OWA DEMATEL

FMEA Method Combining OWA Operator and Fuzzy DEMATEL

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Abstract Considering the shortcomings of traditional failure mode and effect analysis (FMEA) method in practical application, a risk ranking method was proposed based on ordered weighted averaging (OWA) operator and decision marking trial and evaluation method (DEMATEL). FMEA experts make fuzzy evaluation on the three risk factors of the failure modes, and the evaluation information is aggregated by OWA operator to get the influence degree of the failure cause to failure mode. The initial direct-relation fuzzy matrix of the FMEA system is constructed by using fuzzy DEMATEL method, then the total-relation fuzzy matrix is calculated, and the reason degree of each failure cause is computed, based on which the product or system risk assessment is conducted. The proposed method is applied to safety analysis of the basic components of the metro car door system, and the feasibility and effectiveness of the method is verified by comparing with the results of the traditional RPN method.

Keywords Failure mode and effect analysis (FMEA), Risk assessment, Fuzzy number, OWA operator, DEMATEL method
1.2 DEMATEL

DEMATEL (Decision Making Trial and Evaluation Laboratory) is a method used to determine the cause-and-effect relationship among different factors. It is a combination of analytic hierarchy process (AHP) and regression analysis. The steps of DEMATEL are as follows:

1. Construct the survey matrix A, which is an n × n matrix.
2. Calculate the direct relationship matrix D:
   \[ D = \frac{1}{2} (A + A^T) \]
3. Calculate the total relationship matrix T:
   \[ T = \frac{1}{2} (D + D^T) \]
4. Calculate the degree of direct relationship matrix D:
   \[ D = T - D \]
5. Calculate the degree of indirect relationship matrix I:
   \[ I = T - D \]
6. Calculate the degree of total relationship matrix T:
   \[ T = D + I \]

Based on the above steps, we can analyze the cause-and-effect relationships among the factors and identify the major influencing factors.
$$\widetilde{T} = \lim\limits_{\lambda \to \infty}\left(\widetilde{X} \odot \widetilde{X}^2 \odot \cdots \odot \widetilde{X}^n\right) = \widetilde{X}(I - \widetilde{X})^{-1}$$

$$\bar{X} = (x_{ij})_{n \times n} = \bar{X} = (x_{ij})_{n \times n} = \bar{X} = (x_{ij})_{n \times n}$$

3. 计算故障模式的模糊重要度

$$T_1 = [x_{ij}]_{n \times n} = X_1(I - X_1)^{-1}, T_2 = [x_{ij}]_{n \times n} = X_2(I - X_2)^{-1}, \ldots, T_n = [x_{ij}]_{n \times n} = X_n(I - X_n)^{-1}$$

4. 确定各故障模式的模糊影响度

$$R_i = [r_{ij}]_{n \times n} = X_i(I - X_1)^{-1}$$

5. 计算各故障原因的模糊重要度和影响度

$$\bar{C}_i = [c_{ij}]_{n \times n} = \bar{C}_i = [c_{ij}]_{n \times n} = \bar{C}_i = [c_{ij}]_{n \times n} = \bar{C}_i = [c_{ij}]_{n \times n} = \bar{C}_i = [c_{ij}]_{n \times n}$$

6. 对比故障模式和故障原因的影响度

$$I_{ij} = \frac{r_{ij}}{c_{ij}}$$

7. 计算故障原因的模糊原因重要度

$$M_i = \sum_{j=1}^{n} I_{ij}$$

8. 计算故障模式的模糊影响重要度

$$O_j = \sum_{i=1}^{n} I_{ij}$$

9. 计算故障模式的模糊重要度

$$S = \frac{M_i}{O_j}$$

10. 判断故障模式的危险程度

- 高：$$S > 0.9$$
- 中：$$0.5 < S < 0.9$$
- 低：$$S < 0.5$$

11. 输出风险评估结果
FMEA

进行集结

言对故障模式的

所得结果如表

C F 1 2

密封胶条损坏

图

1. 车门切除指示灯不亮
2. 门页出现裂纹
3. 密封胶条损坏

方法确定的风险最大的故障原因为

R P N

3 × 8 × 2

1 FO1

2 FO1

OWA-DEMATEL

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### 表 2

<table>
<thead>
<tr>
<th>CF1</th>
<th>CF2</th>
<th>CF17</th>
<th>CF18</th>
<th>FM1</th>
<th>FM2</th>
<th>FM15</th>
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### 表 3

<table>
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<tr>
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</table>

### 参考文献


### 4.2 透明门

在恶意代码的执行过程中，我们可以通过以下方法来评估其行为。

1. **识别可疑文件**：查看其创建的服务、文件长度为0的文件。
2. **分析文件属性**：设置文件属性为系统，只读。
3. **观察端口**：查看其打开端口。
4. **检查文件使用情况**：文件被使用情况。

通常，这些指标可以用来评估恶意代码的行为，从而确定其是否为恶意代码。

### 参考文献


