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Marine Engineering Environmental Evaluation System Considering Ant Colony Algorithm

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Abstract: In order to meet the needs of marine engineering environment construction, it is necessary to establish an economical and effective marine environment covering the health of the entire marine ecosystem and the health of residents according to the typical characteristics of the marine engineering environment and the characteristics of marine engineering environmental problems and human interference. Environmental assessment system. In order to solve the shortcomings of the existing research on the construction of the marine engineering environmental evaluation system, this paper discusses the marine engineering environmental evaluation factors and evaluation methods and the concept of the ant colony algorithm function equation, aiming at the marine engineering environment of the ant colony algorithm. The parameter settings of the construction of the evaluation system and the experimental conditions of the engineering overview are briefly introduced. And the application structure model of the construction of the marine engineering environmental evaluation system of the ant colony algorithm is discussed. Finally, the application of the ant colony algorithm in the construction of the marine engineering environmental evaluation system is analyzed experimentally. The experimental data shows that the proposed method in this paper is Compared with the other two (F-Q) and (NCHM), the evaluation results of the water environment quality, sediment quality and biological quality environmental indicators calculated by the ant colony algorithm in the construction of the marine engineering environmental evaluation system are the same as the known ones. The difference between the results of the optimal evaluation index is smaller, and the error is within 2%, while the error of the calculation results of (F-Q) and (NCHM) is more than 10%. Therefore, it can be seen that the construction of the marine engineering environmental evaluation system of the ant colony algorithm applicability.

1. Introduction

Aiming at the problems of marine engineering construction, optimizing the marine engineering environmental monitoring scheme, improving the marine engineering evaluation index system and evaluation method, and comprehensively improving the ability of marine engineering monitoring and evaluation have become major issues that need to be solved urgently in the management of marine engineering construction.

Nowadays, more and more scholars pay attention to the research of various algorithms and technologies in the construction of marine engineering environmental assessment system, and through practical research, they have also achieved certain research results.Meramo-Hurtado S I Determining the nature and magnitude of climate change impacts on marine biodiversity through marine environmental impact assessments and associated mitigation measures is a critical step towards reducing adverse impacts and halting biodiversity loss. Meramo-Hurtado S I designed the system and method of environmental impact assessment of the country by investigating the environmental impact factors in the country's management area, and also studied a new international law applied to the assessment of environmental impact factors. To ensure that the protection of organisms in the marine engineering environment can be included in the scope of national management [1]. The threat posed by microplastic pollution in the marine environment of Labianca C has attracted worldwide attention. Labianca C assessed the source, fate and impact of microplastics in marine ecosystems and identified indicators for microplastic evaluation. Most studies document the prevalence and associated environmental impacts of microplastics. Impacts include impacts on marine ecosystems, risks to biodiversity, and threats to human health. The reasons for the leakage of microplastics into marine ecosystems are poor plastic waste management and lack of effective mitigation strategies [2]. Gopalakrishnan S believes that a standardized marine environmental assessment standard is needed to monitor environmental problems in coastal areas. Carrying out the necessary assessments and testing, Gopalakrishnan S aims to reduce pollutants in or near coastal ecosystems, and through policy interventions and assess the marine environment. It is also necessary to determine the main causes and indicators of pollution in the marine environment through the establishment and governance of further environmental assessment systems. These will extend to developing more effective policies, as well as coordinating and expanding educational campaigns and incentives to reduce pollutants [3]. Although the existing research on the construction of the marine engineering environmental evaluation system is very rich, the research on the construction of the marine engineering environmental evaluation system based on the ant colony algorithm is still insufficient.

Therefore, in order to solve the problems existing in the research on the construction of the existing marine engineering environmental evaluation system, this paper uses the ant colony algorithm to construct and apply it. First, the functional equation steps of the ant colony algorithm and the marine engineering environmental evaluation factors and evaluation methods are introduced. Secondly, the parameter setting and engineering overview of the construction and application experiment of the marine engineering environmental evaluation system of ant colony algorithm are discussed. Finally, the model framework of the construction of the marine engineering environmental evaluation system of ant colony algorithm is designed. The calculation results of the other two algorithms are used in the construction of the marine engineering environmental assessment system to conduct comparative experiments. The final experiment shows the effectiveness of the ant colony algorithm proposed in this paper in the construction of the marine engineering environmental assessment system.

2. Marine Engineering Environmental Evaluation System Considering Ant Colony Algorithm

2.1. Environmental Assessment System of Marine Engineering

(1) Environmental assessment factors of marine engineering

According to the environmental impact factors of this project, the main evaluation factors are determined as:

1) The evaluation factors for the status quo of water quality and environment are: pH, dissolved oxygen, chemical oxygen demand, active phosphate and other 15 items [4].

2) The predictor of environmental impact on water quality is: suspended solids (SS) [5].

3) The analysis factors of the status quo of the biological environment are: chlorophyll a, phytoplankton, zooplankton [6].

(2) Environmental assessment methods for marine engineering

The composition of the evaluation method includes four parts, the evaluation items in the evaluation method, the calculation formula used by the evaluation item, the variables of the calculation formula of the evaluation item, and the basic information of the evaluation method [7].

1) The basic information of the evaluation method includes the number, name, and type of the evaluation method. The name of the evaluation method should be unique, and the applicable analysis and evaluation type can be determined through the name of the evaluation method [8].

2) The evaluation items are determined according to the monitoring items in the target marine environmental assessment type of the evaluation method. The evaluation items have information such as number, name, method number, formula number, etc. The method number identifies which evaluation method the evaluation item belongs to, and the formula number Identifies which formula should be used to calculate the evaluation item during the analysis and evaluation process [9].

3) The evaluation formula is an important part of the evaluation method. If the evaluation formula is bound to the evaluation item, the evaluation formula bound to the evaluation item will be bound to the evaluation method indirectly, so that it can be more flexible for a single evaluation item. Adjust and modify the evaluation formula [10].

2.2. Ant Colony Algorithm

When solving the marine engineering environmental assessment problem, the feasible path method of the ant colony algorithm is that each ant selects the next node to go according to the value of the probability selection function at the current node x until the ant completes the construction of the feasible path [11]. Therefore, for the marine engineering environmental assessment problem, the ant chooses the next node according to the following probability selection function $G^t(x,y,n)$:

$$G^t(x,y,n) = \left\{ \frac{H\left(\sum_{u=1}^{k} q_u \alpha^u (x,y,n), \mu(x,y,n)\right)}{D\left(\sum_{u=1}^{k} q_u \alpha^u (x,y,n), \mu(x,y,n)\right)} \right. \quad (1)$$

In the above formula $H(\alpha,\mu)$, $D(\alpha,\mu)$, are all bounded functions with pheromone α and heuristic pheromone μ as variables, and are defined on U^n, and satisfy condition $0 < \left| \frac{H(\alpha, \mu)}{D(\alpha, \mu)} \right| \le 1$.

Each path in the ant colony algorithm corresponds to k pheromone, which is represented by pheromone $\alpha^1, \alpha^2, \ldots \alpha^k$, that is, the corresponding pheromone is different when the optimization objective is different [12]. Each optimization objective has its corresponding weight coefficient, namely $q^1, q^2, \ldots q^k$, $\sum_{u=1}^{k} q_1 = 1$. The core idea of ant colony algorithm is to use pheromone weighted sum $q_1\alpha^1 + q_2\alpha^2 \ldots + q_k \cdot \alpha^k$, the randomness of weight makes the probability of pheromone equal in the optimization process, and ensures the equality of each target [13]. Then the definition of the pheromone function of the multi-ant colony algorithm is as follows:

$$\alpha\ (x, y, n) = q_1 \cdot \alpha^1(x, y, n) + q_2 \cdot \alpha^2(x, y, n) \ldots + q_k \cdot \alpha^k(x, y, n) \quad (2)$$

In the environmental assessment of marine engineering, the definition of the pheromone heuristic function is as follows:

$$\mu(x, y, n) = \frac{1}{q_1 \cdot s_{xy}(1) + q_2 \cdot s_{xy}(2) + \ldots + q_k \cdot s_{xy}(k)} \quad (2)$$

In the above formula, $s_{xy}(k)$ is the cost value of different optimization objectives on arc (x, y) [14].

3. Investigation and Research on the Construction of Marine Engineering Environmental Assessment System Considering Ant Colony Algorithm

3.1. Setting of Construction Parameters of Marine Engineering Environmental Assessment System Considering Ant Colony Algorithm

The parameters related to the construction of the marine engineering environmental evaluation system based on the ant colony algorithm are set as follows: $\gamma = 2$, $\lambda = 5$.

1) Initialize Pheromone $\alpha_0 = 10$ [15].

2) Pheromone residual function $\vartheta_0 = 6$, $\varpi = 0.02$ [16].

3) $M = 1.02$ in the pheromone gain function [17].

4) The weight coefficient of the objective function (environmental assessment index of marine engineering and environmental assessment project of marine engineering) is 0.8, namely $q_1 = q_2 = 0.8$ [18].

The number of ants $n = 40$, the maximum number of iterations is 200. The details are shown in Table 1:

Table 1. Parameter settings

Initialization pheromone	$\alpha_0 = 10$
Pheromone residual function	$\vartheta_0 = 6$, $\varpi = 0.02$
Pheromone gain function	$M = 1.02$
Objective function weight coefficient	$q_1 = q_2 = 0.8$
Number of ants	$n = 40$
The maximum number of iterations	200

3.2. General Situation of Construction of Marine Engineering Environmental Assessment System Considering Ant Colony Algorithm

(1) Sea area conditions

The total area of marine engineering applications studied in this paper is 256.89 hectares, of which the sea area that has changed the natural attributes of the ocean is 56.42 hectares (including: 25.36 hectares of tidal flats and 29.25 hectares of shallow sea), and the sea area that does not change the natural attributes of the ocean is 56.42 hectares. It is 176.52 hectares, with a total of 4256m of marine engineering.

(2) Hydrological status

1) The tidal coefficient is 0.68~1.57, which is an irregular semidiurnal tide.

2) The tidal velocity, the specific data of the average ebb tide speed and the average tide tide speed in the dry season, flood season and spring tide respectively are shown in Table 2:

Table 2. Current speed

Period	Mean ebb tide	Average tide
Dry season	0.25-0.35m/s	0.15-0.275m/s
Flood period	0.13-0.465m/s	0.29-0.565m/s
Spring tide	0.38-0.805m/s	0.35-0.565m/s

4. Construction and Application of Marine Engineering Environmental Assessment System Considering Ant Colony Algorithm

4.1. Construction Model Structure of Marine Engineering Environmental Assessment System Considering Ant Colony Algorithm

According to the mathematical model and basic principle of the ant colony algorithm, the evaluation factors for the construction of the marine engineering environmental assessment system and the basic overview of the marine engineering in the selected area of this paper, the structural design of the construction model of the marine engineering environmental assessment system considering the ant colony algorithm is carried out. , the specific process is shown in Figure 1:

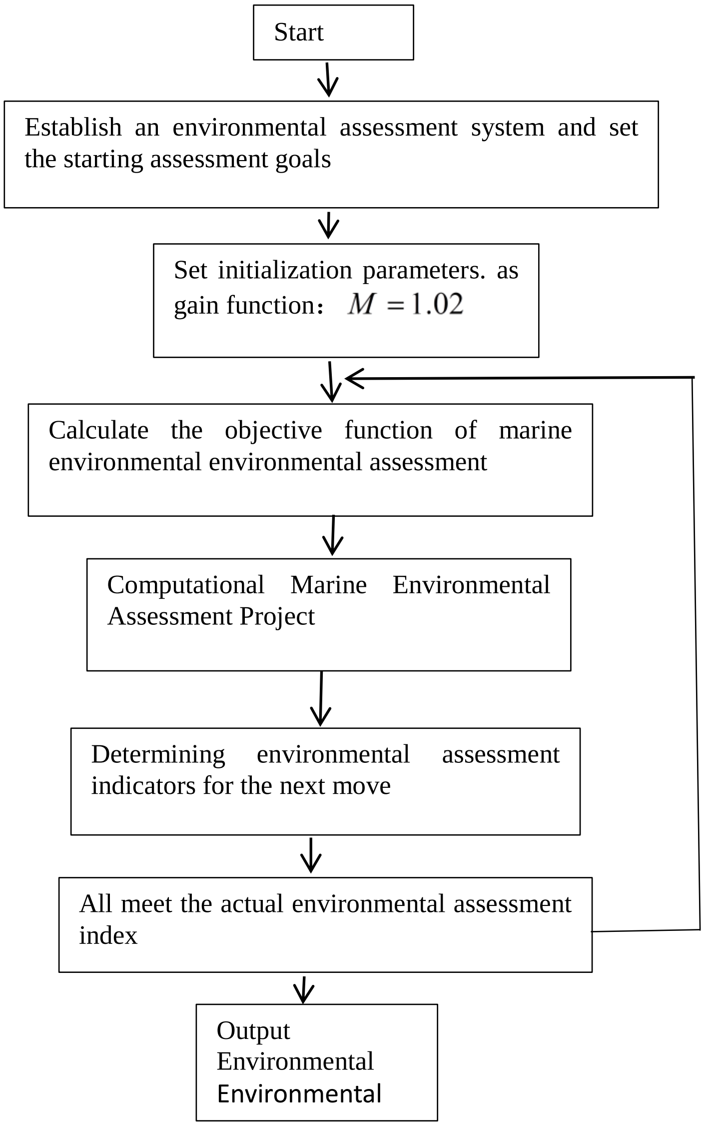

Figure 1. Construction model structure of marine engineering environmental evaluation system based on ant colony algorithm

The construction of the marine engineering environmental evaluation system of the specific ant colony algorithm is as follows:

(1) First, determine the initial point of the ants according to the given marine engineering environmental assessment index and the coordinates of the marine engineering environmental assessment project.

(2) Calculate the selection probability of all marine engineering environmental assessment indicators according to formula (4).

(3) Calculate the values of the two objective functions (the marine engineering environmental evaluation index and the marine engineering environmental evaluation project) constructed by the iterative ants. If the values of the two objective functions belong to the optimal solution set of the marine engineering environmental evaluation index, update The evaluation index pheromone on its path.

(4) Output the marine engineering environmental evaluation system constructed by ants, that is, the optimal solution set of marine engineering environmental evaluation indexes.

4.2. Construction and Application of Marine Engineering Environmental Assessment System Considering Ant Colony Algorithm

In order to further prove the effectiveness of the ant colony algorithm in the construction and application of the marine engineering environmental evaluation system, the evaluation results calculated by the ant colony algorithm on the environmental indicators of water environment quality, sediment quality and biological quality in marine engineering and other The evaluation results calculated by the two algorithms (F-Q) and (NCHM) are compared with the known optimal evaluation results data of water environment quality, sediment quality and biological quality in marine engineering. The specific comparison data results are shown in Table 3 shown:

Table 3. Evaluation result data calculated by ant colony algorithm and (F-Q), (NCHM) algorithm

Algorithm	Best result	F-Q	NCHM	Ant Colony Algorithm
Water quality	28.69	32.65	26.25	28.15
Sediment quality	35.78	37.52	30.24	35.48
Biomass	26.35	28.41	24.32	26.86

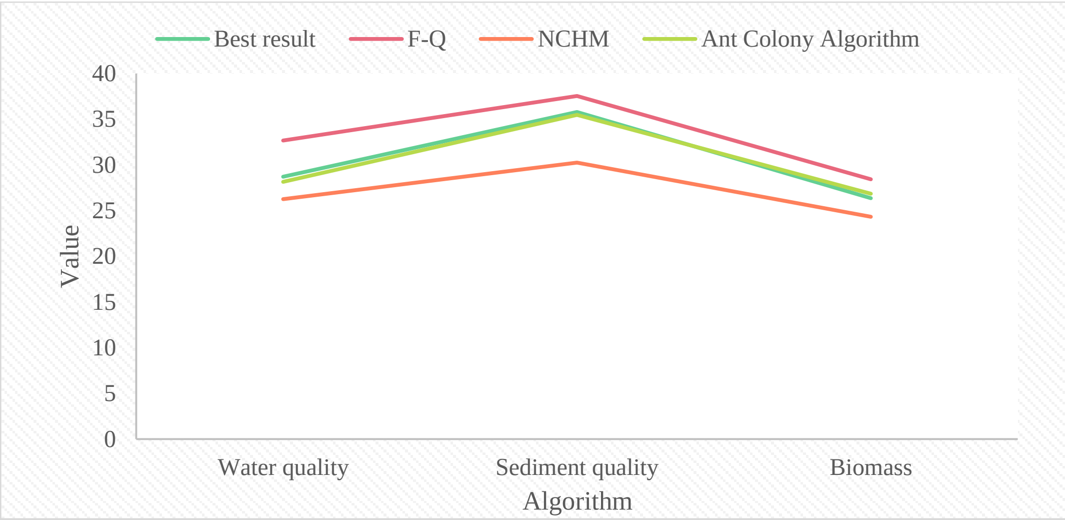

Figure 2. Comparison of evaluation results calculated by ant colony algorithm and (F-Q), (NCHM) algorithm

From the broken line data in Figure 2, it can be seen that in the evaluation results of the calculation of the environmental indicators of water environment quality, sediment quality and biological quality in marine engineering, the ant colony algorithm is closely related to the water environment quality, sediment quality and biological quality in marine engineering. The results of the known optimal evaluation indicators of biological quality environmental indicators are closer, that is to say, the calculation results are more accurate and more reliable than the results of the other two (F-Q) and (NCHM) algorithms. In the calculation of the evaluation results of the environmental quality index, the error between the ant colony algorithm 28.15 and the known optimal evaluation index result 28.69 is smaller, while the calculation results of (F-Q) and (NCHM) 32.65 and 26.25 are both consistent with the known optimal evaluation index. The results are quite different, and the error of the ant colony algorithm is smaller than that of (F-Q) and (NCHM) in the calculation of the evaluation results of other environmental indicators of sediment quality and biological quality, and the calculation results are more accurate. Therefore, it is more suitable for the construction of marine engineering environmental assessment system.

5. Conclusion

Therefore, in order to study the construction of the marine engineering environmental evaluation system of ant colony algorithm, this paper first briefly introduces the concept of the ant colony algorithm function equation and the marine engineering environmental evaluation system, and then discusses the marine engineering environmental evaluation system of the ant colony algorithm. Based on the analysis and discussion of the construction technology, the parameter setting and engineering overview of the construction experiment of the ant colony algorithm's marine engineering environmental evaluation system are investigated and designed. Secondly, the design and analysis of the model framework for the construction of the marine engineering environmental evaluation system of the ant colony algorithm is carried out. Finally, the experimental data analysis is carried out for the application of the construction model framework of the marine engineering environmental evaluation system of the ant colony algorithm designed in this paper, and the final experimental results are verified. The superiority of the construction of the marine engineering environmental evaluation system based on the ant colony algorithm.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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