The concept of embedded is a relatively vague concept compared to traditional personal PCs. The embedded system is composed of hardware and software. The main part of the hardware is the embedded processor and its program memory or memory [22, 23]. Centered on application and based on computer technology, software and hardware can be tailored to meet the strict requirements of application system on function, reliability, cost, size, and power consumption. According to the space requirements for program storage and operation, you can use on-chip program memory and memory or use off-chip external memory and memory. The hardware part generally also has peripherals and power supplies. The power supply is a necessary equipment for embedded systems. It is responsible for providing efficient and stable power supply for all
modules. There are various types of peripherals. Generally, what kind of external equipment is used depends on the specific needs of the embedded system. Assume that the core of the software part is the operating system. Embedded operating systems have their own characteristics. They have their own advantages and disadvantages in terms of real-time, space-occupancy, tailorability, and support for peripherals. Users can choose flexibly during use [24, 25].

3.2. Interbank Offered Rate. Interbank offered rate, also called interbank offered rate, is an interest rate used to raise funds between commercial banks in the money market [26]. The subjects participating in the proposed interest rate estimation are banks with high credit ratings. Compared with other interest rates, they provide funds and demand in the currency market through an open market orientation. The main influencing factors are as follows: (1) the benchmark interest rate of the People’s Bank of China, (2) whether the liquidity of each bank is sufficient, and (3) liquidity required by financial markets in the short term.

3.2.1. Influencing Factors of Fluctuations in Interbank Lending Rates. The interbank lending rate generally represents the cost of obtaining wholesale funds for financial institutions and can reflect the supply and demand of funds in a timely manner. It is the most sensitive financial market interest rate and the financial market as a whole. The interbank loan interest rate is highly conductive, and its changes rapidly expand and are communicated to the market interest

![Figure 9: Packet receiving rate.](image-url)
rate system, thereby bringing changes to the market interest rate as a whole [27].

3.2.2. The Basic Method of Interest Rate Forecasting. The main content of interest rate prediction includes the direction of interest rate changes and the level of interest rate changes. Scientific and accurate interest rate analysis and prediction results provide a reliable decision-making basis for the measurement and management of interest rate risk. Generally speaking, the methods of interest rate forecasting can be divided into judgment forecasting methods, econometric forecasting methods, and technical forecasting methods. That is to solicit and synthesize the opinions of the salespersons of the enterprise and the business personnel of the commercial department and synthesize the forecast of the enterprise.

3.3. Risk Measurement. Essentially, interest rate risk refers to changes in the value and income of financial products caused by changes in interest rates. Since the interest rate risk management of domestic commercial banks started late, many banks still use traditional static risk measurement methods such as sensitivity difference analysis, period difference analysis, and convexity analysis to measure interest rate risk. However, with the progress of interest rate marketization and domestic restrictions on access to foreign banks and the liberalization of business scope, commercial banks will face increasingly fierce competition. The traditional interest rate risk measurement methods can no longer meet the interest rate risk requirements of commercial banks. At present, the most popular risk measurement method in the world is the VaR model method. In order to improve the level of interest rate risk management, domestic commercial banks have begun to gradually adopt the VaR model method.

4. Investigation Experiment on the Interest Rate Risk of Interbank Offered

4.1. Survey on the Transaction Volume of Banks in the Interbank Lending Market over the Years. The interbank lending market, as a market for the financing of financial institutions, is an important part of the money market. In order to further understand the development of the domestic interbank offered interest rate market, changes in the interbank offered rate mainly reflect the current money market conditions; that is, when the currency is loose, the interbank rate will go down; when the currency is tight, the rate will rise. It is often at the end of the month, the end of the quarter, and the end of the year that interest rates rise; this experiment investigated the changes in the transaction volume of the domestic interbank offered market in recent years. Table 1 shows the results of this survey experiment.

It can be seen from the data in Table 1 that over time, the transaction volume of the domestic interbank lending market has exploded, and the transaction volume in 2018 has increased by at least 30% over 2015.

4.2. Investigation of Changes in Interbank Lending Rates. The interbank lending rate is an important factor affecting its transactions, and it is also an important indicator of the interbank lending rate risk measurement. In this study, the interbank lending rates of domestic banks in different periods were also investigated. Table 2 shows the changes in domestic interbank lending rates in recent years.

It can be seen from the data in Table 2 that in recent years, the domestic interbank lending rate has remained above 3%, and the interest rate has changed significantly. With the change of time, the interbank lending rate has also shown an upward growth. In order to more intuitively see the growth trend of the interbank lending rate, Table 3 gives examples of the changes in the interbank lending rate in the past two years.

It can be seen from Table 3 that the average interbank lending rate in 2018 was less than 3.20%, while the average interbank lending rate in 2019 reached more than 3.23% and reached more than 3.30% in 2020.

4.3. Experiments on Measuring the Interest Rate Risk of Interbank Lending. The purpose of the autocorrelation test is to test whether the daily rate of return of the interbank
lending rate in each period has correlation and correlation
characteristics. A total of 12 data are selected in this experi-
ment. Table 4 shows the autocorrelation coefficient and par-
tial autocorrelation coefficient of the daily yield of the
overnight call rate.

After completing the autocorrelation test, this experi-
ment conducted a backtest test on the interbank interest rate
risk measurement model based on the embedded sensor net-
work. Table 5 shows the VaR backtest test results of the
residual sequence with a con-

dence of 90%.

It can be seen from the results in Table 5 that at di-
ff
ferent
con-
dence levels, the
LR
value is greater than the quantile of the chi-square distribution with the degree of freedom at the corresponding confidence level. Therefore, the interbank interest rate risk measurement model based on the embed-
ded sensor network is explained. It has passed the accuracy
test, and the model can be used when measuring the inter-
bank lending interest rate risk.

5. Risk Measurement Model of the Interbank
Offered Interest Rate Based on the
Embedded Sensor Network

5.1. Data Stability Test Based on the Interbank Lending
Interest Rate Risk Measurement Model. This article will use
the overnight lending rate data in the sample for model esti-
mation. Before model estimation, we must analyze the char-
acteristics of these data to determine whether it is suitable
for model estimation based on interbank lending rate risk
measurement. Figure 8 shows the results of data verification.

As can be seen from Figure 8(a), there is a clear trend in
the overnight lending rate, so we can determine that it is a
nonstationary series, so it cannot be directly processed. In
order to obtain stable time series data, this article uses the
logarithmic return rate of the overnight call interest rate
for analysis. From Figure 8(b), it can be seen that the daily
return rate of the overnight call interest rate fluctuates
5.2. Data Packet Reception Rate of Wireless Sensor Network Protocol. Figure 9 is a comparison curve of the successful reception rate of data packets of the three protocols in the wireless sensor network.

It can be seen from the figure that the successful reception rate of DSA-SMAC protocol data packets is slightly higher than that of B-SMAC and S-MAC protocols, which are 4% and 5% higher, respectively. When the network load is large, the successful reception rate of the data packets of the three protocols is relatively low. This is because the channel will become more congested and cause greater delay. The sent data is prone to collisions, and the destination node cannot receive the data in time. As the network load decreases, the successful reception rate of the three data packets gradually increases.

5.3. Interbank Offered Rate Risk Forecast. The embedded sensor network uses a large number of sensors to send, receive, and process data. In this article, the interbank interest rate risk measurement model based on the embedded sensor network is tested. Figure 10 shows the forecasting effect.

It can be seen from Figure 10 that the interbank lending interest rate risk measurement model based on the embedded sensor network has a better fitting effect in the prediction of the first 50 days of data and has a strong ability to capture and fit extreme points. There is less hysteresis, which further improves the predictive ability.

Changes in interbank offered rates have a great impact on banks and other institutions, and only a sound risk assessment system can avoid a large amount of loss of profits. Therefore, in order to verify the benefit analysis efficiency and benefit loss rate of the interbank offered interest rate risk measurement model based on the embedded sensor network designed in this paper, this paper designs a comparison with the traditional benefit risk model. The experimental results are shown in Figure 11.

As can be seen from the figure, the interest analysis efficiency of the interbank interest rate risk measurement model based on the embedded sensor network reached 90.79%, while the interest analysis efficiency of the traditional interbank interest rate risk measurement model reached 81.56%, which shows that the interbank interest rate risk measurement model based on the embedded sensor network is 9.23% more efficient than the interest analysis efficiency of the traditional interbank interest rate risk measurement model and the interbank based on the embedded sensor network. The interest loss rate of the interbank interest rate risk measurement model has dropped to 13.61%, while the benefit analysis efficiency of the traditional interbank interest rate risk measurement model is still 21.42%, which shows that the interbank interest rate based on the embedded sensor network. Compared with the traditional interbank offered interest rate risk measurement model, the risk measurement model reduces the loss rate of 7.81%. The experimental results show that the interbank interest rate risk measurement model based on the embedded sensor network can improve the efficiency of profit analysis and can also reduce the rate of profit loss.

6. Conclusions

Both the money market and the capital market use capital transactions as the medium. The flow of capital from one market to another creates a correlation between the fluctuations between the two markets. Studying the correlation characteristics between the markets enables us to grasp the future trends of the market and serve the government. More information is available in the development of a risk prevention policy. Ramasamy R uses a reverse simulation model to study the risks and rewards associated with the Malaysian Islamic Interbank Offered Rate (IBOR) and compare the results with the conventional interbank offered rate (CIBOR). For interbank networks, Ren X first discusses the mechanisms of systemic risk contagion related to asset recovery rates and capital requirements. Then, under the condition of general regularity of financial networks, some new results are discussed, namely, existence, uniqueness, and continuity results, which can be used as the basic support for systemic risk measurement, through numerical analysis of simulation in practice. According to the research in this article, the following conclusions can be drawn: An accurate interbank offered interest rate risk measurement model can not only effectively cover the market risk of commercial banks but also save capital and reduce costs for banks. The embedded sensor network-based interbank interest rate risk measurement and evaluation model can effectively evaluate the interest rate risk, so as to provide a certain basis for companies to change their development strategies in time. The disadvantage is that there is no research on data fusion between data transmission between multiple sensors, which has certain limitations.

Data Availability

No data were used to support this study.

Conflicts of Interest

The author declares that he has no competing interests.

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References

[1] J. Duan, D. Gao, D. Yang, C. H. Foh, and H. H. Chen, “An energy-aware trust derivation scheme with game theoretic approach in wireless sensor networks for IoT applications,” *IEEE Internet of Things Journal*, vol. 1, no. 1, pp. 58–69, 2014.

[2] S. H. Soo, J. Won, S. Sultana, and, E. Bertino, “Effective key management in dynamic wireless sensor networks,” *IEEE Transactions on Information Forensics and Security*, vol. 10, no. 2, pp. 371–383, 2015.

[3] A. B. Noel, A. Abdouli, T. Elfoully, M. H. Ahmed, A. Badawy, and M. S. Shehata, “Structural health monitoring using wireless sensor networks: a comprehensive survey,” *IEEE Communications Surveys & Tutorials*, vol. 19, no. 3, pp. 1403–1423, 2017.

[4] G. Han, J. Jiang, C. Zhang, T. Q. Duong, M. Guizani, and G. K. Karagiannidis, “A survey on mobile anchor node assisted localization in wireless sensor networks,” *IEEE Communications Surveys & Tutorials*, vol. 18, no. 3, pp. 2220–2243, 2017.

[5] J. Luo, J. Hu, D. Wu, and, R. Li, “Opportunistic routing algorithm for relay node selection in wireless sensor networks,” *IEEE Transactions on Industrial Informatics*, vol. 11, no. 1, pp. 112–121, 2015.

[6] N. Goyal, M. Dave, and, A. K. Verma, “Data aggregation in underwater wireless sensor network: recent approaches and issues,” *Journal of King Saud University-Computer and Information Sciences*, vol. 31, no. 3, pp. 275–286, 2019.

[7] H. Yang, F. Li, D. Yu, Y. Zou, and J. Yu, “Reliable data storage in heterogeneous wireless sensor networks by jointly optimizing routing and storage node deployment,” *Tsinghua Science & Technology*, vol. 26, no. 2, pp. 230–238, 2021.

[8] Z. Min and Y. Ying, “Towards SMT-based LTL model checking of clock constraint specification language for real-time and embedded systems,” *ACM SIGPLAN Notices*, vol. 52, no. 4, pp. 61–70, 2017.

[9] O. I. Khalaf and G. M. Abdulrahim, “Optimized dynamic storage of data (ODS) in IoT based on blockchain for wireless sensor networks,” *Peer-to-Peer Networking and Application*, vol. 14, no. 5, pp. 2858–2873, 2021.

[10] M. Adil, H. Song, J. Ali et al., “Enhanced AODV: a robust three phase priority-based traffic load balancing scheme for Internet of Things,” *IEEE Internet of Things Journal*, 2021.

[11] I. Butun, P. Österberg, and H. Song, “Security of the internet of things: vulnerabilities, attacks, and countermeasures,” *IEEE Communications Surveys & Tutorials*, vol. 22, no. 1, pp. 616–644, 2020.

[12] C. T. Jin, M. Davies, and P. Campisi, “Embedded systems feel the beat in New Orleans: highlights from the IEEE signal processing cup 2017 student competition [SP competitions],” *IEEE Signal Processing Magazine*, vol. 34, no. 4, pp. 143–170, 2017.

[13] Z. Wang, Z. Gu, and Z. Shao, “Optimized allocation of data variables to PCM/DRAM-based hybrid main memory for real-time embedded systems,” *IEEE Embedded Systems Letters*, vol. 6, no. 3, pp. 61–64, 2014.

[14] T. Kunz and B. Tatham, “Localization in wireless sensor networks and anchor placement,” *Journal of Sensor & Actuator Networks*, vol. 1, no. 1, pp. 36–58, 2012.

[15] P. Havinga, N. Meratnia, and M. Bahrepan, “Artificial intelligence based event detection in wireless sensor networks,” *University of Twente*, vol. 85, no. 6, pp. 1553–1562, 2017.

[16] G. Han, L. Liu, S. Chan, R. Yu, and Y. Yang, “ROSE: robustness strategy for scale-free wireless sensor networks,” *IEEE/ACM Transactions on Networking*, vol. 25, no. 5, pp. 2944–2959, 2017.

[17] N. Taușan, J. Markkula, P. Kuvaja, and M. Oivo, “Choreography in the embedded systems domain: a systematic literature review,” *Information & Software Technology*, vol. 91, pp. 82–101, 2017.

[18] J. Saaskilahiti, “Retail bank interest margins in low interest rate environments,” *Journal of Financial Services Research*, vol. 53, no. 1, pp. 37–68, 2018.

[19] R. Chen, Z. Li, L. Zeng, L. Yu, Q. Lin, and J. Liu, “Option pricing under the double exponential jump-diffusion model with stochastic volatility and interest rate,” *Journal of Management Science and Engineering*, vol. 2, no. 4, pp. 252–289, 2017.

[20] T. Ajaz, M. Z. Nain, B. Kamaiah, and N. K. Sharma, “Stock prices, exchange rate and interest rate: evidence beyond symmetry,” *Journal of Financial Economic Policy*, vol. 9, no. 1, pp. 2–19, 2017.

[21] Y. Sun and T. Su, “Mean-reverting stock model with floating interest rate in uncertain environment,” *Fuzzy Optimization and Decision Making*, vol. 16, no. 2, pp. 235–255, 2017.

[22] J. Mcandrews, A. Sarkar, and Z. Wang, “The effect of the term auction facility on the London interbank offered rate,” *Journal of Banking & Finance*, vol. 83, pp. 135–152, 2017.

[23] L. H. Anh, V. Kreinovich, and N. N. Thach, “[Studies in Computational Intelligence] Econometrics for Financial Applications,” *Contagion Risk Measured by Return Among Cryptocurrencies*, vol. 760, 2018.

[24] R. F. D. D. Chaudron, “Bank’s interest rate risk and profitability in a prolonged environment of low interest rates,” *Journal of Banking & Finance*, vol. 89, pp. 94–104, 2018.

[25] A. Wang, “The pricing of total return swap under default contagion models with jump-diffusion interest rate risk,” *Indian Journal of Pure and Applied Mathematics*, vol. 51, no. 1, pp. 361–373, 2020.

[26] S. Mu and Z. Xiong, “Internet financial interest rate risk measure based on genetic rough set reduction,” *Service Oriented Computing and Applications*, vol. 13, no. 4, pp. 309–321, 2019.

[27] Y. Chen, “Optimal reinsurance from the viewpoints of both an insurer and a reinsurer under the CVaR risk measure and Vajda condition,” *The Journal of the IAA*, vol. 51, no. 2, pp. 631–659, 2021.