



Research Article

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## The research and development of the disabled based on the theory of D-S sports equipment

Ying Zhang

*Xi'an Physical Education University, Xi'an, China*

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### ABSTRACT

*This research brings the D-S theory founded by Dempster and Shafer into the sports equipment R&D and discusses the problem of group decision and proof fusion in the procedure of sports equipment R&D. This paper adopts the analytical method of D-S evidence theory to evaluate home-made prompters that is remote control and luminous for the deaf in the basketball match.*

**Key words:** D-S evidence; sports equipment; basketball match

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### INTRODUCTION

Since China's reform and opening up, our country's economy also entered a boom time in the world economy driven by the rapid development. In the backdrop of the rapid growth of GDP, capital investment in China has gradually expanded, corresponding with the size of the sports industry. Sports equipment and instrument play important role in the sports industry; It even has played a certain role in promoting the whole development of physical culture and sports.

Reasonability introduced into the rationality of D-S evidence theory in the research and development of sports equipment. Dempster first proposed D-S evidence theory in 1967, after that Shafer established in 1976. It adopts not the probability which is not accurate to obtain, but trust function. Usually when people did complex decision before doing something, they will analysis a variety of influencing factors using quantitative or qualitative methods, evidence theory integrated the advantages of these two kinds of methods. It can well deals with the ambiguity, incomplete and uncertain synthesis information, the synthesis algorithm and evidence theory can merge information from different sources of uncertainty. D-S evidence theory, as one of the artificial intelligence decision-making method, widely in military decision making, talent selection, fault diagnosis, researches, such as marketing, consumer decision-making. In the process of sports equipment research and development, we not only need professional theoretical knowledge as the basis of assumptions, but also all kinds of expert opinions what is more important in the development stage, the fusion of these opinions for sports equipment research and development provide strong theoretical support. But due to discrepancy in knowledge structure, ability to understand, personal preferences, etc. So each expert evaluation results may not completely reliable. According to the evaluation of complex problem at the same time, each authority, knowledge and experience of experts in the field are not equal, Its advantage is that as long as the information is not completely conflict, we can use formula for synthesis, Even conflict exists completely, also can through information correction to synthesis.

### D-S EVIDENCE THEORY SYNTHETIC LAW

According to the principle of information theory, the information content of single-dimensional has its limitations; the information content of multi-dimensional information by fusion of some single-dimensional information is bigger than that of any single-dimensional information. Therefore, the multi-source information fusion technology has advantages of dealing with the problem of target identification and fault search. As shown in fig.1.

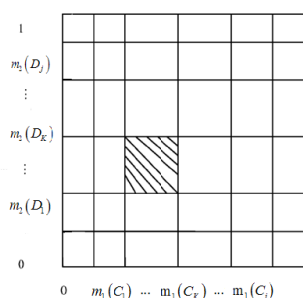


Fig. 1 Synthetic credibility assignment

D-S synthetic law reflects the law of evidence combination based on the assumptions that the data source reliability is identical and there is no evidence conflict. Each data source of multi-source information makes its own judgment according to the definition of evidence function, and then the judgments of multiple data sources or evidence function are combined together reasonably, and thus the reliability function can be as a belief function under the combination of multi-source evidence produced [5].

Supposing that  $BEL_1$  and  $BEL_2$  are two different evidence-based belief functions on the same frame of discernment  $U$ , the corresponding basic credibility assignment are  $m_1$  and  $m_2$ , and the focal elements are respectively  $C_1, C_2, \dots, C_K$  and  $D_1, D_2, \dots, D_N$ , it is shown in Fig. 2. If  $C \subseteq U$  and  $m(C) > 0$ , then

$$K = \sum_{C_i \cap D_j = \phi} m_1(C_i) m_2(D_j) < 1 \quad (2)$$

Where,  $K$  is to evaluate the degree of the conflict different evidence. The greater the  $K$ , the greater the conflict between evidence. The basic probability  $m: 2^U \rightarrow [0, 1]$  after synthesis is:

$$m(C) = \begin{cases} 0 & C = \phi \\ \frac{\sum_{C_i \cap D_j = C} m_1(C_i) m_2(D_j)}{1 - K} & C \neq \phi \end{cases} \quad (3)$$

Recording as  $m_1 \oplus m_2$ , this combination is called orthogonal summation. The calculation of multiple evidence combination regardless of the order of operation, the evidence can be combined with each other.

$$m = \{[(m_1 \oplus m_2) \oplus m_3] \oplus \dots\} \oplus m_n \quad (4)$$

#### Information fusion based on D-S theory

It is found that Zadeh paradox, one ticket veto, robustness and fairness exist in D-S evidence theory during applications, the improvements comes mainly from two aspects: modifying data sources and modifying synthesis rule. Evidence body modification based on the credibility and synthetic laws based on the distribution of local conflicts are used for fusion of evidence [6].

##### (1) Evidence body modification based on the credibility

The evidence credibility  $\mu_i (\mu_i \leq 1)$  reflects the relative degree of reliability between evidences. The credibility of evidence which has the highest reliability in the evidence group is 1. To modify the original evidence body  $M'$  with  $\mu_i$  used as a correction factor, the remaining probability is assigned to unknown circumstances  $m(\Theta)$ , the BPA value of evidence body  $M$  is obtained after correction:

$$M = [m(C_1) m(C_2) \dots m(C_n) m(\Theta)] \quad (5)$$

In which, element  $m(C_m) = \{ \mu m'(C_m) | m = 1, 2, \dots, n \}$ ;  $m(\Theta) = 1 - \sum_{m=1}^n m(C_n)$ ;  $m'(C_m) \in M'$ .

(2) Synthetic law based on the distribution of local conflicts

Local conflict is assigned between the two focal elements which caused the conflict:

$$\left\{ \begin{array}{l} m_{jk}(C) = \sum_{D \cap E = C} m_j(D) m_k(E) + f(C) \\ f(C) = \sum_{C \cap D = \emptyset} \left( \frac{m_j^2(C) m_k(F)}{m_j(C) + m_k(F)} + \frac{m_k^2(C) m_j(F)}{m_j(F) + m_k(C)} \right) \end{array} \right. \quad (6)$$

In which,  $D, E, F \subset \{C_1, C_2, \dots, \Theta\}$ , BPA value  $m_j(\bullet) \subset M_j$ ,  $m_k(\bullet) \subset M_k$ ,  $m_{jk}(C)$  is a BPA value after fusion of the new evidence body  $M_{jk}$ .

After synthesis of every two evidences, the new evidence body obtained is to be processed by normalization, and element  $m'_{jk}(C)$  is obtained after normalization:

$$m'_{jk}(C) = \frac{m_{jk}(C)}{\sum m_{jk}(\bullet)} \quad (7)$$

In this paper, fault degree  $E^A$  of energy distortion, energy failure degree  $E^I$ , fault degree  $Y^{net}$  of improved RBF neural network and Bayesian fault of the body time sequence Bayesian fault degrees  $E^B$  are used as evidence bodies, the selection of its credibility which takes 1, 0.95, 0.9 and 0.8 respectively in this paper can be determined by statistical analysis or expert experience, and the improved D-S evidence theory of multi-source information fusion theory is being used as the primary method of research.

## CONCLUSION

And through the study of this paper discussed, the synthesis algorithms proves that D-S evidence theory in empowerment aspect compared to traditional experts is objective and accurate than empowerment method, and using the method of D-S evidence theory analysis, in the processing of data, we can calculate by statistical software with the corresponding formula editor, it can realize a simple, rapid and practical work requirements, efficiency is relatively high.

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