Hindawi
Mathematical Problems in Engineering
Volume 2022, Article ID 1129419, 8 pages
https://doi.org/10.1155/2022/1129419

Research Article

Design and Analysis of Intelligent Agricultural Monitoring System Based on Biological Intelligence Optimization Algorithm

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Received 31 March 2022; Revised 9 May 2022; Accepted 17 May 2022; Published 24 June 2022

Academic Editor: Man Fai Leung

The traditional optimization method has insufficient intelligence, slow operation speed, and some problems in the calculation of optimal parameters when facing the relationship between too large sample size and complex thread. The biological intelligence optimization algorithm is based on the genetic and evolutionary mechanism of the genetic system. The smart agricultural system is the application of new IOT technology in the field of smart agriculture, mainly including real-time monitoring, wireless monitoring, and remote image and analysis functions. Through this topic, it is concluded that (1) when the parameter is set to $\mu = 0.02$, $\beta = 0.99$, the deviation of the optimal value = 1.74, the deviation of the average value = 3.86, the standard deviation of the experimental value = 3.81, the performance evaluation = 2.68, and the maximum number of peaks = 4. It can give full play to the advantages of various algorithms and learn from each other's strengths. (2) The sNIOA algorithm is the best. Compared with the NIOA algorithm, the accuracy of N is increased by 50% and the accuracy of $L = 8$ is increased by 20%. Compared with the NGA algorithm, the error of I is reduced by 23.5% and the offset of M is reduced. NPSO algorithm pm performance is improved by 20%, and pmk peak value is reduced by 20%. The domestic research on smart agriculture has experienced explosive growth, and the research has been carried out from the concept of smart agriculture, related technologies, constraints, industrial chain, etc., to provide theoretical guidance for the development of smart agriculture. The worst algorithm parameter is the NIOA model whose offset increases little, the performance decreases by 20%, and the peak value becomes worse. (3) The smart agriculture project uses the latest Internet of Things and cloud computing technology, and based on the analysis of big data and artificial intelligence technology, a new service form is proposed, that is, a cloud, network, and platform composite service system to establish a regional closed-loop ecological chain integrating agricultural production, processing, and marketing. (4) In the biological genetic algorithm model, the recall rate of Cp is low, the ROC curve fluctuates greatly, the specificity AEa is poor, and the sensitivity is not high. Using the integrated technology integrating GIS technology, RS technology, spatial statistics, mathematical models, and other methods, based on the differences of various temporal and spatial scales and their monitoring methods, combined with regression model and spatial sampling method, quantitative analysis was performed, and its influencing factors were analyzed. The comparison shows that the optimal $F1$ score of biological intelligence optimization parameters is up to 23% higher, the accuracy rate Ao is increased by 20%, and the accuracy rate is high.

1. Introduction

Artificial intelligence control is used to express human reasoning and decision-making behavior in the form of computer language and apply it to the control process. An immune feedback controller is proposed based on the feedback mechanism of the immune system [1–3]. On this basis, combined with fuzzy theory, a novel fuzzy self-adjusting immune feedback control system is proposed. Based on the interconnection between the three major systems in the organism, a biological network structure is constructed, which is the solution to the overall intelligence of complex systems. Behavior provides ideas. The neuro-endocrine immune network is a complex large system with deep negative feedback and high stability, with unique adaptability and stability. Intelligent control is used to intelligentize the control process. The intelligence here is inseparable from the study of biological intelligent behavior, especially the study of human intelligent behavior. These algorithms are widely used in practical optimization problems due to their excellent performance and simplicity. The immune system is a delicate, complex, and complete physiological defense system with the characteristics of diversity, adaptability, robustness, memory, immune self-regulation, and evolution. Fuzzy control imitates human's fuzzy reasoning and decision-making process. Expert control imitates the process of human experts making decisions based on experience and knowledge. Neural network simulates the information transmission of the human brain in many aspects. Besides, genetic algorithms are produced by simulating biological genetic and evolutionary mechanisms. The search range of genetic algorithm docking is much larger than that of ordinary docking. The search algorithm has to face the more complex energy landscape of the entire genetic surface, and for search algorithms of different sizes, the search range of blind docking is regarded as rigid and small molecules. For a problem to be solved by AIS algorithm, it should firstly be clear whether the field corresponding to the problem belongs to optimization problem or classification problem. Fuzzy control, as the earliest intelligent control, and its entire development process are of great significance to the development of intelligent control. Heuristic search algorithms (such as particle swarm algorithm) are used to make targeted adjustments to the pose of the ligands to try to find the ideal pose for small molecules and proteins to bind. Since the fuzzy set theory and the basic principles of fuzzy control were proposed [4–6], people continue to research and innovate on the basis of its theory. The aforementioned basic fuzzy models have been improved in many ways [7–10]. Blind docking experiments are very different from ordinary docking experiments. On one hand, the search range of blind docking experiments is much larger than that of ordinary docking experiments, so the search algorithm will face more energy "trap" (i.e., local optima regions) on larger protein surfaces, which gives a greater challenge to the algorithm. On the other hand, since the blind docking box needs to contain the whole protein, the search range size of the blind docking is different for different docking cases, which tests the adaptability of the algorithm to the search range of different sizes. For results related to the mean lowest binding energy, LGA performed much better, second only to GDCGL-RDPSO and MSPL-RDPSO-S6, but LPSO was still the worst, suggesting that LPSO may not be suitable for the search range much bigger blind docking problem. The number of best scoring conformations and the best-sampled RMSD for successful docking are somewhat more important results for blind docking. Because for the blind docking problem, the user is likely to examine all the conformations found one by one according to the binding energy ranking given by the docking software. Therefore, if the algorithm can find the best scoring conformation for successful docking, it can save a lot of research time. The best sampled RMSD correlation results (including the number of best sampled conformations successfully docked and the mean of the best sampled RMSDs) refer to the user evaluating all conformations found by the algorithm one by one. The user is able to successfully reproduce the crystal conformation, and that crystal conformation are sufficiently similar.

The smart agricultural system is the application of new IOT technology in the field of smart agriculture, mainly including real-time monitoring, wireless monitoring, and remote image and analysis functions. Real-time monitoring: according to the information of animal and plant growth environment obtained by wireless network. The system is responsible for receiving the data sent by the wireless sensors, realizing the acquisition, management, dynamic display, and analysis processing of all information, and displaying it to the user in the form of intuitive charts and curves. Control: these are crucial for China in a transitional period. SMS alarm information is provided according to different needs. Empirical models are used with very little ground data [11–14]. Compared with traditional data, the error of simulation results is smaller. RS technology has multiple functions, among which information is based on the growth characteristics of crops, and is used to evaluate the damage degree and area of crops. The intelligent agricultural problem has high requirements on the quality of the search algorithm, but it is difficult to find a solution of sufficient quality in a short time only by relying on the partial global intelligent search algorithm. The search algorithm developed based on intelligent optimization usually makes the search behavior more global. The algorithm is used in conjunction with the PSW local search algorithm. Using a hybrid algorithm framework can calculate the optimal solution more sensitively [15].

2. Biosmart Agriculture

2.1. Biological Information Processing System. People have proposed the genetic and evolutionary mechanism of artificial neural network based on the genetic system. People have proposed the mechanism of immune recognition and immune regulation based on the immune system of genetic algorithm. Introductory books include artificial neural networks, genetic algorithms, particle swarm optimization, simulated annealing, immune algorithms, and combinatorial optimization algorithms. Then, the basic AIS model is selected according to the nature of the problem. Finally, choose the corresponding AIS algorithm [16–19]. The combination of fuzzy control and neural network makes full use of the adaptive learning ability of neural network and the ability of fuzzy control to express qualitative knowledge. The original data stream is denoised, as shown in Figure 1. Population Parallelism (MSP) strategy is combined with the RDPSO algorithm to form the MSP-RDPSO algorithm. The MSP strategy draws on the idea of part of the island model and part of the CPSO algorithm architecture, divides the entire population into multiple subpopulations evenly, and assigns characteristic components to each subpopulation. The algorithm uses the feature exchange method to realize the information exchange between the subpopulations and every certain number of iterations. Since the iterative process of RDPSO and the exchange of feature components in each subpopulation can be executed evenly in the unit of

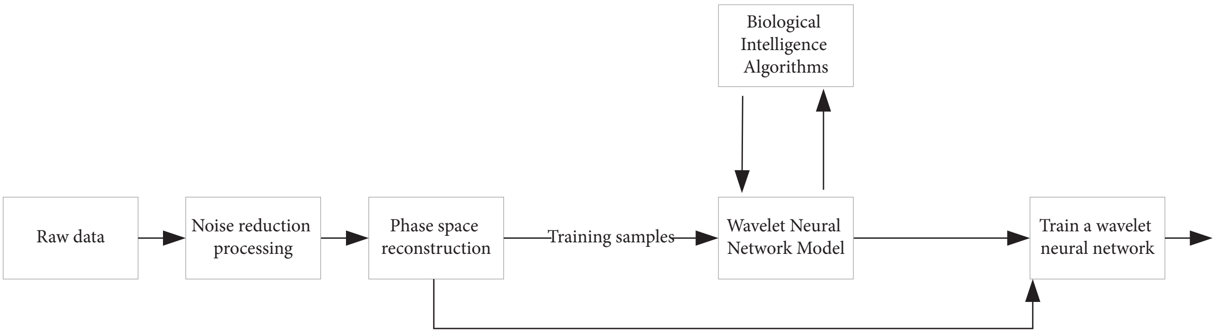

Figure 1: Modeling process of biological intelligence algorithms.

subpopulation, the MSP-RDPSO algorithm can be fully parallelized. The interval between the two feature exchange methods and the value range of the number of subpopulations are determined. The value has an important impact on the performance of the algorithm. Multiple MSP-RDPSO versions are compared with the classic version of the RDPSO algorithm and the RDPSO algorithm based on the classic island model. The performance comparison is carried out to prove the effectiveness of the MSP strategy in improving the performance of the algorithm. After wavelet noise reduction, it enters the phase space reconstruction and uses the training wavelet model to perform biological intelligence algorithms on the training samples to obtain the optimal parameter model.

2.2. Grey Linear Programming. It takes a long time for each subpopulation to continuously perform the RDPSO search behavior, and each subpopulation has converted to a relatively small area before the FE operation. At this time, even if the FE operation is performed again, it is difficult to expand the search range of the particle swarm to a very small area. Large range, which is obviously disadvantageous for multimodal problems, but more local searches are more beneficial for unimodal problems. When it is larger, the number of iterations between two FE operations is relatively small, so that the entire search process is interrupted by the FE operation before the subpopulation converges to a smaller area for a more local search. In this case, the algorithm cannot achieve better results on the unimodal function, but more FE operations mean more frequent information exchange between subpopulations, which is conducive to maintaining the diversity of the entire population, which can help the algorithm to better solve the problem. As a veritable agricultural country, there are significant differences in agricultural resources and conditions in various regions of our country. It is precisely because of this that it is very necessary to further develop smart agriculture. Smart agriculture simulates the information transmission of the human brain in many aspects and is becoming mature in the continuous research and development, which can effectively achieve the goal of increasing food production and provide reliable food security for human beings. Simulation of biological genetics and evolutionary mechanism produces genetic algorithm, which is mainly based on professional technology and operation platform research. From the perspective of policy supply and demand, macro research on the development of smart agriculture and its application in each link of the industrial chain is less involved, as shown in Figure 2.

3. Biological Intelligence Optimization Algorithm

3.1. sNIOA Algorithm. Biological intelligence [20–23]:

$$I_{e_i} = I_{P_e}\frac{I_{f_i}}{\sum_{i=1}^{n} I_{f_i}} + \left(1 - I_{P_e}\right)\frac{I_{c_i}}{\sum_{i=1}^{n} I_{c_i}}. \tag{1}$$

Blur self-adjustment:

$$\begin{gathered}\left\{\left(x^{(1)}, y^{(1)}\right), \ldots, \left(x^{(1)}, y^{(1)}\right)\right\}, \ldots, y^{(i)} \in \{1, 2, \ldots, k\},\\ h_{\theta}\left(x^{(i)}\right) = p\left(y^{(i)} + x^{(i)}\right).\end{gathered} \tag{2}$$

Artificial intelligence control:

$$\begin{gathered}\Gamma_i = \frac{1}{\sum_{j=1}^{k} e^{\theta x^{(i)}}},\\ p\left(y^{(i)} = jx^{(i)}\right).\end{gathered} \tag{3}$$

3.2. NIOA Algorithm [24, 25]. Reasoning and decision-making:

$$J(\theta) = -\frac{1}{m}\left[\sum_{i=1}^{m}\sum_{j=1}^{k}\left\{y^{(i)} = j\right\}\log e^{\theta_j x^{(i)}}\right]. \tag{4}$$

Immune intelligent controller:

$$\begin{gathered}f(x, y) = 0.5 + \frac{\sin^2\left(\sqrt{x^2 + y^2}\right) - 0.5}{1 + 0.001\left(x^2 + y^2\right)},\\ R = \left\{r_1, r_2, \ldots, r_q\right\},\\ T = \left\{t_1, t_2, \ldots, t_s\right\}.\end{gathered} \tag{5}$$

Intelligent control:

$$\begin{aligned} &\min f = \sum_{j=1}^{s} c_{ij} k_{ij} p_j, \\ &s.t. \sum_{j=1}^{s} k_{ij} = 1, \forall i = 1, 2, \ldots, q, \\ &\sum_{i=1}^{q} \sum_{j=1}^{s} k_{ij} = s. \end{aligned} \tag{6}$$

Evolutionary computation:

$$i = 1, 2, \ldots, q. \tag{7}$$

Remote sensing data:

$$\begin{aligned} &j = 1, 2, \ldots, s, \\ &s \leq q, \\ &k_{ij} \in \{0.1\}, \quad \forall i, j. \end{aligned} \tag{8}$$

3.3. NGA Algorithm [26]

$$\begin{aligned} T_i &= \left\{t_i^1, t_i^2, \ldots, t_i^j\right\}, \\ D_i &= \left\{A_\varphi, T_i, A_\varphi\right\}. \end{aligned} \tag{9}$$

Smart agriculture:

$$\min f = \sum_{i=1}^{q} \sum_{u=1}^{D_i} \sum_{v=1}^{D} \delta_{uv} \zeta_{uv}, \psi(i) = \left\{j, k_{ij} = 1, \forall j \in R\right\}. \tag{10}$$

Real-time monitoring:

$$\psi^{-1}(i) = \left\{i, k_{ij} = 1, \forall i \in V\right\}. \tag{11}$$

Empirical model:

$$\begin{aligned} &N(i) \in \{1, 2, \ldots, n\}, \\ &\alpha_i = \frac{r_c - d_{iC}}{r_C}. \end{aligned} \tag{12}$$

Wireless monitoring:

$$d_{AB} \sqrt{\left(x_A - x_B\right)^2 + \left(y_A - y_B\right)^2}. \tag{13}$$

Image and analysis:

$$\begin{aligned} &\min f = \sum_{i=1}^{m} \alpha_i \Phi(i), \\ &\rho_i = r_i \frac{\sum_{\mu=0}^{e_p - 1} 2^{\mu} b\mu}{2^{e\mu}}. \end{aligned} \tag{14}$$

4. Simulation Experiment

4.1. Smart Agriculture. Smart agriculture is mainly based on professional technology and operation platform research, and there is less macro research on the development of smart agriculture and its application in various links of the industrial chain from the perspective of policy supply and demand. Under the guarantee of policy, science and technology, and the popularization of education, smart agriculture in developed countries has developed better. Each country develops suitable smart agriculture models according to their specific national conditions, and each country has its own characteristics of smart agriculture. The experimental results of parameter analysis are shown in Table 1 and Figures 3 and 4. When $\mu = 0.02$, $\beta = 0.99$, deviation from optimal value = 1.74, deviation from mean value = 3.86, standard deviation of experimental value = 3.81, performance evaluation = 2.68, and the maximum number of peaks = 4. In the academic field of biological sciences, the interaction between them, that is, the "neuroendocrine immune network", has attracted the attention of scholars and carried out systematic research since the 1990s. In the parameter setting, when $\mu = 0.05$, $\beta = 0.67$ is the optimal value in the prediction result of smart agriculture, the optimal value deviation = 2.05, the average deviation = 3.22, the experimental value standard deviation = 3.24, the performance evaluation = 1.47, and maximum number of peaks = 4. When $\mu = 0.1$, the predicted result $\beta = 0.88$ is the optimal value, the optimal value deviation = 1.47, the average deviation = 3.35, the experimental value standard deviation = 3.07, the performance evaluation = 1.61, and the maximum number of peaks = 5.

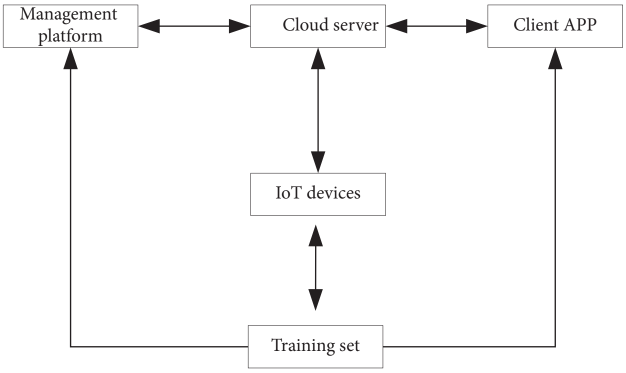

Figure 2: Grey linear programming model.

4.2. Grey Linear Programming Model. GLP refers to the gray linear programming model and finally configures the results of the two optimization schemes and applies them to the space unit. As a veritable agricultural country, there are significant differences in agricultural resources and conditions in various regions of our country. It is precisely because of this that it is very necessary to further develop smart agriculture. The construction of smart agriculture will help to increase farmers' income, agricultural growth, and balance the total area of arable land. Realized by neural networks, biological intelligent controllers inspired by biological physiological structures and regulatory mechanisms have emerged. The parameter settings are shown in Table 2 and Figure 5. The sNIOA algorithm is optimal, $N = 5$, $L = 8$, I = 6, $M = 8$, Pc = 6, pm = 5, pmk = 6, Ip = 9, μn = 6, and

Table 1: Parameter analysis experimental results.

Parameter		Experimental results				
μ_n	β	Optimal value deviation	Mean deviation	Standard deviation of experimental value	Function evaluation times	The most peak number
0.02	0.99	1.74	3.86	3.81	2.68	4
	0.19	2.63	3.89	3.36	2.16	3
	0.86	2.75	2.10	3.71	2.12	5
	0.26	2.34	3.79	3.12	2.93	3
0.05	0.90	2.54	2.73	3.20	1.13	5
	0.67	2.05	3.22	3.24	1.47	4
	0.95	2.77	3.92	3.63	2.59	4
	0.40	1.33	3.21	3.91	1.41	5
0.1	0.76	2.77	3.57	3.45	1.70	5
	0.88	1.47	3.35	3.07	1.61	5
	0.61	2.83	2.07	3.36	2.66	2
	0.11	1.71	3.37	3.74	1.30	4
0.2	0.23	1.94	3.67	3.87	2.52	2
	0.06	2.16	3.63	3.90	2.92	2
	0.70	1.98	2.28	3.45	1.39	2
	0.55	1.28	3.30	3.23	2.47	2

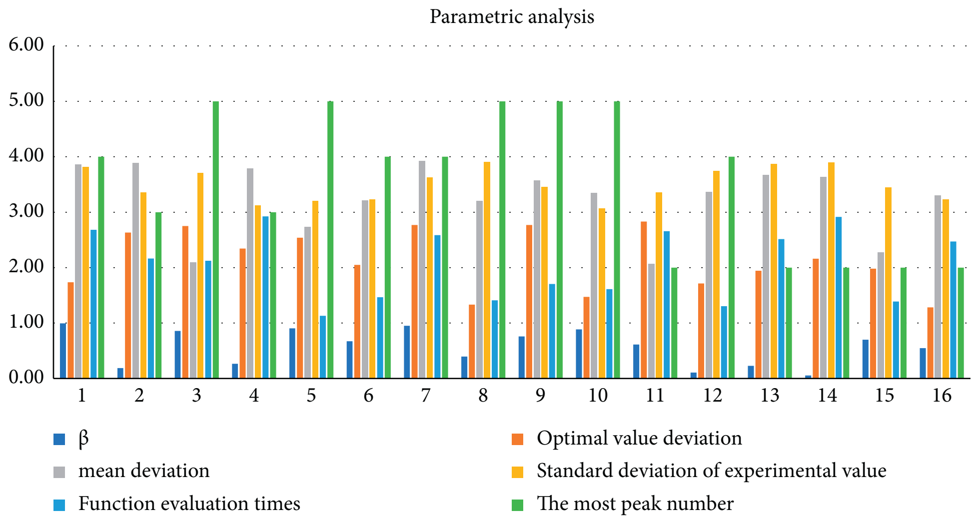

Figure 3: Parameter analysis.

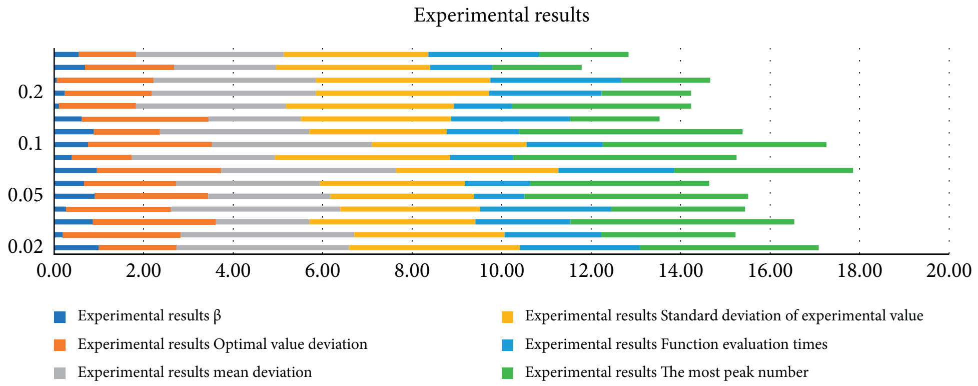

Figure 4: Experimental results.

$\beta = 8$. The domestic research on smart agriculture has experienced explosive growth, and the research has been carried out from the concept of smart agriculture, related technologies, constraints, industrial chain, etc., to provide theoretical guidance for the development of smart agriculture. The worst algorithm parameters are NIOA model,

Table 2: Comparison algorithm parameter settings.

	sNIOA	NIOA	NGA	NPSO
N	5	10	5	8
L	8	10	8	8
I	6	7	8	9
M	8	9	5	6
P_c	6	8	10	9
p_m	5	5	6	7
p_{mk}	6	5	7	9
I_p	9	8	9	6
μ_n	6	9	9	10
β	8	10	8	7

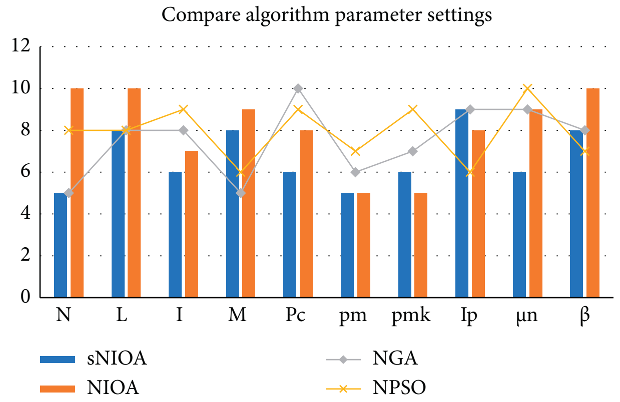

Figure 5: Comparison algorithm parameter settings.

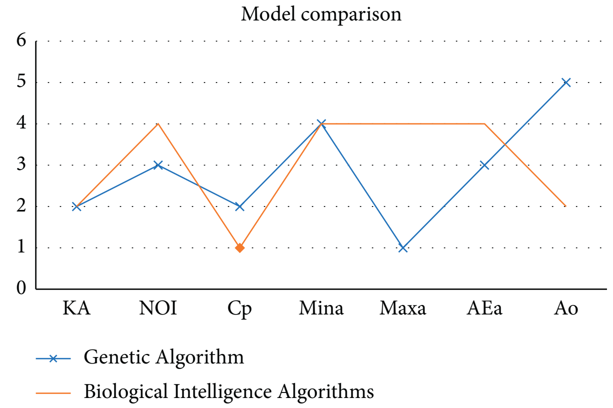

Figure 6: Algorithm comparison.

$N=10$, $L=10$, $\mathrm{I}=7$, $M=9$, $\mathrm{Pc}=8$, $\mathrm{pm}=5$, $\mathrm{pmk}=5$, $\mathrm{Ip}=8$, $\mu\mathrm{n}=9$, and $\beta=10$. The gray linear programming model was performed at NGA parameters set to $N=5$, $L=8$, $\mathrm{I}=8$, $M=5$, $\mathrm{Pc}=10$, $\mathrm{pm}=6$, $\mathrm{pmk}=7$, $\mathrm{Ip}=9$, $\mu\mathrm{n}=9$, and $\beta=8$ around the average. The results of NPSO parameter setting and NGA parameter setting are similar to $N=8$, $L=8$, $\mathrm{I}=9$, $M=6$, $\mathrm{Pc}=9$, $\mathrm{pm}=7$, $\mathrm{pmk}=9$, $\mathrm{Ip}=6$, $\mu\mathrm{n}=10$, and $\beta=7$.

4.3. New Management Model of Smart Agriculture. The smart agriculture project uses the data of the original system of an agricultural company and adds modern information technology means on this basis, as shown in Figure 6. The basic agricultural information was replaced by KA, NOI, Cp, Mina, Maxa, AEa, and Ao, and the two models were optimized and compared.

Table 3: Model comparison.

	KA	NOI	Cp	Mina	Maxa	AEa	Ao
Genetic algorithm	2	3	2	4	1	3	5
Biological intelligence algorithms	2	4	1	4	4	4	2

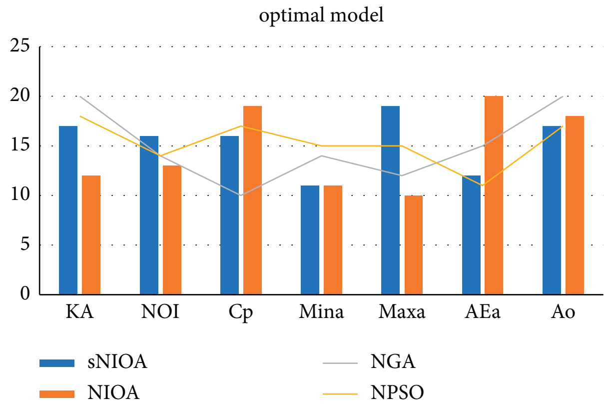

Figure 7: Optimal model.

4.4. Model Comparison. The biological intelligence algorithm consists of two parts: the global directional optimization unit and the local fine optimization unit. The biological intelligence optimization model consists of $\mathrm{KA}=2$, $\mathrm{NOI}=4$, $\mathrm{Cp}=1$, $\mathrm{Mina}=4$, $\mathrm{Maxa}=4$, $\mathrm{AEa}=4$, and $\mathrm{Ao}=2$, and in the global directional optimization unit, a large-scale global optimization and a local fine optimization are performed. As shown in Table 3 and Figure 7, in the biological genetic algorithm model: $\mathrm{KA}=2$, $\mathrm{NOI}=3$, $\mathrm{Cp}=2$, $\mathrm{Mina}=4$, $\mathrm{Maxa}=1$, $\mathrm{AEa}=3$, and $\mathrm{Ao}=5$. Using the integrated technology integrating GIS technology, RS technology, spatial statistics, mathematical models, and other methods, based on the differences of various temporal and spatial scales and their monitoring methods, combined with regression model and spatial sampling method, quantitative analysis was performed and its influencing factors were analyzed.

5. Conclusion

The smart agricultural system is the application of new IOT technology in the field of smart agriculture, mainly including real-time monitoring, wireless monitoring, remote image, and analysis functions. Through this topic, it is concluded that (1) when the parameter is set to $\mu=0.02$, $\beta=0.99$, the deviation of the optimal value = 1.74, the deviation of the average value = 3.86, the standard deviation of the experimental value = 3.81, the performance evaluation = 2.68, and the maximum number of peaks = 4. It can give full play to the advantages of various algorithms and learn from each other's strengths. (2) The sNIOA algorithm is the best. Compared with the NIOA algorithm, the accuracy of N is increased by

50% and the accuracy of $L = 8$ is increased by 20%. Compared with the NGA algorithm, the error of I is reduced by 23.5% and the offset of M is reduced. NPSO algorithm pm performance is improved by 20%, and pmk peak value is reduced by 20%. The domestic research on smart agriculture has experienced explosive growth, and the research has been carried out from the concept of smart agriculture, related technologies, constraints, industrial chain, etc., to provide theoretical guidance for the development of smart agriculture. The worst algorithm parameter is the NIOA model whose offset increases little, the performance decreases by 20%, and the peak value becomes worse. (3) The smart agriculture project uses the latest Internet of Things and cloud computing technology, and based on the analysis of big data and artificial intelligence technology, a new service form is proposed, that is, a cloud, network, and platform composite service system to establish regional closed-loop ecological chain integrating agricultural production, processing and marketing. (4) In the biological genetic algorithm model, the recall rate of Cp is low, the ROC curve fluctuates greatly, the specificity AEa is poor, and the sensitivity is not high. Using the integrated technology integrating GIS technology, RS technology, spatial statistics, mathematical models, and other methods, based on the differences of various temporal and spatial scales and their monitoring methods, combined with regression model and spatial sampling method, quantitative analysis was performed and its influencing factors were analyzed. The comparison shows that the optimal $F1$ score of biological intelligence optimization parameters is up to 23% higher, the accuracy rate Ao is increased by 20%, and the accuracy rate is high.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this work.

Acknowledgments

This work was sponsored in part by Science and Technology Program of Jieyang, China, Research and Development of Internet of Things Monitoring System for Planting Smart Agriculture in Chinese Yam (Grant no. skjcx001), and Jieyang Polytechnic Science Foundation, China (Research on Intelligent Agricultural Monitoring System Based on High Performance Fusion Algorithm, Grant no. 2021JYCKY24).

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