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A Radio Fuze Anti-Jamming Performance Evaluation Method

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Abstract: How to objectively and quantitatively evaluate anti-jamming ability of the radio fuze with accuracy is an important issue in the field of radio fuze. However, currently, there areno ideal radio fuze anti-jamming performance evaluation methods and mature theoretical system. In this paper, the system architecture, evaluation standard, evaluation indexes, evaluation methods and evaluation models of the radio fuze anti-jamming performance evaluation have been studied based on a comprehensive analysis of the anti-jamming performance of the radio fuze. A number of evaluation standards and evaluation indexes which portray different aspects of radio fuze anti-jamming performance were set. A test method for testing evaluation index was selected, and a platform for anti-jamming performance evaluation tests were built. Following this, a fuzzy comprehensive evaluation model for radio fuze anti-jamming performance evaluation was established based on the test platform. Finally, a radio fuze anti-jamming performance was evaluated by using the proposed method to verify the feasibility of the method.

Keywords: Anti-jamming performance evaluation, Fuzzy comprehensive evaluation model, Radio fuze, Evaluation indexes.

1. INTRODUCTION

With the increasing struggle between electronic jamming and anti-jamming, the modern warfare demands more efficient radio fuzes with excellent anti-jamming performance. How to objectively and quantitatively evaluate anti-jamming ability of the radio fuze with accuracy is an important issue in the field of radio fuze. However, currently there are no ideal radio fuze anti-jamming performance evaluation method and mature theoretical system [1].

One of the essential functions of radio fuze anti-jamming is the identification of the target signal and interfering signals, and the other is the suppression of the interference signal [2]. However, due to diversity of radio fuzes working system and the operating frequency, complexity of the work environment, uncertainty of working condition and the randomness of the working time make the evaluation of target signal to be effectively identified and effective interference signal suppression has serious uncertainty and fuzziness. Therefore, it is difficult to grasp the common and representative physical characteristics as the evaluation indexes which can reflect the performance of radio fuze anti-jamming. In addition, the relationship between anti-jamming characteristic quantity and interference conditions is difficult to analyse using the mathematical methods. Therefore, the evaluation methods and evaluation models are difficult to determine, resulting in more challenging evaluation.

In this paper, based on a comprehensive analysis of the anti-jamming performance of the radio fuze, the system architecture, evaluation standards, evaluation indexes, evaluation methods and evaluation models of the radio fuze anti-jamming performance evaluation have been studied. The factors and parameters which reflect radio fuze anti-jamming performance were determined by analyzing the characteristics of the radio fuse, interference sources, and anti-jamming measures. A fuzzy comprehensive evaluation model of radio fuze anti-jamming performance evaluation was established based on the test platform. Finally, a radio fuze anti-jamming performance was evaluated by using the proposed method to verify the feasibility of the method.

2. THE ARCHITECTURE OF RADIO FUZE ANTI-JAMMING PERFORMANCE EVALUATION

The radio fuze anti-jamming performance evaluation must be considered with both interference and anti-jamming performance based on one situation, for the evaluation of the confrontation results. Anti-jamming performance is the result of joint action of multiple factors, therefore, it is necessary to select reasonable measures, assessment criteria and evaluation indexes to obtain the final results by a reasonable evaluation model.

Therefore, the whole idea of radio fuze anti-jamming performance evaluation is as follows: On the basis of quantitative analysis of the radio fuze, the paper characterized and established a reasonable and effective evaluation criteria for the assessment of the test methods based on specific facilities situation. Following this, an objective and effective evaluation model was built based on the characteristics of radio fuze anti-jamming performance evaluation. After obtaining specific data of the evaluation indicators by the test methods, quantitative evaluation results were obtained by using the designed model. Under the guidance of this whole idea, the establishment of the architecture of radio fuze anti-jamming performance evaluation is shown in Fig. (**1**).

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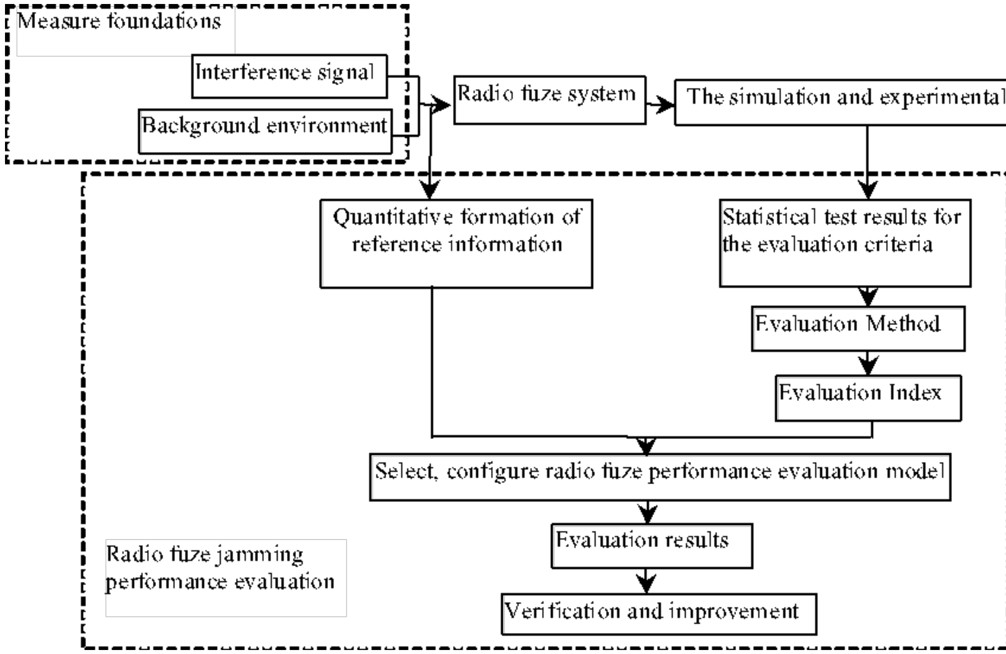

Fig. (1). Radio fuze anti-jamming performance evaluation system diagram.

It can clearly be seen that the selection of measure foundations and the establishment of evaluation criteria and indexes are the foundations of radio fuze anti-jamming performance evaluation. In addition, evaluation model is the comprehensive bridge for determining measure foundations and evaluation indexes to obtain the conclusions of the evaluation.

3. MEASURE FOUNDATIONS OF THE RADIO FUZE ANTI-JAMMING PERFORMANCE EVALUATION

The output signal of the target reflected wave which be formed in the receiver is closely related to the time-space condition of the rapid relative motion between the bomb and the target when the fuze works. This target makes the target signal features different from the interference signal. An effective or ineffective fuze anti-jamming performance is determined by whether these features have been fully applied. These features include: frequency, amplitude, duration of action, and so on. These identifying characteristics provide anti-jamming capability to radio fuzes .As a result , the measure foundations can be determined of the radio fuze anti-jamming performance evaluation based on these features.

The detection process of radio Fuze extracts useful information from a variety of disturbances by a "select" process.Therefore, anti-jamming measures of radio fuze can be determined through a variety of "select" ways. Based on the depth of the selected signal, anti-jamming capability test of radio fuze can be considered from the following aspects: space, time, energy, frequency, signal structure, polarization, etc. Therefore, the first level factors which reflect anti-jamming performance of radio fuze include four factors: ways of bringing disturbance , energy of disturbances, interference time and interference distance. Each first level factor contains two second level factors. The set of factors (also named as measure foundations) which reflect the radio fuze anti-jamming performance is shown in detail in Fig. (**2**).

4. THE EVALUATION CRITERIONS, INDEXES AND METHODS OF RADIO FUZE ANTI-JAMMING PERFORMANCE

In this paper, power standard, time standard and efficiency standard were selected as the radio fuze anti-jamming performance evaluation criteria. Based on the parameters of each criterion, the anti-jamming performance evaluation index was drafted. Following this, a method to test the ability of anti-jamming radio fuze was designed.

4.1. Evaluation Indexes Corresponding to the Power Standard

The level of interference power reflects the performance of radio fuze anti-jamming to some extent, on the basis of which the evaluation indexes corresponding to the power criteria are determined as shown below.

(1) Interference power factor

This index reflects the minimum successful interference power ($P_{i\min}$) when the jammer implements interference on a fuze at a certain distance. It can be represented by the interference power factor (K_p), which is defined as:

$$K_p = \frac{P_{i\min}}{P_0} \tag{1}$$

Where: K_p is the interference power factor, $P_{i\min}$ is the minimum interference power which interferes with fuze successfully at a certain distance, P_0 is the standard power which is set in advance. This power value can be selected as the maximum value by analyzing the interference power of existing fuze jammer. Once identified, it is considered as the standard.

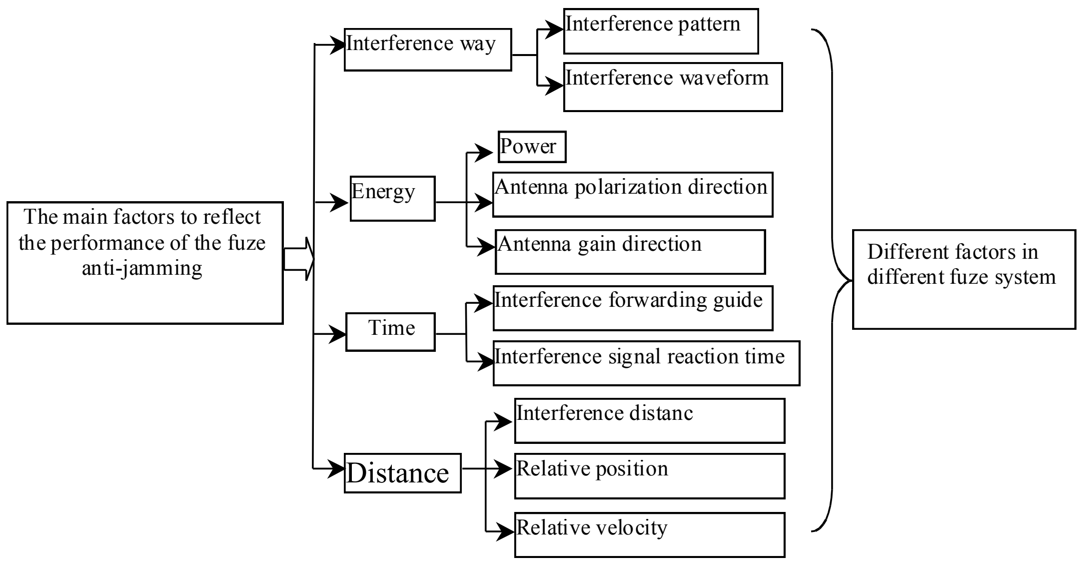

Fig. (2). The factors which reflect the radio fuze anti-jamming performance.

It can clearly be seen that the larger interference power factor means better anti-jamming performance of the radio fuze.

(2) Sensitivity degradation factor

The index determines the fuze interference effect by comparing the minimum input power which detects the target signal required before and after the interference. At a distance, $S_{\min}$ is the minimum input power for fuze to detect target signal successfully at no interference condition. When a certain interference is exerted, the input signal power of the fuze must be increased to detect the target signal. The minimum input power is set as $S_{j\min}$, to define the ratio of the two powers determining the sensitivity degradation factors as shown below:

$$K_{SD} = \frac{S_{\min}}{S_{j\min}} \tag{2}$$

It can be seen that when: $0 < K_{SD} \le 1$, K_{SD} is bigger, fuze anti-jamming performance is better.

4.2. Evaluation Indexes Corresponding to the Time Standard

The response time of fuze aspects is measured in terms of delays in the disturbance in the fuze. If the radio fuze has appropriate anti-jamming measures, the delay is relatively small. Otherwise, it is relatively large. The fuze anti-jamming evaluation indexes were set corresponding to the time standard shown as below :

(1) Jammer intercepted Time

The jammer needs the fuze signal when the jammer disturbs the fuze. If the fuze has a strong anti-jamming capability, the jammer does not easily receive the fuze signal or needs a long time to receive the signal. Therefore, the time in which the jammer obtains the fuze signal reflects the strength of fuze anti- jamming capability [3]. The index of jammer's intercepting time is set as one of the radio fuze anti-jamming performance indicators. For example, it is assumed that for the fuze in a working state, the jammer's intercepting time is the time interval from the opening of the jammer to the jammer intercepting the fuze signal, namely:

$$\Delta T_i = T_i - T_0 \tag{3}$$

Where, T_i is the time of jammer's interception in the fuze signal and T_0 is the time when the jammer begins to interfere. The index reflects the high frequency of the anti-jamming capability of fuze to some extent.

(2) The guide interference time

One consequence of the jammer's interference in the fuze is that it bursts the fuze early . From the fuze performance, it can be observed that the fuze has been interfered successfully if the low-frequency circuit of the fuze output gives a signal [4]. At the same interference conditions, a delayed fuze start time output gives stronger fuze anti-interference ability. Therefore, the interference time can be defined as one of the radio fuze anti-jamming performance indicators. When the fuze is switched on, T_0 is the time of the beginning of the jammer interferences, T_j is the time of start signal of the fuze, and the interference time is defined as :

$$\Delta T_j = T_j - T_0 \tag{4}$$

The index reflects anti-jamming capability of the low-frequency part of the fuze.

4.3. Evaluation Indexes Corresponding to the Efficiency Standard

(1) Anti-jamming success rate

Practically, the results of interference tests are very random because the factors that affect radio fuze anti-jamming effect are very complex [5]. Therefore, only one anti-jamming test result is not enough but the probabilities of the fuze anti-jamming equipment withstanding interference under certain conditions can be referred to as anti- jamming success rate.

Based on the interference that can lead to early initiation of radio fuze or blind fire, so that the success and failure of fuze anti-jamming can be determined by analyzing early initiation of fuze or blind fire. When the interference is implemented, if fuze detonates the warhead to be in its normal detonation area, this anti-jamming is considered as successful; if the fuze however starts early or blind fires, then this anti-jamming is unsuccessful.

Anti-jamming success rate is based on a probability index. It can be defined as the rate of the number of effective radio fuze anti-jamming and the total number of the interferences under specified conditions. Namely:

$$\eta = \frac{n_e}{n} \times 100\% \quad (5)$$

Where n is the total number of interferences and n_e is the number of effective radio fuze anti-jamming.

When the anti-jamming success rate is higher, the radio fuze anti-jamming performance is better. In practical applications, the anti-jamming performance of fuze can be divided into several levels based on the anti-jamming success rate according to the needs of actual assessment [6]. The anti-jamming capability can be divided into five levels based on the radio fuze anti-jamming capability from weak to strong if the individual indicators are taken as interference assessment criteria shown as follows:

a. While $0 \le \eta < 10\%$, it has 0–level anti-jamming capability;

b. When $10 \le \eta < 30\%$, it has 1–level anti-jamming capability;

c. When $30 \le \eta < 50\%$, it has 2–level anti-jamming capability;

d. When $50 \le \eta < 80\%$, it has 3–level anti-jamming capability;

e. When $\eta \ge 80\%$, it has 4–level anti-jamming capability.

(2) Target detection probability factor

With the presence of interference that can affect the fuze, real target signal is analyzed. There is less impact on fuze to find the target signal if the fuze has better anti-jamming capability [7]. Therefore, it is possible to determine the strength of the anti-jamming performance of fuze by comparing the changes in the target detection probability before and after interference. If the target detection probability of radio fuze is P_f in the absence of interference, and the target detection probability of radio fuze is P_{fj} with interference, the target detection probability factor is defined as follows:

$$K_f = \frac{P_{fj}}{P_f} \quad (6)$$

It can be seen that $0 \le K_f \le 1$, and if K_f is larger, the fuze anti-jamming performance is better.

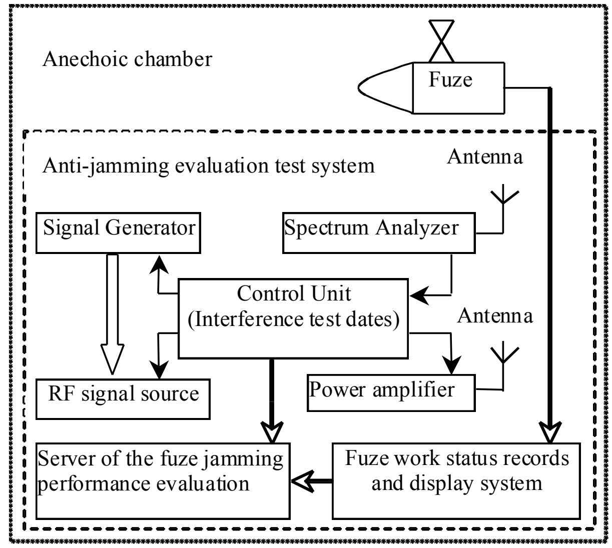

Fig. (3). The working schematic of radio fuze anti-jamming performance assessment test platform.

Based on the above evaluation indexes, a platform for the assessment of radio fuze anti-jamming performance was established as shown in Fig. (**3**).

The relationship between the fuze anti-jamming assessment test system and the assessed fuze is shown in Fig. (**3**). The assessed fuze washanged at the top of the anechoic chamber. It simulated a variety of intersection attitudes of projectile and target, and moved at low speed. The system of the fuze anti-jamming assessment test was controlled by the control unit which has two kinds of control ways (automatic and manual control). The interference experiment database of the control unit was used to form interference parameters at a variety of interference conditions, such as interference patterns, waveforms, energy, spatial relations, and so on. Various kinds of interference signals can be formed by control signal generator and an RF signal source. After receiving the fuze signal, the interfering signals were generated from the interference experiments database and transmitted by the the Central Control Unit. A variety of interference patterns were formed. In addition, the quantitative measure foundation waveforms were generated automatically based on the fuze parameters which were detected by spectrometer. The fuze work status records and display system were constituted with the data acquisition system and an oscilloscope. It can display the working status of interfered fuze system in real time, and record the distance, the relative position, the effective action time of the interfering signals and other information. The interference parameters of the central Control Unit (interference style, waveform, energy , spatial relations) and the working status of the fuze and the display system were transmitted to the fuze anti-jamming performance evaluating server. The results of the fuze anti-jamming performance evaluation wereobtained by the server system based on the interference test parameters, fuze working conditions and a fuze anti-jamming evaluation model.

5. RADIO FUZE ANTI-JAMMING PERFORMANCE EVALUATION MODEL BASED ON FUZZY COMPREHENSIVE EVALUATION

The assessment indexes of radio fuze anti-jamming performance system were made clear. But, because one evaluation index reflects a single aspect of the radio fuze anti-jamming effect, and cannot represent the overall anti-jamming performance of fuze, therefore, a unified result is required to reflect the comprehensive fuze anti-jamming performance [8]. To achieve this target, it is necessary to build a rational, quantitative, generic evaluation model which is suited for radio fuze anti-jamming performance evaluation.

5.1. The Establishment of the Evaluation Model

The relationships between the indicators and the overall performance of fuze anti-jamming can be established through the evaluation model. In this study, a comprehensive fuze anti-jamming performance evaluation result was obtained based on the evaluation indexes.

Because there are many factors that affect the performance of radio fuze anti-jamming, it is difficult to provide a reasonable weight distribution. Therefore, we two levels fuzzy comprehensive evaluation model was used. Based on the evaluation standards and evaluation indexes, the power standard, time standard, efficiency standard and other factors were considered as the first level elements, where every index corresponding to the evaluation standards was taken as the second level element, to establish the two level evaluation model of radio fuze anti-jamming performance evaluation as shown in Fig. (**4**).

5.2. Evaluation Model Components and Evaluation Steps

After the structure of the assessment model was determined, all the components were set and evaluated in accordance with the appropriate procedure.

(1) The set of factors was determined.

The set of factors was: {Power standard, time standard, efficiency standard, other factors} , denoted as:

$$U=\{U_1,U_2,U_3,U_4\} \tag{7}$$

The elements of factors' set were classified as follows:

{Interference power factor, sensitivity degradation factor};

{Jammer intercepted time, guided interference time};

{anti-jamming success rate, target detection probability factor };

{interference way , interference waveform }.

The factor set was divided into four sub-factors sets：

$$U_1=\{u_1,u_2\},\quad U_2=\{u_3,u_4\},\quad U_3=\{u_5,u_6\},\quad U_4=\{u_7,u_8\} \tag{8}$$

(2) Selection of remarks set

Remarks set was selected as {excellent, good, medium, qualified, unqualified}, which is written as:

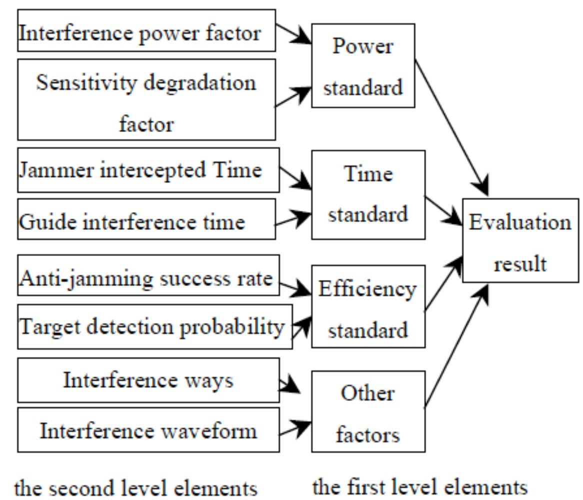

Fig. (4). Two levels evaluation model of radio fuze anti-jamming performance evaluation.

$$V=\{v_1,v_2,v_3,v_4,v_5\} \tag{9}$$

The level weight vectors were required to easily distinguish the results of comprehensive evaluations. The paper selected hundred-mark system, ie: 100-90 as excellent, 89-80 as good, 79-70 as medium, 69-60 as qualified, below 59 as unqualified. The weight vectors were taken as median:

$$V=\{95,85,75,65,30\} \tag{10}$$

(3) The first level fuzzy comprehensive evaluation

a. The weight set of first level fuzzy comprehensive evaluation was selected.

The weight sets of U_1,U_2,U_3,U_4 were written as:

$$A_1=\{a_{11},a_{12}\},\quad A_2=\{a_{21},a_{22}\},\quad A_3=\{a_{31},a_{32}\},\quad A_4=\{a_{41},a_{42}\} \tag{11}$$

And there:

$$\sum_{j=1}^{2} a_{ij}=1, \forall i=1\sim 4 \tag{12}$$

b. The results of the first level fuzzy comprehensive evaluation

If the single factor evaluation matrix was as follows:

$$R_i=\begin{bmatrix} r_{11}^{(i)} & r_{12}^{(i)} & r_{13}^{(i)} & r_{14}^{(i)} & r_{15}^{(i)} \\ r_{21}^{(i)} & r_{22}^{(i)} & r_{23}^{(i)} & r_{24}^{(i)} & r_{25}^{(i)} \end{bmatrix}, i=1\sim 4 \tag{13}$$

The results of the first level of fuzzy comprehensive evaluation is shown below：

$$B_1=A_1 \circ R_1=(b_{11},b_{12},b_{13},b_{14},b_{15}) \tag{14}$$

$$B_2=A_2 \circ R_2=(b_{21},b_{22},b_{23},b_{24},b_{25}) \tag{15}$$

$$B_3=A_3 \circ R_3=(b_{31},b_{32},b_{33},b_{34},b_{35}) \tag{16}$$

$$B_4 = A_4 \circ R_4 = (b_{41}, b_{42}, b_{43}, b_{44}, b_{45}) \quad (17)$$

(4) The second level fuzzy comprehensive evaluation

a. Select the second level fuzzy comprehensive evaluation weight set.

Given the elements weight set of U as:

$$A = (a_1, a_2, a_3, a_4), \quad \sum_{i=1}^{4} a_i = 1, \quad (18)$$

b. Determine the Single factor evaluation matrix

The second level fuzzy comprehensive evaluation is taken as a single factor evaluation matrix：

$$R = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \\ b_{31} & b_{32} & b_{33} & b_{34} & b_{35} \\ b_{41} & b_{42} & b_{43} & b_{44} & b_{45} \end{bmatrix} \quad (19)$$

And the result of the second level fuzzy comprehensive evaluation is represented as：

$$B = A \circ R = (b_1, b_2, b_3, b_4, b_5) \quad (20)$$

(5) Final results of the evaluation

B was converted to the centesimal system to obtain a final comprehensive evaluation result Z：

$$Z = BV^T \quad (21)$$

5.3. Example of a Radio Fuze Anti-jamming Performance Evaluation

(1) Each evaluation index data

The evaluation index dates of a radio fuze measured by the above radio fuze anti-jamming performance assessment test platform are shown in Table **1**.

(2) The first level evaluation matrix

Table 1. The evaluation index dates a radio fuze.

Power standard	Interference power factor	0.86
	Sensitivity degradation factor	0.79
Time standard	Jammer intercepted Time	58ms
	guided interference time	76ms
Efficiency standard	anti-jamming success rate	78%
	Target detection probability factor	72%
Other factors	interference ways	Sweep frequency
	Interference waveform	white noise

Each index was evaluated as a single standard which defines the evaluation criteria as shown in Table **2**.

The membership of each index can be calculated based on the fuze indicator dates and membership functions of each index, respectively (as shown in Table **3**).

Therefore, the first level evaluation matrix was obtained as follows:

$$R_1 = \begin{bmatrix} 0.77 & 0 & 0 & 0 & 0 \\ 0 & 0.74 & 0 & 0 & 0 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0 & 0 & 0.64 & 0 & 0 \\ 0 & 0 & 0.82 & 0 & 0 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} 0 & 0.97 & 0 & 0 & 0 \\ 0 & 0.87 & 0 & 0 & 0 \end{bmatrix}$$

$$R_4 = \begin{bmatrix} 0 & 0.80 & 0 & 0 & 0 \\ 0 & 0 & 0.48 & 0 & 0 \end{bmatrix}$$

(3) The first level evaluation

Table 2. The individual evaluation criteria of evaluation index.

Evaluation Grade	Excellent	Good	Medium	Qualified	Unqualified
Interference power factor	0.85-1	0.7-0.85	0.55-0.7	0.55-0.4	Below 0.4
Sensitivity degradation factor	0.85-1	0.7-0.85	0.55-0.7	0.55-0.4	Below 0.4
Jammer intercepted Time	More than 80ms	60-80ms	40-60ms	20-40ms	Below 20ms
Guided interference time	More than 100ms	80-100ms	60-80ms	30-60ms	Below 30m
Anti-jamming success rate	More than 80	70-80	60-70	50-60	Below 50
Target detection probability	More than 80	65-80	50-65	35-50	Below 35
Interference ways	-	Sweep frequency	deception	-	-
Interference waveform	Triangular pulse	amplification waveform	white Noise	Sawtooth wave	-

Table 3. The membership of each fuze index.

Power standard	Interference power factor	0.77
	Sensitivity degradation factor	0.74
Time standard	Jammer intercepted time	0.64
	Guided interference time	0.82
Efficiency standard	Anti-jamming success rate	0.97
	Target detection probability factor	0.87
Other factors	Interference ways	0.8
	Interference waveform	0.48

According to fuzzy transformation, there are:

$$B_1 = A_1 \circ R_1 = \begin{bmatrix} 0.75 & 0.25 \end{bmatrix} \circ \begin{bmatrix} 0.77 & 0 & 0 & 0 & 0 \\ 0 & 0.74 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0.75 & 0.25 & 0 & 0 & 0 \end{bmatrix}$$

$$B_2 = A_2 \circ R_2 = \begin{bmatrix} 0.25 & 0.75 \end{bmatrix} \circ \begin{bmatrix} 0 & 0 & 0.64 & 0 & 0 \\ 0 & 0 & 0.82 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0.75 & 0 & 0 \end{bmatrix}$$

$$B_3 = A_3 \circ R_3 = \begin{bmatrix} 0.8 & 0.2 \end{bmatrix} \circ \begin{bmatrix} 0 & 0.97 & 0 & 0 & 0 \\ 0 & 0.87 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0.8 & 0 & 0 & 0 \end{bmatrix}$$

$$B_4 = A_4 \circ R_4 = \begin{bmatrix} 0.67 & 0.33 \end{bmatrix} \circ \begin{bmatrix} 0 & 0.80 & 0 & 0 & 0 \\ 0 & 0 & 0.48 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0.67 & 0.33 & 0 & 0 \end{bmatrix}$$

(4) The second level evaluation matrix

The first level evaluation results were combined to form the secondary level evaluation matrix as follows:

$$R = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{bmatrix} = \begin{bmatrix} 0.75 & 0.25 & 0 & 0 & 0 \\ 0 & 0 & 0.75 & 0 & 0 \\ 0 & 0.8 & 0 & 0 & 0 \\ 0 & 0.67 & 0.33 & 0 & 0 \end{bmatrix}$$

(5) The second level evaluation results

Evaluation result of the second level is:

$$B = A \circ R = \begin{bmatrix} 0.28 & 0.3 & 0.21 & 0.21 \end{bmatrix} \circ \begin{bmatrix} 0.75 & 0.25 & 0 & 0 & 0 \\ 0 & 0 & 0.75 & 0 & 0 \\ 0 & 0.8 & 0 & 0 & 0 \\ 0 & 0.67 & 0.33 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0.28 & 0.25 & 0.3 & 0 & 0 \end{bmatrix}$$

(6) The final evaluation result

The second level evaluation result was converted into the centesimal system, and the comprehensive evaluation result was obtained as:

$$Z = BV^T = \begin{bmatrix} 0.28 & 0.25 & 0.3 & 0 & 0 \end{bmatrix} \begin{bmatrix} 95 \\ 85 \\ 75 \\ 65 \\ 30 \end{bmatrix} = 70.35$$

It can be seen that the level of the fuze jamming performance was observed as medium, which can verify the feasibility of the method.

CONCLUSION

In this paper, based on a comprehensive analysis of the anti-jamming performance of the radio fuze, the system architecture, evaluation standards, evaluation indexes, evaluation methods and evaluation models of the radio fuze anti-jamming performance evaluation were studied. First of all, radio fuze anti-jamming performance evaluation was carried out . Following this, the techniques for the assessment of radio fuze anti-jamming performance were designed . The factors and parameters which reflect radio fuze anti-jamming performance were determined by analyzing the characteristics of the radio fuse, interference sources, and anti-jamming measures. In the next section, a number of assessment criteria and evaluation indicators which portray different aspects of radio fuze anti-jamming performance were set. The paper selected one of the physical confrontation experiments as a testing method for testing the evaluation index, and built a platform for anti-jamming performance evaluation tests. Following this , a fuzzy comprehensive evaluation model of radio fuze anti-jamming performance evaluation was established based on the test platform. Finally, a radio fuze anti-jamming performance was evaluated by using the proposed method to verify feasibility of the method.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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