

Healthy Assessment Research Electronic Equipment

Ming Yin ^{*1}, Xiaohui Ye ¹,

¹ Department of Electronic Engineering, Naval University of Engineering,
JieFangDadao.No. 717,
430033Wuhan, China

{^{*}Yin Ming, Ye Xiaohui, }569121080@qq.com

Abstract. Healthy assessment weights of using of modern electronic equipment is too subjective problem, it is proposed in this paper that is based on fuzzy analytic hierarchy process and the method based on the theory of the D-S evidence. D-S evidence fusion is applied solid state transmitter overall healthy assessment results.

Keywords: Electronic equipment, healthy assessment, D-S evidence theory.

1 Introduction

With the development of monitoring technology, the theory of healthy monitoring is from condition monitoring to healthy management, the Prognostics and Healthy Management (PHM), the flight Integrated Vehicle Healthy Management (IVHM), Boeing company Aircraft Healthy Management (AHM) and Health use and Monitoring System (HUMS) and other concepts. In addition, the United States department of defense on the basis of the situation and maintenance in recent years, puts forward the concept of enhanced Condition Based Maintenance (CBM+), further consolidated the CBM, and maintenance of reliability management, automatic protection. The goal is to equip the system ability of healthy management and equipment condition monitoring, maintenance decision, after put into use life prediction, logistics, cost control, etc., for the integration of the overall planning and design.

Among of the electronic equipment, the radar system composition is highly complex, and frequent using and failure rate is high. The radar transmitter is in the most typical. The radar transmitter is as the research object for three reasons.

(1) Radar transmitter structure is highly complex, which a typically electromechanical mixing equipment with typical structure;

(2) Using frequency of radar transmitter is high, with large power, large current, high voltage, large heat loss of using environmental characteristics, which works in pulse way, low reliability. It is difficult to guarantee and maintenance.

(3) Radar transmitter in radar plays the core functions of RF signal power levels, which the healthy management is of great significance.

Therefore, radar transmitter is chosen as the research object, discuss the key of PHM technology - healthy parameters processing, condition monitoring, healthy status

evaluation, healthy trend prediction in radar launch on the custom transformation has important theoretical guiding significance and practical value.

2 Healthy Assessment model

2.1 Synthesis Principle

D-S evidence theory is based on the Bayesian Networks is a kind of numerical method of uncertainty reasoning. It has established the general Bayesian theory, according to the reasoning model, using evidence to determine the probability distribution and uncertainty multiple under the assumption of the likelihood function. The uncertainty evidence theory is to use the "Half Add" principle, so can be well in the main problems of uncertainty reasoning to compromise, the contradiction between the objectivity.

2.2 Multi-index Evaluation Model

The healthy status of transmitter, the safety and reliability of the transmitter factors such as complicated corresponding relationship. This relationship has a strong fuzzy features and characteristic, evidence space of each index can be used as the evaluation factors set, and the corresponding experts given by each sensor or the corresponding fuzzy membership degree, and then through membership function into characterization of each index evaluation of state basic probability distribution, then by D-S theory of evidence rules of synthetic evaluation index for fusion. As shown in Figure 1.

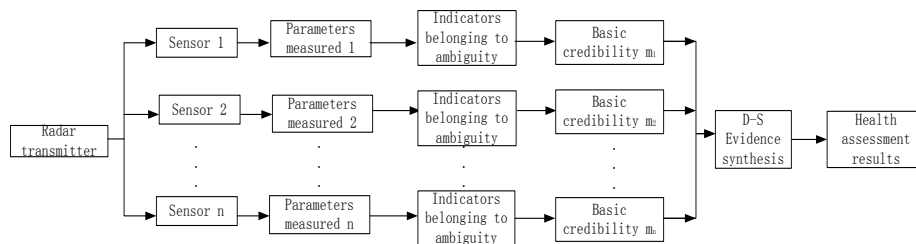


Fig. 1. D-S evidence fusion scheme of Solid state transmitter Healthy assessment

Usually, by l pattern A_1, A_2, \dots, A_l , in the domain U , According to the radar sensors or expert experience n membership degree is given $\mu_1, \mu_2, \dots, \mu_n$. The framework of the membership degree of all sensors for identifying is as follows.

$$\begin{bmatrix} \mu_1(A_1) & \mu_1(A_2) & \dots & \mu_1(A_l) \\ \mu_2(A_1) & \mu_2(A_2) & \dots & \mu_2(A_l) \\ \dots & \dots & \dots & \dots \\ \mu_n(A_1) & \mu_n(A_2) & \dots & \mu_n(A_l) \end{bmatrix}$$

Belongs to the proposition of the basic reliability distribution has get that.

$$m_i(A_j) = \frac{\mu_i(A_j)}{\sum_{j=1}^l \mu_i(A_j)} \quad (1)$$

To get the $m_i(A_j)$, which is constructed by the field of membership function according to experts or sensors, the reserve uncertainty based on the results of observation, avoid the distortion problem of human information processing. Thus it effectively solved the evidence theory in the basic reliability allocation problem.

Basic steps are as follows.

(1) It takes the healthy assessment indicators for evaluating factors set. In fuzzy evaluation set V as an identified frame, $v_L (L = 1, 2, 3, 4, 5)$ is to evaluate the specific evaluation. According to expert opinion, it can assume evaluation value that is $P(V) = \{P(v_1), P(v_2), P(v_3), P(v_4), P(v_5)\} = \{0.9 \ 0.7 \ 0.5 \ 0.3 \ 0.1\}$.

(2) Determine the credibility of the indexes and weights. Using D-S evidence theory to the indexes of evaluation index system to make a comprehensive evaluation, according to the experts give the membership function of analysis of each evaluation index, to determine the basic reliability index layer. Analytic Hierarchy Process is used to determine the index weights.

(3) To set up the evidence synthesis. To distribute the weight of an indexed standardization and the basic reliability shall be carried out in accordance with the formula of evidence synthesis.

(4) The computing evaluation results is based on $E = \sum_{r=1}^5 P(v_r)P(v_r)$.

(5) Comparing the difference between the assessment results and empirical knowledge to modify the weight, improve the evaluation model.

3 Healthy Assessments for State of Solid State Transmitter

During the period of maintenance, plant team to follow master for repair work, measured data and calculate the relative value shown in the following Table 1.

Table 1. measuring data of Solid state transmitter

Indicators	deviation	Value range	Healthy index
------------	-----------	-------------	---------------

Average power	1.3%	$\pm 10\%$	0.93
Pulse envelope	1%	$\pm 15\%$	0.90
pulse width	0.8%	0-2%	0.72
Transmission power	10%	15%	0.70
power supply voltage	0	10%	1
instantaneous bandwidth	1%	3%	0.95
water temperature	0	20%	1
Waveguide pressure	70%	-20%	0.16
Waveguide lighter	yes	no	0.25
traffic	5%	$\pm 15\%$	0.96
Standing wave ratio	85%	0-2	0.14
machine efficiency	-3.9%	-10%	0.71

Through data get the fuzzy membership degree of each evaluation index, evaluation index is obtained using membership degree into basic probability distribution of the information provided, and then D-S evidence fusion of evaluation indexes, so as to realize the multilevel and multifactor, scheme of radar transmitter healthy comprehensive evaluation. And through the improvement of D-S resultants, it effectively reduces the conflict between evidence, and improves the credibility of the avionics healthy assessment of PHM.

References

1. Shunong Z, Rui K, Xiaofei H, et al. China's Efforts in Prognostics and Healthy Management[J]. IEEE Transactions on Components and Packaging Technologies, 2008,31(2):509-518
2. Vichare N M, Pecht M G. Prognostics and Healthy management of electronics[J]. IEEE Transactions on Components and Packaging Technologies, 2006, 29(1): 222-229.
3. Xiaoguo J. Integration of Interval Numbers and the Method of AHP Along with its Improvement and Application[C]//Information Management, Innovation Management and Industrial Engineering (ICIII), 2010 International Conference on. IEEE, 2010, 1: 421-424.
4. Lianghua X, Liqing R, Mei Z, et al. Research on open system architecture for equipment Healthy management based on OSA-CBM[C]Intelligent Computing and Intelligent Systems (ICIS), 2010 IEEE International Conference on. IEEE, 2010,2: 246-250.