

$$\text{Set } \partial L / \partial W_i = 0, \text{ then, } KW + \lambda e = 0 \quad (16)$$

Among equation (16),

$$K = \begin{bmatrix} \sum_{i=1}^m B_{i1}^2 + m - 2 & -(B_{12} + B_{21}) & \dots & -(B_{1m} + B_{m1}) \\ -(B_{21} + B_{12}) & \sum_{i=1}^m B_{i2}^2 + m - 2 & \dots & -(B_{2m} + B_{m2}) \\ \dots & \dots & \dots & \dots \\ -(B_{m1} + B_{1m}) & -(B_{m2} + B_{2m}) & \dots & \sum_{i=1}^m B_{im}^2 + m - 2 \end{bmatrix} \quad (17)$$

$$W = [W_1, W_2, \dots, W_m]^T \quad (18)$$

$$e = [1, 1, \dots, 1]^T \quad (19)$$

$$m = 3 \quad (20)$$

Weight vector W is calculated:

$$W = [0.3322, 0.2733, 0.3945]^T$$

Then standard searching decision matrix S after weighted is written as:

$$S = \begin{bmatrix} 0.0997 & 0.0788 & 0.1211 \\ 0.0518 & 0.0706 & 0.1165 \\ \dots & \dots & \dots \\ 0.0638 & 0.0761 & 0.1072 \end{bmatrix}$$

Ideal solution $S^+ = \{0.0040, 0.0027, 0.0093\}$

Negative ideal solution $S^- = \{0.1036, 0.0788, 0.1211\}$

The distance to the ideal solution of each solution

$$D_i^+ = \{0.1657, 0.1356, \dots, 0.1361\}$$

The distance to the negative ideal solution

$$D_i^- = \{0.0039, 0.0526, \dots, 0.0423\}$$

The relative close degree of each solution to the ideal solution

$$E_i = \{0.0232, 0.2796, 0.8919, 0.5257, 0.6986, 0.5233, 0.9030, 0.7334, 0.6377, 0.7432, 0.4052, 0.3540, 0.6105, 0.5262, 0.5004, 0.4382, 0.3266, 0.2951, 0.5202, 0.8856, 0.8478, 0.9328, 0.6724, 0.6028, 0.5949, 0.1833, 0.2831, 0.5207, 0.2432, 0.4362, 0.4278, 0.2370\}$$

According to value of E_i , order of searching scheme is determined. The scheme with the largest E_i should be search, detect and diagnose first. According to the above calculation search scheme, the rank of searching scheme is sorting for $X_{22}, X_7, X_3, X_{20}, X_{21}, X_{10}, X_8, X_5, X_{23}, X_9, X_{13}, X_{24}, X_{25}, X_{14}, X_4, X_6, X_{28}, X_{19}, X_{15}, X_{16}, X_{30}, X_{31}, X_{11}, X_{12}, X_{17}, X_{18}, X_{27}, X_{2}, X_{29}, X_{32}, X_{26}, X_1$ is shown in Fig.4

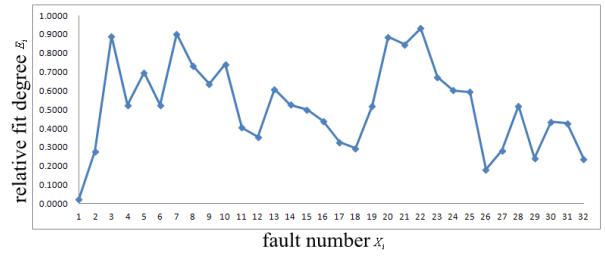


Fig.4 rank orders of searching scheme

If successfully searched, the diagnosis would be stopped. Otherwise, update the established fault decision matrix of fin stabilizer and the searching cost after test, in order to consider the previous results and the present detection result together, and then searching for a new solution until diagnosis is successful.

V. Conclusion

In this paper, on the basis of in-depth analysis of anti-rolling fin system, the fault tree model is established based on fault tree analysis method, and the main failure modes of anti-rolling fin system are found. Multi-objective optimization decision theory is applied, and multi-IF (impact factors) including fault probability, search costs and illuminating value provided by the searching are comprehensive considered, the most likely path to reach the problem solving is selected in the state space, and the optimal search strategy is determined. As the path of fault reason searching be simplified, the fault of anti-rolling fin system is quickly located, and the efficiency of diagnosis is improved, and it has use for reference for rapid fault location strategy of other complex systems.

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