

# Signal Recognition Model of Ginseng Diseases and Insect Pests in Agricultural Internet of things

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**Abstract:** In view of the relationship between diseases and insect pests in the growth process of ginseng, the safety of ginseng planting production and the key scientific problems of product quality and yield are solved, and the signal identification model of ginseng disease and insect pest is adopted to ensure the quality and safety of ginseng products and the increase of yield. Combined with the key technology of Agricultural Internet of things, a signal recognition model for diseases and pests of ginseng was constructed to realize the identification of pests and diseases in the process of ginseng planting. A signal recognition model for ginseng pests and diseases in Agricultural Internet of things is proposed, and the fuzzy clustering probability of signal characteristics is calculated to get the critical value of catastrophic anomalies. The simulation results show that the proposed model algorithm can obtain accurate data of ginseng disease and insect pests signal, the error after test is 0.00213, the correct rate of normal ginseng signal is 91.03%, and the correct rate of ginseng signal is 99.93%, which greatly improves the accuracy of the signal recognition model of ginseng disease and insect pests.

## 1. Introduction

With ginseng prices rising, ginseng planting ginseng enthusiasm is high. But at the same time, the new forest land which is suitable for the planting of ginseng is scarce, which makes the planting area of ginseng grow rapidly, and the area of cultivated land and two stubble soil is increasing rapidly. The physiological and insect pests and diseases and insect pests of ginseng, which are caused by the discomfort of climate and soil conditions, are increasing, according to the disease and insect pests. Occurrence regularity, environmental conditions, characteristics of disease, occurrence dynamics, timely and accurate pesticide application, protection and treatment of [1]. In pursuit of ginseng production, Shen Nong also controls the quality of ginseng products. Ginseng's product quality is the most prominent problem in the production process. The effects of ginseng and insect pests on ginseng growth were constantly changed during the growing and scale planting of ginseng, and the quality of ginseng was affected to a great extent. Establishing a signal recognition model for diseases and insect pests of ginseng is of great significance for traditional cultivation methods.

This paper, based on the key technology of the Agricultural Internet of things, calculates the relationship between the critical threshold and the equilibrium point, studies the stability of the signal balance point of ginseng disease and insect pests, and relies on the modern agricultural scientific calculation method to ensure the rational application of pesticides to inhibit the occurrence of ginseng diseases and pests.

## 2. Overall Plan Design

In order to realize the scale and automation of ginseng planting, it is necessary to use the key technical equipment of the Agricultural Internet of things to avoid the traditional ginseng planting to rely on manual work, reduce the labor force, improve the efficiency of the large-scale ginseng planting process and the precision cultivation [2]. It is equipped with wireless communication technology to enhance the stability of the signal recognition of ginseng disease and insect pests, and the degree of automation is high. In view of the signal of ginseng disease and insect pests, the overall frame of the signal recognition model of ginseng disease and insect pests of the Agricultural Internet of things is shown in Figure 1.

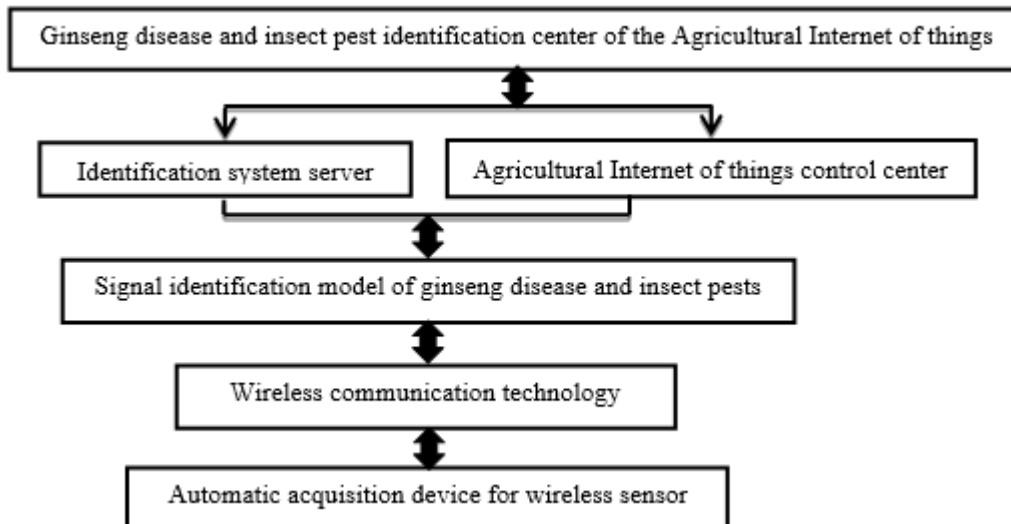


Fig.1 Time-frequency window of wavelet transform

The signal identification model of ginseng disease and insect pests of the Agricultural Internet of things is designed to detect the ecological factor signal of ginseng field, and realize real-time monitoring and prediction. The ginseng ecological factors include soil physical, chemical properties, pesticide residue and temperature, growth temperature, relative humidity and growth state, and real-time monitoring [3]. The surveillance of ginseng disease and insect pest in a certain area is serious, then it is sent to the ginseng disease and insect pest identification center of the Agricultural Internet of things by wireless network communication, and the recognition model of ginseng disease and insect pest recognition can be accurately identified and identified. The Agricultural Internet of things real-time monitoring and monitoring of ginseng diseases and insect pests area, using the wireless sensor to collect ginseng ecological factors for data pre-processing, through the ginseng disease and insect pest small signal identification model to get a more serious target area [4].

## 3. Signal Identification Model of Ginseng Disease and Insect Pests

### 3.1 Model Description.

The model analysis of ginseng pests and diseases were divided into two categories, namely, the ecological factors of Panax ginseng and the ecological factors carrying diseases and pests, and the number [5] of the ecological factors of ginseng and insect pests carrying ginseng and insect pests at t time, respectively, with  $X(T)$  and  $Y(t)$ . Using  $X$  and  $Y$  instead of  $X(T)$  and  $Y(T)$ , the ginseng ecological factors are divided into normal and susceptible to pests and insect pests and the number of infected pests and diseases.  $S$  and  $I$  are used instead of  $S(T)$  and  $I(T)$ . Therefore, the signal identification model of ginseng disease and insect pest

$$\begin{cases} X' = a - \mu X - kXI \\ Y' = kXI - \gamma Y \\ S' = b - \alpha YS - \beta S \\ I' = \alpha YS - \delta I \end{cases} \quad (1)$$

Among them,  $a$  is the input rate of ginseng ecological factor constant,  $B$  is the constant increment rate of ginseng ecological factor, which is the death rate of not carrying ginseng disease and insect pests signal, the death rate of ginseng and insect pests signal,  $K$  as the probability of carrying the signal of disease and insect pests on ginseng ecological factor, the alpha is the probability of the signal of disease and insect pests on the human ginseng, beta is The harvest rate of the susceptible insects was [6]. According to the balance of ginseng ecological factors, is calculated by means of omega =  $(X, Y, S, I)$ , where  $X > 0, Y$  equal to 0,  $S > 0, I > 0$  [7].

### 3.2 The Existence of Critical Threshold and Equilibrium Point.

According to the formula (1), the inference calculation shows that the ginseng disease free equilibrium point  $P_0(X_0, Y_0, S_0, I_0)$ , that is, satisfies  $\left[\frac{a}{\mu}, 0, \frac{b}{\beta}, 0\right]$ , and  $H = (Y, I, X, S)^T$ . The formula (1) can be written as  $H' = F - G$ , in which

$$F = \begin{bmatrix} kXI \\ \alpha YS \\ 0 \\ 0 \end{bmatrix} \quad (2)$$

$$G = \begin{bmatrix} \gamma Y \\ \delta I \\ -a + \mu X + kXI \\ -b + \alpha YS + \beta S \end{bmatrix} \quad (3)$$

According to the algorithm of critical threshold, the critical threshold of formula (1) is obtained.

$$R_c = \sqrt{\frac{abk\alpha}{\mu\beta\gamma\delta}} \quad (4)$$

Through the study of the critical threshold and equilibrium point of the signal model of ginseng diseases and insect pests, we can see that there is a critical state in the signal model of ginseng and insect pests. When the critical threshold is  $R_c < 1$ , the signal of ginseng ecological factor in the ginseng field is disease-free, that is, the signal of ginseng disease and insect pest is eradicated, which is the ideal state of [8]. When the critical threshold is greater than 1, the ecological factor of ginseng in the cultivated ginseng field has a balance point of disease and insect pests, that is, the signal of ginseng and insect pests will not disappear. With the infinite expansion of the time domain and the space, the signal of ginseng disease and insect pest will spread and spread [9]. Therefore, we should make clear the target of prevention and control, carefully adjust the ecological environment of ginseng, timely and accurate application of anti inversion and disease control agents, and actively create an ecological environment which is beneficial to the growth of ginseng, which is not conducive to the occurrence of diseases and pests, and can make the disease and insect pests of ginseng eventually eliminate [10].

## 4. Results and Analysis

The experimental site was selected in the Northern Campus of the Agriculture Science And Technology College, taking ginseng and pests and diseases as the research object, and collecting ginseng and normal diseases and insect pests respectively, setting the time interval set to 1 s, the length of time is 1800s, each measure has subtracted local noise, normal and insect pests. 25 groups of data were measured in each group, with a total of 50 groups of data. Then 30 groups of normal ginseng signals and the first 15 groups containing signals of pests and insect pests were taken as

training samples, and 20 groups of normal ginseng signals and 10 groups containing signals of pests and insect pests were used as test samples.

#### 4.1 Feature Extraction.

The characteristics of ginseng ecological factors are mainly measured and described from three aspects. The characteristics of ginseng ecological factors are shown in Table 1.

Table 1 Characteristics of the ecological factors of ginseng

Position characteristics	Median	Unity	mean value	Discrete coefficient
Morphological character	kurtosis	skewness	variance	
scatter characteristic	Mean difference	Four division difference		

The shape feature of Table 1 is the shape of distribution, which reflects the degree of skewness and kurtosis of data distribution, including skewness (skewness) and kurtosis (kurtosis). Dispersion is the dispersion of distribution, reflecting the trend of the data far away from its central value, including the four quartile deviation, the mean difference (mean deviation), the variance (variance) and the discrete coefficient (ACV). The location feature is the concentration trend of distribution, reflecting the degree to which the data are gathered or gathered at its central value, including the mode, the median (median) and the mean (mean). After extracting the signal characteristics of ginseng pests and diseases, 9 groups of eigenvectors are formed. Therefore, the wireless sensor acquisition node is determined to be 9. The number of signal recognition nodes is determined according to the classification results of sampling samples. The sample ginseng is divided into two categories, which contain diseases and insect pests and no diseases and insect pests. Therefore, the identification nodes are determined to be 2.

#### 4.2 Classification Recognition.

First, the extracted 9 sets of eigenvector sets are normalized to [0, 1], and the input vector is  $X = (X_1, X_2, \dots, X_9)$ , and the output vector is  $Z = (Z_1, Z_2)$ , and the output results are binary coded, and the signals containing disease and insect signals are  $Z=[1, 0]$ , and normal ginseng ecological factor signals. The time and the number of cycles used in the experiment are compared with the training functions of different training functions. The training time and the number of cycles of different training functions are shown in Table 2.

Table 2 training time and cycle number of different training functions

training method	Time used (/s)	Cycle times
Gauss Newton method	1.131	174
Adaptive gradient descent method	0.816	14
Model algorithm in this paper	0.156	200

From table 2, it can be seen that the improved method using the standard numerical optimization in this paper is faster and more time saving than the improved method using the Gauss Newton method and the adaptive gradient descent method.

#### 4.3 Analysis of Simulation Results.

Through the training of the Agricultural Internet of things, 30 groups of training samples were used to test the signal identification model of ginseng disease and insect pests, and the error was 0.00213, which met the requirements of the Agricultural Internet of things. It showed that the trained model could meet the identification requirements of the hidden ginseng disease and insect pests, carrying 20 sets of test samples and some output nodes. The fruit is shown as shown in Table 3.

**Table 3 The output results of the test data**

Test pattern	sample	Normal signal		Signals containing diseases and insect pests	
Actual output		0	1	1	0
	Sample 1	0.991091	1.772E-5	1	5.2653E-09
	Sample 2	1.1845E-09	1	1	5.3384E-12
Ideal output	Sample 3	7.0652E-8	0.999999	1	4.8433E-08
	Sample 4	2.1176E-13	1	1	3.2325E-12
test result	The total accuracy rate is about 96.24, of which the correct rate of normal ginseng signal is 91.03%, and the accuracy rate of ginseng and ginseng signals is 99.93%.				

If the sample output and the ideal output error are within 1%, then the classification is successful, the total accuracy of the experiment reaches 96.24%, and the test result achieves the expected goal.

## 5. Summary

In this paper, a new intelligent model algorithm is designed, which combines the key technology of the Agricultural Internet of things and combines the automatic acquisition device of wireless sensor and the signal recognition model of ginseng disease and insect pests. By constructing the wireless communication network, the model test of the target recognition of ginseng disease and pest signal is realized, and the recognition model is universal. It can meet the ecological factors of ginseng (soil physical, chemical properties, pesticide residue and temperature, growth temperature, relative humidity and growth state) in real time, and the recognition efficiency and recognition accuracy are high. By using the critical threshold and the existence of equilibrium point, the signal of normal ginseng and the signal of ginseng and insect pests can be well divided. It does not need to destroy the normal physiological state of the ecological factors of ginseng. It is helpful to study the relationship between the agro ecological signal and the insect pests signal from the new vision.

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