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Monitoring of Pests and Diseases by New Energy Aerial Mapping Methods

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Abstract. To expand the application of new energy technology in agriculture and improve the monitoring effect of agricultural pests and diseases, this paper proposes a new energy aerial tracing method to extract the identification indicators of pests and diseases in aerial photography. Then, combined with the occurrence area and occurrence rate of pests and diseases, the calculation and analysis were carried out, and the early warning was carried out according to the point characteristics of pests and diseases. The results show that the monitoring and identification of pests and diseases can improve the identification rate of flying pests, plant pests and underground pests by combining the new energy aerial mapping method, improve the identification accuracy from 74.68% to 88.67%, and carry out early warning, reduce the cost of agricultural loss by 38 million~154 million yuan, and the identification range from 14,500 hectares~16,500 hectares, and reduce the monitoring time by 74.5~87.5%. Therefore, new energy technology can meet the monitoring requirements of agricultural pests and diseases, which is helpful to promote the development of new energy further.

Key words. Renewable Energy, Aerial Mapping Methods, Pests and Diseases, Monitoring.

1. Introduction

At present, there are more than 1,400 kinds of pests and diseases in the agricultural field, mainly affecting single varieties of crops and occasionally concentrated outbreaks, causing serious damage to crops and irreparable economic losses. Pests and diseases are not only the key causes of reduced agricultural production and quality [1], [2], but also hinder high agricultural yields, and timely monitoring of pests and diseases is essential for the agricultural sector. As a clean energy source, new energy can provide a sustainable power supply for agriculture, especially photovoltaic energy. Moreover, direct current cannot carry out wireless transmission of energy, which limits the application of new agricultural equipment, especially uncrewed aircraft, so the application of photovoltaic energy to uncrewed aircraft has become a hot topic in agriculture New energy aviation. Aircraft can scan a certain area [3], [4], and draw high-definition agricultural maps to identify the growth of crops and crop pests and diseases. And the intelligent algorithm path planning and aerial mapping are combined. Some scholars believe that the shortcomings of the methods and theories of new energy aerial scanning are mainly due to the inability to conduct in-depth analysis in the scanning process, and the scanning results cannot be used to judge the harmfulness of insects, and it is easy to misidentify them, so more practical cases are needed as support, otherwise it is difficult to prove its effectiveness in the actual implementation process. Therefore, the relevant practical case studies have important theoretical value, which can provide more support for the relevant theoretical analysis and case studies. Combined with aerial mapping, it is found that the effective identification of pests and diseases in the area has great development potential, but through actual case analysis, it is found that the pests and diseases are hidden, and the conventional aerial drawing can not be identified, and some scholars will count the pests and diseases in the area. It is found that the new energy aerial mapping can identify more obvious pests and diseases, but the identification rate of underground diseases or plant diseases is low, and it is recommended to add infrared scanning equipment for drawing recognition. Through multiple iterative analyses and analysis of abnormal areas, the occurrence of pests and diseases can be predicted or early warning, and the identification of pests and diseases can be carried out in combination with the hydrological data and historical data of the region, but there is a lack of specific practical cases, so it is recommended to apply the new energy aviation hit method to agricultural production, and conduct hierarchical analysis and judgment of the types of pests and diseases [5], [6], the measurement accuracy and measurement range, and compare them with the actual pest and disease test, and verify the effectiveness of the results [7], [8]. Based on the above analysis, this paper mainly starts from the following aspects. Firstly, the new energy aerial mapping method is analyzed, and the data of pests and diseases are standardized and input into the aviation system, and then the processing power of the remote PC is used for data analysis and identification, and the joint detection of intelligent algorithms and manual work is realized, and finally the identified areas are repeatedly measured to confirm and identify the occurrence rate of pests and diseases, among which the main observation indicators are flying pests, plant insects and underground pests, and the effectiveness and implementation cost of the new energy

aerial mapping method are verified. This study aimed to explore the monitoring effect of new energy aerial surveying and mapping methods on pests and diseases. The specific steps are as follows:

Step 1: Screening the characteristic role of new energy aerial tracking, constructing cross-layer non-local plates, further clarifying the characteristic indicators of new energy aerial tracking methods, and forming a quantitative analysis formula.
Step 2: Combined with the scanning code aerochart, refine the pest monitoring indicators, build a data set, and calculate the pest compliance rate.
Step 3: Based on the relevant data processing of pest and disease monitoring indicators and data formulas, calculate the accuracy of the scan.
Step 4: Through the measurement algorithm, the above index data is deeply processed, the effectiveness of the pest monitoring image is explored, the accuracy and loss value are clarified, and the verification results are output [9], [10].
Step 5: Through the above calculations, the correlation between the new energy aerial survey method and the identification and monitoring of pests and diseases is clarified according to the indicators combined with the identification and monitoring of pests and diseases and the application potential of new energy in the agricultural aerial survey is further explored.

2. Related Problem Description

In this paper, the monitoring index system of agricultural pests and diseases is constructed based on the tracing method of energy and aviation equipment, and the characteristics of local pests and diseases are identified. At the same time, the correlation between new energy aerial photography and pest monitoring was discussed and judged, and the monitoring characteristics of pests and diseases were further discussed.

A. Iterative Drawing of New Energy Aviation Equipment

New energy spacecraft has a long stay in the air, so its energy demand is larger, and the traditional petrochemical raw materials can not meet its requirements, new energy aircraft can achieve long-term detention at high altitudes, can carry out fixed-point scanning, with a part of the area of structural analysis to improve the identification rate of pests and diseases, new energy aircraft is mainly photovoltaic panels for the power supply [11], so pay attention to power, voltage and current, and optimize the path L_{f}, extend the distance of tracing. Hypothesis 1: The scanning area L_W is the number of layer iterations, the flight angle is δ, and the geodetic coordinate system p is established to determine the aircraft's trajectory. Due to the delay of the aircraft, as well as external disturbances such as weather and wind resistance, the kinematic equations are established as follows.

$$\begin{cases} \dot{x}_i = \left(v + v^{\mathrm{d}}\right) \cdot \cos\psi / L_{\mathrm{w}} + \Delta\xi \\ \dot{y}_i = \left(v + v^{\mathrm{d}}\right) \cdot \sin\psi / L_{\mathrm{w}} + \Delta\xi \\ \dot{\tan\delta} = \left(u - \tan\delta\right) / T_{\mathrm{d}} + \Delta\theta \end{cases} \tag{1}$$

where: v^{d} is the perturbation of flight speed; δ^{d} for the delay of the steering; T_{d} is the delay time; u and is the amount of control of the flight rudder. The scanning process of new energy aircraft is multi-level iterative, so the graphic analysis and pixel analysis during the flight have theoretical solid value, which can support later pest control. At the same time, the change model of the Introduction of tracing is:

$$\begin{cases} \dot{x}_i = d_i \cdot [\left(v + v^{\mathrm{d}}\right) \cdot \cos\psi / L_{\mathrm{w}} + \Delta\xi] \\ \dot{y}_i = d_i \cdot [\left(v + v^{\mathrm{d}}\right) \cdot \sin\psi / L_{\mathrm{w}} + \Delta\xi] \\ \dot{\tan\delta} = \left(u - \tan\delta\right) / T_{\mathrm{d}} + \Delta\theta \end{cases} \tag{2}$$

where: d_1 is the scanning data of the device, the unit is M/s, and the interference unit of the pixel is M·rad/s. Therefore, in the process of pest control, the new energy aerial scanning method should pay attention to its endurance, especially pay attention to the stability between the new energy power flow and the aircraft power flow, and maintain the balance of the output of the two, so as to improve the endurance of the aircraft, prolong the flight time of the aircraft, and effectively plan its path.

B. Path Planning for New Energy Endurance

In the process of spring scanning, the calculator is also used to analyze and judge insufficient factors such as starting route, endurance, attitude, etc., improve the relationship between its path and flight speed, and better adjust the aircraft to ensure its stability. At the same time, it is necessary to effectively identify each picture in the scanning process to improve the actual effect of pest control and pest control. The scanning path of the aircraft is designed as a two-stage type. The aircraft starts from the initial position point p_1, takes the centre of the circle O_1, and R makes the reciprocating motion with the radius as the center. In this process, the drawing of the aircraft renders a specific angle until the point is reached p_2. At the same time, the photovoltaic cells continue to supply power to p_2 meet the distance to the point p_3 until the entire scan is completed $\sum p_i$. In the process of flying code scanning, any insect anomaly point is D_i, and the suspicious point is M_i when the code scanning point D_i and the anomaly point M_i are in direct contact with each other, and the output is crossed, then the change of the flight path DR_1 is as follows:

$$DR_1 = \sqrt{\left(R + P_1M\right)^2 + L_{\mathrm{r}}^2} \cdot x_1 \tag{3}$$

where x_1 is the abscissa of the starting point, M is the intersection of the scanning point, and is approximately equal to $L_w / 2$. In the path planning, the matching of power and speed should be satisfied, as follows.

$$x_1 = \sqrt{\left(R + W/2\right)^2 + L_r^2} \cdot v_i \tag{4}$$

The balance of the aircraft is equal in power

$$x_i - x_j \geq \sqrt{\left(R + W/2\right)^2 + L_r^2} \tag{5}$$

where x_j is the reserved capacity of photovoltaic cells, and the minimum path L_{wmin} satisfies the following relationship:

$$L_{\text{wmin}} = n \cdot \left(D_1 R_1 - R_m + x_j\right) \tag{6}$$

According to the analysis of the above content, it can be found that the new energy aerial scanning process is affected by many factors, and various factors continue to affect it. Therefore, aerial scanning has large wind resistance regarding its own flight stability and distance. Use mathematical algorithms and photovoltaic angles to make continuous judgments and extend the aircraft's residence time in the air to reduce the impact of grouping and different data interference during the flight on the flight process. Therefore, it is necessary to analyze and draw the flight speed, altitude and dynamics. The relevant graphics are shown in Figure 1.

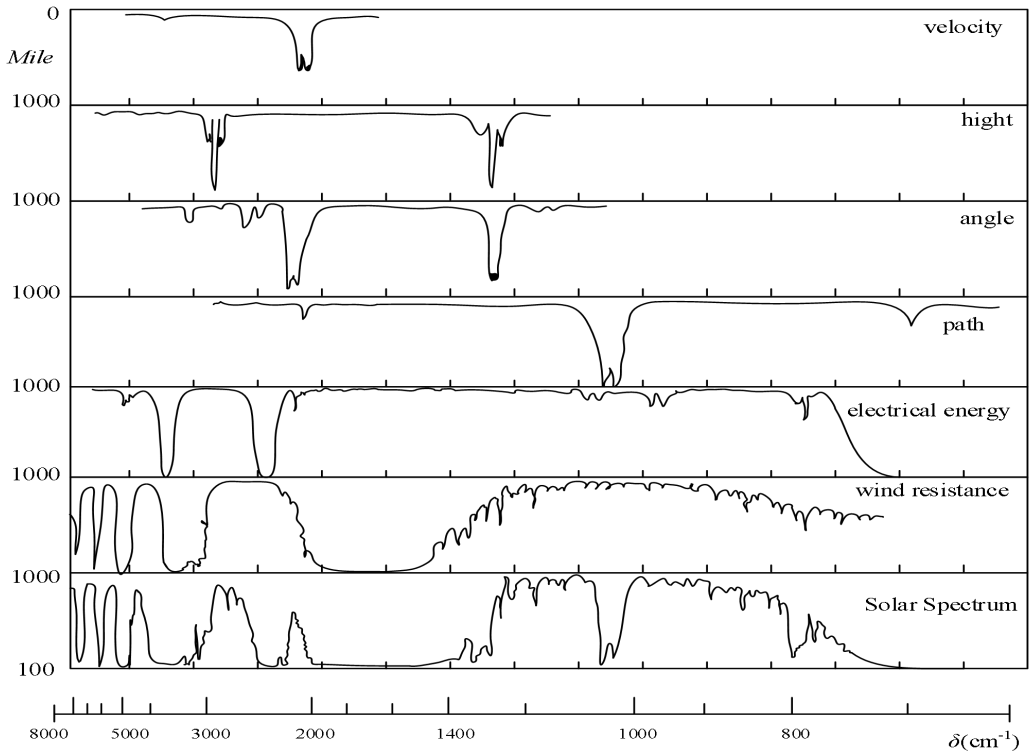

Figure 1. Problems Encountered by New Energy Aircraft in Controlling Detention

C. Identification of Abnormal Points of Pests and Diseases

In pest identification, it is necessary to pay attention to the differences between outliers N and database disease characteristics H to improve the identification rate. When the aircraft reaches the point p , the difference between the point N and H forms a set N_1 is recorded, the corresponding graphics and positioning information are recorded, and the starting coordinates (x, y) and the radius R_2Q of the pest area are output at the same time, and the mathematical relationship is calculated, and the critical collision condition with the parking space boundary can be obtained HF .

$$R_2N_1{}^2 = \left(R - y_1\right)^2 + \left(x_1 - S_w\right)^2 \tag{7}$$

Where S_w is the ordinate of the starting point, and the radius area R is approximate. After obtaining the area information of pests and diseases, the code $R_{\min}$ is scanned with the minimum radius as the range, and the level information is recorded, as follows

$$\left(R_m - W/2 - L_{se}\right)^2 = \left(R_m - y_1\right)^2 + \left(x_1 - S_w\right)^2 \tag{8}$$

According to N the comparison of the differences between the points H , the pest p_2 and disease level $y_{2\min}$ of the points can be obtained

$$y_{2\,\min} = k \cdot \sqrt{\left(R_m - L_{se}\right) - \max\left(R_m - S_w\right)} \tag{9}$$

When the pest and disease levels coincide, i.e., $R = R_{\min}$ the number of pests and diseases is solved, which is calculated as follows.

$$\mathrm{R}_3 A^2 = \sum RM_i + M_j \cdot A \tag{10}$$

In addition, according to the current of the new energy battery, the treatment method is selected, as follows

$$\left(R_{\mathrm{m}} - y_1\right) + L_{\mathrm{rd}} - L_{\mathrm{se}} \approx \sqrt{\left(R_{\mathrm{m}} + 0.5W\right)^2 + \left(L_{\mathrm{w}} + L_{\mathrm{f}}\right)^2} \tag{11}$$

During the flight of the new energy aircraft, the scanning depth analysis of the code scanning area and the detection area is carried out according to the power to maximize the identification of pests and diseases. In order to avoid the battery current being too low to complete the code scanning, the polynomial is used to optimize the fit of the path:

$$y = \sum K_i x^i \tag{12}$$

To sum up, the new energy aircraft in the flight process involves the problem of path planning and new energy power supply, the power supply of new energy is affected by the natural environment, such as weather and customs, etc., but the new energy can photon conversion rate, light intensity and angle and other factors will also increase the endurance of the aircraft, the new energy space vehicle by adjusting the angle to obtain more photovoltaic energy, so as to provide support for the aerial mapping method, so the new energy aircraft has a great advantage in the process of tracing. And it can continue to fly to make up for the short endurance of traditional fuels.

3. Actual Case Analysis of Pests and Diseases

A. Case Introduction

In this paper, ResNet50 is used as the reference scanning model, and the high-definition scanning of pests and diseases is carried out through the combination of single code scanning, multiple scanning and tracking methods, and the effect of the new energy aerial photography tracking method. Among them, the observation indicators include the scanning depth, scanning cost, scanning range, as well as flying pests, plant pests and underground pests. The test time was 30 days, the test area was 102 hectares, and the mapping content included soybeans, sorghum, rice and corn, as well as shelter belts, as follows.

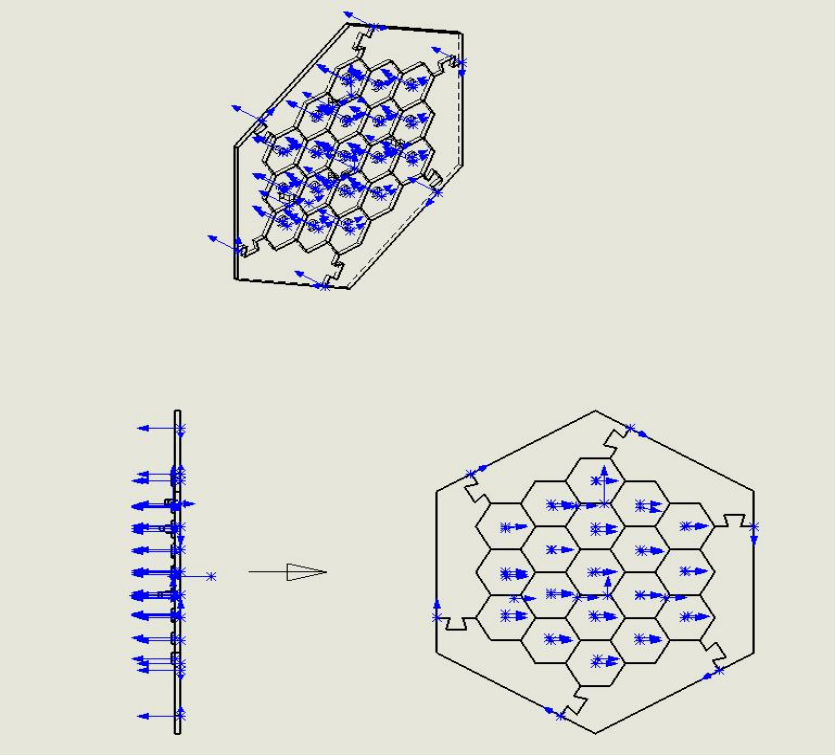

Figure 2. Aerial Scanning Area

From the analysis of aerial scanning data in Figure 2, it can be seen that the monitoring process of pests and diseases presents a 3D three-dimensional process, and the UAV conducts three-dimensional scanning of up, down, left and right, mainly to carry out multi-level scanning and analysis of pests and diseases, so as to find the location of pests and diseases. Through the above analysis, it can be known that the new energy aerial scanning can segment the scope of pest monitoring, identify the relationship between each segment of the pest and disease pest, better judge and analyze the data, and improve the integrity and optimization ability of the data.

B. Comparative Experiments on Pests and Diseases

Based on the application characteristics of new energy aerial surveying and mapping indicators in pest and disease monitoring, the pest and disease datasets were collected and verified, and the pests were identified by combining the new energy aerial surveying and mapping methods. For different weather, the accuracy rate reached 88.617% and 74.66%, respectively. Through multiple scans, it was found that the accuracy of the recognition results increased. At the same time, the new energy has significantly increased

the number of aircraft, the accuracy has not changed, and its amplitude has decreased by 3.18%, as follows.

Table 1. Analysis of Pest and Disease Datasets for New Energy Aerial Tracing

TRACING FORM	DISEASE	ACCURACY/%		NEW ENERGY ENDURANCE (M)	WEATHER	
		Single scan	Multiple scans		Cloudy	Fine
New Energy Aviation Scanning	Flying pests	85.50	95.73	40.43	0.84	0.86
	Plant pests	71.82	79.98	1.47	0.66	0.69
	Underground pests	87.31	97.23	60.38	0.85	0.87
Manual monitoring	Flying pests	72.76	81.63	21.22	0.67	0.71
	Plant pests	87.23	97.02	0.39	0.85	0.86
	Underground pests	72.74	81.42	1.24	0.67	0.70

Combined with the experimental data in Table 1, compared with other models, the new energy aerial photography scanning method can effectively identify the disease subset, and its error is 0.073~0.325%, and the recognition rate in different weather also significantly improved. The values of each indicator have increased. Combined with the analysis of the above experimental results, the new energy aerial photography method is more feasible in the identification of pest and disease training sets after verification, indicating that the new energy aerial photography method is closely related to the monitoring of diseases and pests, and the application of multiple scans to improve the effectiveness of identification is more practical, and the specific scanning results are shown in Figure 3.

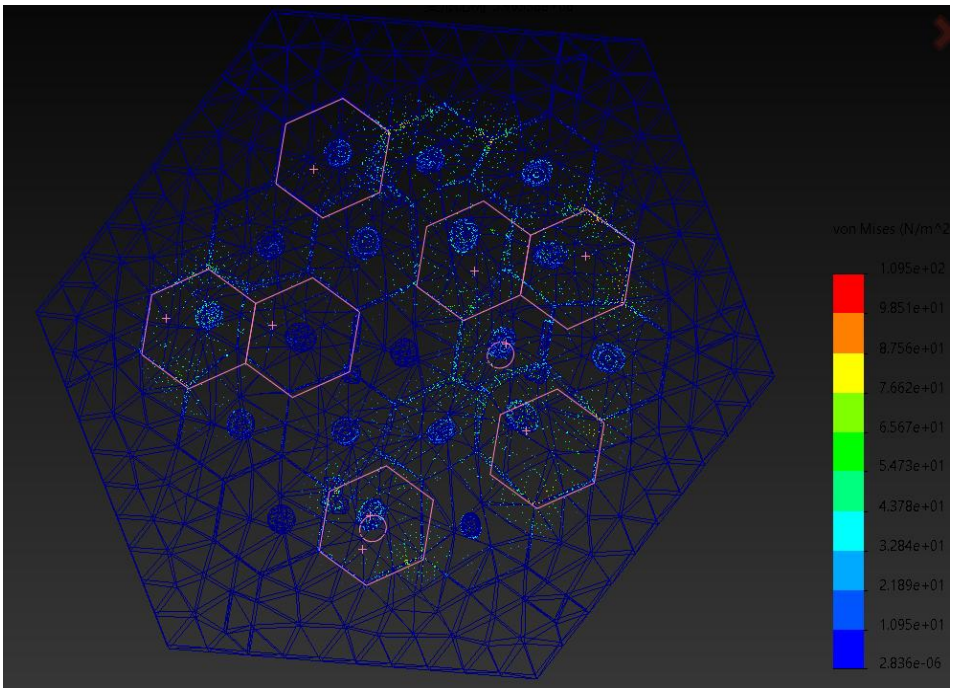

Figure 3. Focused Scanning Areas for Pests and Diseases

It can analyze the trunk nature of pests and diseases and identify them through historical data, so as to judge the occurrence of pests and diseases in each region and give early warning in time, and at the same time, the evolution process and evolution process of pests and diseases in each region can be analyzed, so as to enhance and enhance the integrity of pests and diseases, and provide a basis for pest control and pest identification in the later stage. The characteristics of large scanning depth can meet the in-depth analysis of agriculture and the identification of pests and diseases.

C. Time of Identification of Pests and Diseases

Manual identification time is a better way to identify new energy sources of aircraft. More accurate virus monitoring and control. Therefore, it is necessary to prevent and scan for different intervals and different periods. Identify the key indicators. In order to prove better the practical value of the new energy aerial surveying and mapping method proposed in this paper in the monitoring of pests and diseases, and compare the effectiveness of new energy batteries. A multi-level comparison was performed, and the verification results are shown in Table 2.

Table 2. Analysis of Pest Identification Time [unit: h]

JOURNEY	RECOGNITION RATE (%)	TYPE OF DISEASE	BATTERY LIFE		WEATHER		FOCUS AREA		SCAN HIERARCHY	
			One-way	Return	Cloudy	Fine	Not	Yes	Mono-layer	Multi-layer
1~2 laps	80.381	Flying pests	85.144	94.798	0.833	0.849	0.831	0.851	0.832	0.851
	81.383	Plant pests	69.006	78.347	0.613	0.684	0.576	0.687	0.594	0.69
	80.348	Underground pests	86.500	96.706	0.853	0.873	0.845	0.874	0.849	0.875
3~6 laps	80.374	Flying pests	86.122	96.872	0.849	0.869	0.831	0.871	0.840	0.871
	81.178	Plant pests	72.509	81.032	0.670	0.725	0.627	0.728	0.648	0.731
	80.355	Underground pests	86.869	97.453	0.854	0.866	0.834	0.868	0.844	0.868

According to the data analysis in Table 2, compared with 1~2 circles, the accuracy of the new energy aerial photography method on pest bio-identification and monitoring did not change, and the increase of key areas and scanning layers did not affect the results. In the case of 88.617% and 74.668% recognition accuracy, respectively, the scanning power of 1~2 turns and 3~6 turns is not reduced. In terms of weather, key areas and scanning layers, the scanning results of new energy vehicles are relatively satisfactory. Based on the above experimental analysis, it can be seen that the new energy aerial photography method can effectively monitor pests and diseases. At the same time, the results of the specific pests were found to be more efficient, as follows.

Table 3. Analysis of Experimental Results for the Training Set of Self-collected Data

PEST TYPE	ACCURACY/%		PLANTING STAGE		
	Single kind	Mixed kinds	Sow	Fertilize	Harvest
Fly	81.625	98.500	0.846	0.816	0.826
Beetle	91.250	99.875	0.917	0.913	0.913
Butterflies	89.250	99.500	0.899	0.893	0.894
Moths	91.375	99.625	0.941	0.936	0.937
Aphids	91.500	99.875	0.929	0.925	0.926
Mites	93.625	99.875	0.958	0.953	0.955

Combined with the verification effect of the measured data in the above experiments, the new energy aerial photography method combined with historical agricultural data significantly identifies various pests and diseases such as flying insects, beetles, butterflies, moths, aphids, mites, etc.

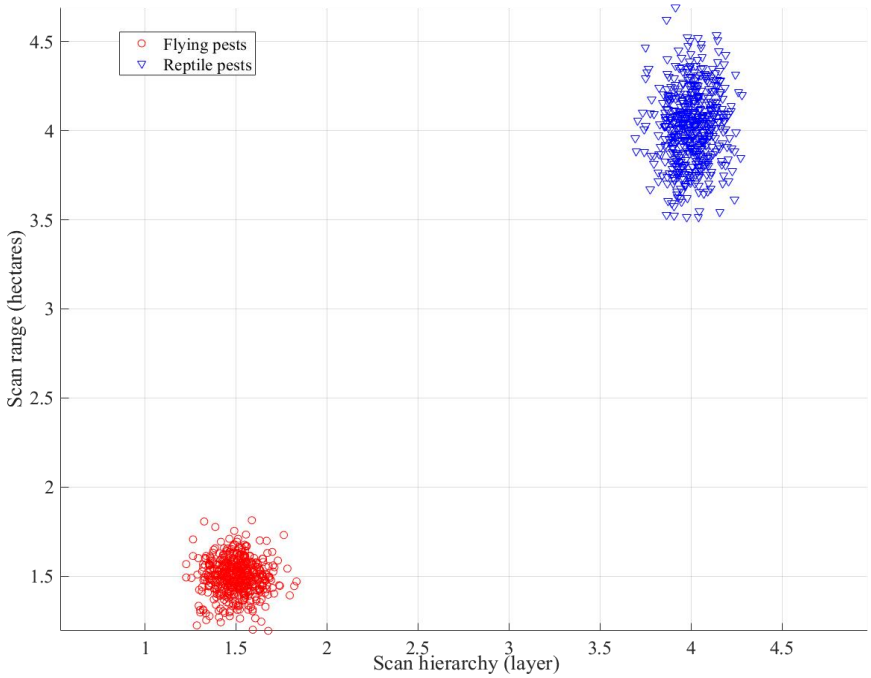

Figure 4. Identification Characteristics and Classification of Pests and Diseases

Figure 4 shows obvious characteristic differences in the aeronautical scanning of different pests and diseases, which can better monitor the disease. The above results show that the new energy aerial scanning method can carry out a more comprehensive and accurate characteristic analysis of pest and disease monitoring, so as to improve the effective identification method of pests and diseases, cluster and segment the pests and diseases, and the research results show that there are significant differences between different pests and diseases, mainly because the new energy aerial scanning scheme identifies the scanning results of pests and diseases through multi-layer analysis, and carries out multi-angle and characteristic analysis of pests and diseases, and judges the activity area of pests and diseases in combination with historical data In this way, we can have a more comprehensive grasp of the pathological analysis process. In summary, the new energy aerial scanning method can effectively monitor the virus, comprehensively judge the stability of the scanning process and graphics, improve the accuracy of its analysis, and realize the differential analysis of fish species, so as to ensure the rationality of the analysis, which has high theoretical and practical value.

4. Conclusion

Agricultural virus damage is one of the main hazards now, it has the problem of large harm in the generator, and has a serious impact on the social economy and production, the traditional aircraft use fuel for reconnaissance and monitoring, so there is no problem with short range and high cost, so new energy has become one of the main methods of aerial scanning, new energy for the aircraft to carry out continuous work, mainly using light energy and wind energy, among which light energy has strong sustainability, to the length and time of the pair, and the characteristics of low cost, can better meet the field of crop monitoring. Moreover, long-term endurance can be carried out through the conversion of new energy, so there is no feasibility of new energy in theory, and sustainable analysis of crops can be carried out. This study combined the characteristics of typical pests and diseases in China's agricultural field, and deeply discussed the monitoring effect of new energy aerial surveying and mapping methods on pests and diseases. According to the scanning results, the identification accuracy of flight, plant and underground pests reached more than 88.7%, the energy consumption of new energy batteries was reduced to less than 0.348, and the identification accuracy of different scanning layers was more than 87.5%. In general, compared with other models, the new energy aerial survey method is more practical in the monitoring of pests and diseases, indicating that the new energy has a significant effect on the control of agricultural pests and diseases, and the aerial survey method is feasible and practical for the monitoring effect of pests and diseases. However, there are many types of pests and diseases, and there is a lack of data in this study, more data will be collected in the future.

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