Research on dispatching decision of large amphibious aircraft based on improved fuzzy algorithm

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Abstract: In view of the application requirements of large amphibious aircraft in maritime life accident rescue in middle and far seas and the insufficiency of research on dispatch decision, this paper constructed a large amphibious aircraft dispatch decision model based on an improved fuzzy algorithm. Based on the method of statistical analysis and expert discussion, this paper established a decision index system of large amphibious aircraft dispatch with 8 indicators with applicability, safety and reachability as the evaluation criteria. This paper got the decision indicator's interval intuitionistic fuzzy number by constructing five grades fuzzy evaluation criteria and the membership functions of the indicators. This method reduces the subjective influence of determining the fuzzy number for each indicator solely by the expert score, and improves the objective credibility and accuracy of the decision results. Proposed fuzzy entropy to calculate the weight of each indicator, matching function is used to get the matching degree of large amphibious aircraft for different accidents, make the dispatching decision of large amphibious aircraft in maritime life accident rescue is more scientific and reasonable. Finally, the large amphibious aircraft dispatch decision model proposed in this paper is verified by a practical case, and the calculation results are compared with those of the commonly used TOPSIS algorithm and projection algorithm. The results show that the model is reliable and effective.

1. Introduction

In the maritime accident, the dispatching decision of large amphibious aircraft is a multi-attribute dynamic fuzzy decision problem with completely unknown attribute weight in the middle and far sea. Scientific and reasonable dispatch decision of large amphibious aircraft is the key to ensure the success rate of maritime accident rescue missions, is an important content of the application and exploration of large amphibious aircraft in maritime accident rescue. The key to solve the problem of multi-attribute fuzzy decision-making is the construction of decision index system and the determination of index weight. Finally, according to the actual engineering requires to construct decision model to realize the dispatch decision. The large amphibious aircraft dispatch decision must consider reliability, applicability, accessibility, security and other indicators,due to the complexity of the evaluation index, it is quite fuzzy and uncertain, therefore, the dispatch and evaluation of large amphibious aircraft is difficult to be quantified with a deterministic mathematical model. The fuzzy comprehensive evaluation method [1-3] provides effective means for multi - factor fuzzy decision. Through fuzzy transformation principle and maximum membership principle, it can evaluate things in grade or category, which is suitable for dispatch decision of large amphibious aircraft. At present, there are few researches based on fuzzy evaluation in the field of maritime rescue decision-making. Malyszko[1] based on multi-criteria decision analysis (MCDA) and fuzzy evaluation method, realized the selection of civil ship in maritime rescue task. Yang[4] constructed a fuzzy evaluation model of search and rescue capability of western inland rivers based on analytic hierarchy Process and fuzzy comprehensive evaluation method. Wu and Li etc.[5-6] optimized and sorted the salvage ships based on the analytic hierarchy process and fuzzy evaluation method. Zhang[7] completed the selection and adjustment of maritime rescue force based on fuzzy analytic hierarchy process and voronoi diagram. Du[8] realized the maritime base location decision of large amphibious aircraft based on the interval

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intuitionistic fuzzy TOPSIS method. Dai[9] established the mathematical models of dynamic pre-assessment of marine traffic risk under three kinds of bad weather which improves the pertinence and rationality of risk assessment based on the fuzzy comprehensive evaluation method. Min[10] established a water rescue capability evaluation model based on analytic hierarchy process (AHP) and fuzzy comprehensive evaluation method. In the above literatures, the fuzziness of indexes is considered and the corresponding decision index system is established, but the method of fuzzy processing and weight determination is too simple. Due to the limitation of the decision-maker and the complexity and dynamic variability of the decision process, the uncertainty and fuzziness of the information contained in the decision process cannot be fully expressed in the actual dispatch decision. The concept of the interval intuitionistic fuzzy set theory(IVIFS)is came up by Atanassov [11]. On the basis of the concept of intuitionistic fuzzy set, the membership degree, non-membership degree and hesitation degree are extended into interval numbers, more flexible and practical in dealing with ambiguity and uncertainty. The research is quite mature and has achieved a lot of results [12-17] on the IVIFS.

The large amphibious aircraft dispatch decision model is established based on interval intuitionistic fuzzy theory and fuzzy comprehensive decision method in this paper. In the process of assigning weights to indicators, the fuzziness and hesitation of the experts' understanding for decision indicators and the limitation of single expert decision are considered. Different from the traditional way of assigning the index by experts subjectively, this paper innovatively proposes to construct the membership function of each index respectively. The interval intuitionistic fuzzy matrix is established by the method of expert group decision and fuzzy transformation based on the calculated result the membership value of the index. Then fuzzy entropy method is used to assign weights to each index and score function is used to calculate the score of large amphibious aircraft dispatch. Finally, the matching degree of large amphibious aircraft for the current maritime rescue mission is obtained according to the evaluation grade. It provides a new idea for large amphibious aircraft dispatch decision and makes the process and the result of decision more scientific and reasonable.

2. Interval intuitionistic fuzzy entropy and matching function

The large amphibious aircraft dispatch decision is a process full of complexity and uncertainty. Compared with the traditional weight determination method, the fuzzy entropy method that is based on interval intuitionistic fuzzy number is adopted to calculate the weight of the evaluation indicators, which not only considers the objective fact that the indicator data cannot be expressed with accurate numbers, but also takes into account the fuzziness and hesitation of the experts' understanding for the indicators.

Definition 1[11]: Assume $\mathrm{int}[0,1]$ represents all the closed subsets of the interval number $[0,1]$, X is a given domain, called

$$A = \left\{ \left\langle x, \mu_A(x), \nu_A(x) \right\rangle / x \in X \right\}$$

is the interval intuitionistic fuzzy set on the domain X (IVIFSs(X)). Among them

$$\mu_A(x) : X \to \mathrm{int}[0,1], \nu_A(x) : X \to \mathrm{int}[0,1],$$

and meet $0 \leqslant \sup \mu_A(x) + \sup \nu_A(x) \leqslant 1, \forall x \in X$ .interval number $\mu_A(x)$, $\nu_A(x)$ respectively represents the membership degree and non-membership degree of the element x in A of X which are denoted as

$$\mu_A(x) = \left[\mu_A^L(x), \mu_A^U(x) \right],$$

$$\nu_A(x) = \left[\nu_A^L(x), \nu_A^U(x) \right],$$

then the interval intuitionistic fuzzy set A can be written as

$$A = \left\{ \left\langle x, \left[\mu_A^L(x), \mu_A^U(x) \right], \left[\nu_A^L(x), \nu_A^U(x) \right] \right\rangle / x \in X \right\},$$

called $\pi_A(x) = \left[\pi_A^L(x), \pi_A^U(x) \right]$ is the hesitancy of elements A.

$$\pi_A^L(x) = 1 - \mu_A^U(x) - \nu_A^U(x),$$

$$\pi_A^U(x) = 1 - \mu_A^L(x) - \nu_A^L(x).$$

Especially, when $\mu_A^L(x) = \mu_A^U(x), \nu_A^L(x) = \nu_A^U(x)$,the interval intuitionistic fuzzy set degenerates into intuitionistic fuzzy set. To simplify things, denote $\alpha = ([a, b], [c, d])$ is an interval intuitive fuzzy number, where, $0 \leqslant a \leqslant b \leqslant 1$, $0 \leqslant c \leqslant d \leqslant 1$, $0 \leqslant b + d \leqslant 1$.

Definition 2[12]:Assume $\alpha_j = \left(\left[a_j, b_j \right], \left[c_j, d_j \right] \right) (j = 1, 2, \ldots, n)$ is a group of interval intuitive fuzzy numbers, then called $F_w\left(\alpha_1, \alpha_2, \cdots, \alpha_n \right)$ is an interval intuitionistic fuzzy weighted arithmetic average operator,

$$F_w\left(\alpha_1, \alpha_2, \cdots, \alpha_n \right) = \sum_{j=1}^{n} w_j \alpha_j$$
$$= \left(\left[1 - \prod_{j=1}^{n} \left(1 - a_j \right)^{w_j}, 1 - \prod_{j=1}^{n} \left(1 - b_j \right)^{w_j} \right], \left[\prod_{j=1}^{n} c_j^{w_j}, \prod_{j=1}^{n} d_j^{w_j} \right] \right) \tag{1}$$

in the formula (1), $W=(w_1, w_2, \ldots, w_n)$ is the weight vector of $\alpha_j (j = 1, 2, \ldots, n)$, $w_j < 1$, $\sum_{j=1}^{n} w_j = 1$.

Definition 3[14-17]:In the interval intuitionistic fuzzy multi-attribute decision making problem, there are n objects to be evaluated, m attributes,if the j attribute value of the i object to be evaluated can be expressed as r_{ij}.

$r_{ij} = \left(\left[\mu_{ij}^L, \mu_{ij}^U \right], \left[\nu_{ij}^L, \nu_{ij}^U \right] \right)$, $i = 1, 2, \ldots, n; j = 1, 2, \ldots, m$ make the interval intuitive fuzzy entropy of the attribute $j(j = 1, 2, \ldots, m)$ is

$$E_j = \frac{1}{n} \sum_{i=1}^{n} e\left(r_{ij} \right) = \frac{1}{n} \sum_{i=1}^{n} \frac{4 - \left[\left| \mu_{ij}^L - \nu_{ij}^L \right| + \left| \mu_{ij}^U - \nu_{ij}^U \right| \right]^2 + \left[\pi_{ij}^L + \pi_{ij}^U \right]^2}{8} \tag{2}$$

the weight of the j attribute can be expressed as

$$w_j = \frac{1 - E_j}{m - \sum_{j=1}^{m} E_j} \tag{3}$$

Definition 4[13]:Make the interval intuitionistic fuzzy number $\alpha = \left(\left[a, b \right], \left[c, d \right] \right)$,It's matching function is

$$S\left(\alpha \right) = \left[a + p\Delta_1 - c + \left(1 - p \right) \Delta_2 \right] \left(1 + \Delta_1 + \Delta_2 \right)$$

In order to fully reflect the influence of membership degree and non-membership degree on the value of hesitation. Introducing parameter p.The rule for p is that when the membership degree interval is greater than the non-membership degree interval, $p = 0.6$;When two numbers are equal, $p = 0.5$; When the membership degree interval is smaller than the non-membership degree interval, $p = 0.4$. so, $S(\alpha)$ can be written as a piecewise function

$$S(\alpha) = \begin{cases} (a + 0.6\Delta_1 - c - 0.4\Delta_2)(1 + \Delta_1 + \Delta_2), a + b > c + d \\ (a + 0.5\Delta_1 - c - 0.5\Delta_2)(1 + \Delta_1 + \Delta_2), a + b = c + d \\ (a + 0.4\Delta_1 - c - 0.6\Delta_2)(1 + \Delta_1 + \Delta_2), a + b < c + d \end{cases} \tag{4}$$

in the formula (4), $\Delta_1 = b - a$, $\Delta_2 = d - c$,the larger of $S(\alpha)$, the more applicable of the large amphibious aircraft for the current rescue.

3. Dispatch decision model based on interval intuitive fuzzy sets

3.1 Determine the dispatch decision indicator system

The dispatch decision of large amphibious aircraft in the maritime accident rescue that requires comprehensive consideration of the aircraft's design parameters, rescue mode, deployment location, rescue objects, rescue space information and other factors affecting the implementation of the rescue mission. This paper takes the maritime life accident as an example, China's newly developed large amphibious aircraft AG600 as the research object, the middle and far seas of South China Sea as the maritime accident rescue research space. Through the statistical analysis of wind, wave and current in South China Sea each season, the natural conditions and status of ownership and construction of over 200 islands and reefs, the data of water depth, distribution of channel and anchorage in water area with frequent accidents, deployment and cruise of rescue bases of the South China Sea Rescue Bureau, maritime rescue cases and maritime rescue programs and other information data [18-21]. Combined with the Marine rescue experts and AG600 research and development expert questionnaire survey and scoring, based on the decision criteria of applicability, accessibility and safety, eight decision indicators that affect the dispatch decision of large amphibious aircraft in maritime life accident rescue are obtained. The attribute value of indicators can be divided into two types from the data type, namely interval number A and language description V. According to the data influence, it can be divided into benefit types B and cost types C, see the Tab.1.

Table 1: Large amphibious aircraft maritime rescue dispatch decision indicators

rule	indicator	label	type	description
applicability	bearing ratio	u_1	A\C	The ratio of the actual rescued number of AG600 to the actual maximum number of AG600 passengers.
	runway	u_2	A\B	The area of water runway shall not be less than 10.5 km^2 .
	water depth	u_3	A\B	The water depth should not be less than 2.5m.
reachability	flightpath	u_4	A\C	The ratio of theoretical minimum time to actual time from standby point to accident point.
	difficulty of rescue	u_5	V\C	The qualitative determination of difficulty from aircraft landing point to target in distress.
safety	wind	u_6	A\C	The maximum lateral wind force of aircraft taking off and landing shall not exceed 10.3m/s.
	wave	u_7	A\C	The wave height of the landing area shall not exceed 2.5m.
	visibility	u_8	A\B	Visibility must not be less than 2km.

3.2 Fuzzy evaluation grades

This paper refers to the International Aviation and Maritime Search and Rescue Manual, Civil

Aviation Law of the People's Republic of China, Emergency Response Law of the People's Republic of China and other documents, combined with fuzzy classification standards, the evaluation level of language description was divided into 5 grades. In order to facilitate fuzzy operation and make fuzzy evaluation more precise and intuitive, fuzzy number interval is used to quantify each grade, See Tab. 2 for the fuzzy evaluation grades obtained.

Table 2: Large amphibious aircraft fuzzy evaluation grades

level	fuzzy number	description
1	0~0.45	Poor, not applicable at all. Rescue efficiency and success rate approach 0.
2	0.45~0.60	Not qualified, not applicable. Rescue efficiency and success rate are low.
3	0.60~0.75	Qualified, applicable. Rescue efficiency and success rate are high.
4	0.75~0.90	Good, very applicable. Rescue efficiency and success rate are very high.
5	0.90~1	Excellent, very applicable. Rescue efficiency and success rate approach 1.

3.3 Construct the membership function

Delphi method and questionnaire are usually used to determine the interval intuitionistic fuzzy number, but the results are too subjective. According to the characteristics of large amphibious aircraft dispatch decision, this paper proposes to construct membership function for each indicator that affects the large amphibious aircraft dispatch decision, see the Tab.3. Firstly, the membership degree and non-membership degree of the indicator are calculated according to the objective data of the accident. On this basis, the interval intuitionistic fuzzy number of the indicator is determined by combining expert analysis. The whole decision-making process is not divorced from objective practical needs, but also consider the importance of expert experience. Due to space limitation, the construction process of indicator membership function is not discussed in this paper.

Table 3: The membership degree function of dispatch decision indicator

indicator	membership function
u_1	$U_1(x)=\begin{cases}1, & 0\le x\le 0.8\\ (1-x)/0.2, & 0.8<x<1\\ 0, & x\ge 1\end{cases}$
u_2	$U_2(x)=\begin{cases}0, & 0<x<0.5\\ 1, & x\ge 0.5\end{cases}$
u_3	$U_6(x)=\begin{cases}0, & 0<x\le 2\\ (x-2)/0.5, & 2<x<2.5\\ 1, & x\ge 2.5\end{cases}$
u_4	$U_4(x)=\begin{cases}1, & 0\le x\le 1\\ (1.5-x)/0.5, & 1<x<1.5\\ 0, & x\ge 1.5\end{cases}$
u_5	$U_5(x)=\begin{cases}1, & 0<x\le 2\\ (5-x)/3, & 2<x<5\\ 0, & x\ge 5\end{cases}$
u_6	$U_6(x)=\begin{cases}1, & 0\le x\le 8\\ (10.5-x)/2.5, & 8<x<10.5\\ 0, & x\ge 10.5\end{cases}$

u_7	$U_7(x) = \begin{cases} 1, & 0 \le x \le 2 \\ (2.5-x)/0.5, & 2 < x < 2.5 \\ 0, & x \ge 2.5 \end{cases}$
u_8	$U_8(x) = \begin{cases} 0, & 0 \le x \le 2 \\ (x-2)/8, & 2 < x < 10 \\ 1, & x \ge 10 \end{cases}$

To sum up, applying the large amphibious aircraft fuzzy dispatch decision model to the actual maritime life accident rescue, the specific steps as follows:

Step 1: Construct large amphibious aircraft dispatch decision matrix, namely case matching degree matrix R. Determine maritime life accident case, $A_i, i = 1, 2, \ldots, m$, dispatch decision indicators $U_j, j = 1, 2, \ldots, n$,according to the actual accident data and the indicator membership function, calculate the indicator membership degree. On this basis, determine the interval intuitionistic fuzzy number of indicators objectively by combining expert experience, $r_{ij} = \left(\left[\mu_{ij}^L, \mu_{ij}^U\right], \left[\nu_{ij}^L, \nu_{ij}^U\right]\right)$, the interval intuitionistic fuzzy matrix is obtained $R = \left(r_{ij}\right)_{m\times n}$.

Step 2: According to the decision matrix, the objective weight of each attribute can be obtained by formulas (2) and (3), $w_j, j = 1, 2, \ldots, m$.

Step 3: Formula (1) is used to calculate the comprehensive matching attribute value α_i of the case A_i.

Step 4: The comprehensive matching score $S(\alpha_i)$ of A_i is calculated by formula (4), That is, for the maritime life accident, the dispatch matching degree of large amphibious aircraft.

4. Instance analysis

The maritime life accidents in South China Sea in the past three years were statistically analyzed[18]. Take Yongxing Island as the rescue base, four typical cases $A = \{A_1, A_2, A_3, A_4\}$ were identified in the same sea area where maritime life accidents often occur, due to the article is limited in length, details of the cases will not be described in this paper. According to the index system $U = \{u_1, u_2, u_3, u_4, u_5, u_6, u_7, u_8\}$ of AG600 selection, interval intuitionistic fuzzy matrix $R = \left(r_{ij}\right)_{m\times n}$, $r_{ij} = \left(\left[\mu_{ij}^L, \mu_{ij}^U\right], \left[\nu_{ij}^L, \nu_{ij}^U\right]\right)$ is established by indicator membership function and expert group decision, see the Tab 4.

Table 4: Interval intuitionistic fuzzy decision matrix R

	u_1	u_2	u_3	u_4
A_1	([0.85,0.95],[0.1,0.2])	([0.85,0.95],[0.1,0.2])	([0.8,0.9],[0.1,0.2])	([0.9,0.95],[0.05,0.15])
A_2	([0.85,0.95],[0.1,0.2])	([0.8,0.9],[0.05,0.15])	([0.8,0.9],[0.1,0.3])	([0.7,0.9],[0.1,0.2])
A_3	([0.1,0.2],[0.8,0.95])	([0.1,0.2],[0.85,0.95])	([0.8,0.9],[0.1,0.2])	([0.7,0.9],[0.1,0.2])
A_4	([0.85,0.95],[0.1,0.2])	([0.8,0.9],[0.05,0.15])	([0.8,0.9],[0.1,0.2])	([0.05,0.15],[0.9,0.95])
	u_5	u_6	u_7	u_8
A_1	([0.4,0.45],[0.5,0.65])	([0.85,0.95],[0.1,0.25])	([0.9,0.95],[0.1,0.2])	([0.8,0.9],[0.1,0.2])
A_2	([0.1,0.2],[0.8,0.95])	([0.15,0.3],[0.8,0.9])	([0.3,0.45],[0.8,0.9])	([0.25,0.4],[0.6,0.8])
A_3	([0.15,0.2],[0.85,0.95])	([0.05,0.15],[0.85,0.95])	([0.1,0.2],[0.9,0.95])	([0.1,0.2],[0.85,0.9])
A_4	([0.15,0.2],[0.85,0.95])	([0.05,0.15],[0.9,0.0.95])	([0.1,0.2],[0.9,0.95])	([0.9,0.95],[0.05,0.15])

Combined with the decision matrix R, the weight $w_j, j = 1, 2, ..., m$ of each attribute u_j is calculated according to formula (2) and (3), see the Tab 5.

Table 5: The decision indicator attribute weight w_j

index	w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8
weight	0.1251	0.1245	0.1264	0.1239	0.1226	0.1260	0.1259	0.1256

In order to obtain the contribution of each attribute to dispatch decision, formula (1) is used to calculate the comprehensive attribute value α_i of the case A_i. $\alpha_1 = ([0.81, 0.91], [0.15, 0.27])$

$$\alpha_2 = ([0.60, 0.77], [0.27, 0.44])$$

$$\alpha_3 = ([0.45, 0.61], [0.41, 0.55])$$

$$\alpha_4 = ([0.64, 0.67], [0.36, 0.51])$$

The dispatch decision matching score $S(\alpha_i)$ of large amphibious aircraft for maritime cases was calculated according to the score function formula (4),see the Tab.6.

Table 6: Dispatch decision matching score $S(\alpha_i)$

case	$S(\alpha_1)$	$S(\alpha_2)$	$S(\alpha_3)$	$S(\alpha_4)$
score	0.8180	0.5062	0.1653	0.5501

The results of large amphibious aircraft dispatch decision in the four maritime life cases were obtained by substituting the scores $S(\alpha_i)$ into the evaluation grade table, see the Tab.7.

Table 7: Large amphibious aircraft dispatch decision result

case	grade of selection evaluation					evaluation result
	1	2	3	4	5	
A_1	0	0	0	1	0	applicable
A_2	0	1	0	0	0	not applicable
A_3	1	0	0	0	0	not applicable at all
A_4	0	1	0	0	0	not applicable

From the calculating results, in case 1, interval intuitionistic fuzzy numbers of every decision indicator all meet the dispatching requirements of large amphibious aircraft. Therefore, the calculating matching degree is high, and the success rate of large amphibious aircraft is more high during rescue missions, so it is inevitable to be dispatched. The inapplicability of case 2 and case 4 is influenced by the dispatch decision indicator u_4 and indicator u_5. That is, the ratio of actual flight time to theoretical flight time is too large, and obstacles at the scene of the accident or other factors that affect the rescue forces to reach the target increased the difficulty of rescue. Compared with case 2 and case 4, the indicators of Case 3 almost all not meet the requirements of large amphibious dispatch, so it is inevitable that case 3 is judged as completely unsuitable. In order to further verify the accuracy of the method proposed in this paper, TOPSIS method in reference [22] and projection method in reference [23] were used to construct the models respectively to calculate the cases in this paper. The results are shown in Table 8. Due to space limitations, the model construction process is not described in this paper.

It can be seen from the calculation results in Table 8 that the dispatching decision method proposed in this paper is consistent with the calculation results of the methods in literatures [22] and [23]. However, it is not difficult to find from the data that the results obtained by this method have a higher identification degree than the other two methods. Through the discussion with marine rescue experts and first-line rescue personnel for the calculation results of the large amphibious aircraft dispatching decision model, it is concluded that the calculation results of the model are fully in line with the actual rescue needs of maritime life accidents. It can be applied to the actual rescue tasks at sea, realize the scientific dispatch decision of large amphibious in the maritime life accident rescue.

Table 8: Comparison and analysis of calculation results between the proposed method and other methods

	proposed method $S(A_i)$	TOPSIS method $S(\alpha_i)$	projection method $CI(A_i)$
A_1	0.8180	0.6262	0.4746
A_2	0.5062	0.4805	0.5014
A_3	0.1653	0.3644	0.5277
A_4	0.5501	0.5384	0.4801
result	$A_1 \succ A_4 \succ A_2 \succ A_3$	$A_1 \succ A_4 \succ A_2 \succ A_3$	$A_1 \succ A_4 \succ A_2 \succ A_3$

5. Conclusion

In this paper, the large amphibious aircraft dispatching decision for maritime life accident rescue with completely unknown attribute weight is taken as the research goal, and the dispatching decision model is constructed based on improved fuzzy algorithm. The dispatch decision indicator system of large amphibious aircraft for maritime accidents was firstly proposed and determined. Based on the interval intuitionistic fuzzy theory, this paper proposed innovatively the method of determining interval intuitionistic fuzzy number and interval intuitionistic fuzzy matrix combining five grades fuzzy evaluation criteria, indicator membership function and expert experience. This paper calculated objectively the indicator's weight by the interval intuitionistic fuzzy entropy method, and got the matching score of large amphibious aircraft by the matching function. Finally, the applicability degree of large amphibious aircraft in maritime life accident is determined through the evaluation grades, to conclude whether the aircraft is suitable for dispatch in the current case. The model is verified by a practical case, and the results meet the actual needs of marine life rescue. In this paper, large amphibious aircraft AG600 is firstly brought into the maritime rescue system, and the dispatch decision problem is firstly put forward and solved. Comprehensively considered the importance of both objective facts and expert experience in the decision-making process, constructed the large amphibious aircraft dispatching decision model. It provides scientific basis and guarantee for large amphibious aircraft intelligent dispatch and application for maritime accident in the future.

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References

[1] Malyszko, M. Fuzzy Logic in Selection of Maritime Search and Rescue Units [J]. Applied Sciences, 2021, 12(1): 21.

[2] Yang Jin, Minjian Yu. Fuzzy comprehensive Evaluation for route aided Generation decision making [J]. Science and Technology innovation, 2021, 34:73-75.

[3] Jianghua Zhou. Research on Evaluation Method of Search and Rescue Ship Optimization and Sequencing [J]. China Navigation, 2005, 1:68-73.

[4] Xueqian Yang. Evaluation model and application of emergency search capability of inland Rivers in west China[D]. Dalian: Dalian Maritime University, 2020.

[5] Xiaolin Wu, Peizhen LAN. Fuzzy similarity Optimization method for Salvage Vessels at sea [J]. China Navigation, 2018, 41(1):74-77.

[6] Wei L, Liu W. The optimized selection methods of marine search and rescue ships[C]// 2016 13th

International Conference on Service Systems and Service Management (ICSSSM). Kunming: IEEE, 2016.

[7] Qian Zhang, Maritime Emergency rescue Force scheduling model based on spatial relations [J]. Journal of Geo-information Science, 2018, 20(6):772-780.

[8] Du, B., Xiong, W., et al. AG600 Maritime Base Location Decision Based on the Interval Intuitionistic Fuzzy TOPSIS Method. IEEE Access[J]. IEEE Access, 2022, 10:82483-82492.

[9] Houxing Dai. Dynamic Pre-assessment of Marine Traffic Risk under Inclement Weather[D]. Dalian: Dalian Maritime University, 2019.

[10] Yangguang Min. A hybrid optimization Model for Water rescue Capability Evaluation based on comprehensive fuzzy Evaluation [J]. Jiangsu Science and Technology Information, 2018,35(11):19-21.

[11] KT Atanassov. Interval valued intuitionistic fuzzy Sets[M]. Elsevier North-Holland, Inc. 1989.

[12] Tiwari, P. Generalized entropy and similarity measure for interval-valued intuitionistic fuzzy sets with application in decision making[J]. International Journal of Fuzzy System Applications (IJFSA), 2021,10(1), 64-93.

[13] Min Yang, Shibin ZHANG. Interval-intuitive Fuzzy Multi-attribute Decision Making Based on New Fuzzy Entropy and Score Function [J]. Operations research and management, 2021 ,p. 63-68.

[14] Gao Mingmei, et al. Interval-intuitive Fuzzy Multi-attribute Decision Making Based on Improved Entropy and New Score Function [J].Control and decision making, 2016, 31(10):1757-1764.

[15] He, Z., et al. A method for interval-valued intuitionistic fuzzy multiple attribute decision making based on fuzzy entropy [J]. Journal of Intelligent & Fuzzy Systems, 2020,38(6):7779-7785.

[16] Bu, F., et al. Interval-valued intuitionistic fuzzy MADM method based on TOPSIS and grey correlation analysis[J]. Mathematical Biosciences and Engineering, 2020,17(5):5584-5603.

[17] A Tiwari, QMD Lohani. Proposed intuitionistic fuzzy entropy measure along with novel multicriteria sorting techniques [J]. IEEE Access, 2022, 11: 7630-7656.

[18] China Maritime Search and Rescue Center [DB/OL]. https://zizhan.mot.gov.cn

[19] National Meteorological Science Data Center [DB/OL]. http://data.cma.cn

[20] Chunlin Shi. Study on China's Construction of Search and Rescue Bases on Islands and reefs in South China Sea [J]. Pacific Journal, 2017, 25(6):78-87.

[21] Shuzong Han, et al. Study on temporal and Spatial variation characteristics of waves in the South China Sea [J]. Bulletin of Marine limnology, 2020, 29(3):1-9.

[22] Haocun Chen, Xuedong Fang. General airport site selection evaluation model based on interval number TOPSIS [J]. Journal of Civil Aviation Flight University of China, 2021,32(6):31-34.

[23] Shouzhen Zeng, Dandan Luo. Research on interval intuitionistic fuzzy multi-attribute decision making method based on projection model [J]. Operations Research and Management Science, 2020, 29(3):10-15.