

- Use the similarity plus the weights, and get the RUL of the target system, as follow.

$$\hat{y}(x) = \frac{1}{a} \sum_{i=1}^n (w_i Y_i) \quad (11)$$

VI. LIFE PREDICTION ANALYSIS OF GYROSCOPE

A. Traditional Statistical Life Prediction Analysis

In the gyroscopes' testing, we selected 5 gyroscopes as the test samples, and three samples failed under 100°C, 80°C, 60°C. Under 40°C, there were no samples failed, so we selected the pre-design time to stop the testing. After the testing, we extrapolated the performance and time under the 100°C, 80°C, 60°C, 40°C to the normal temperature 20°C.

Beside PACE, we first used the traditional reliability statistics method to get the character life of gyroscope. Fig.4 is the fitting result on Weibull model.

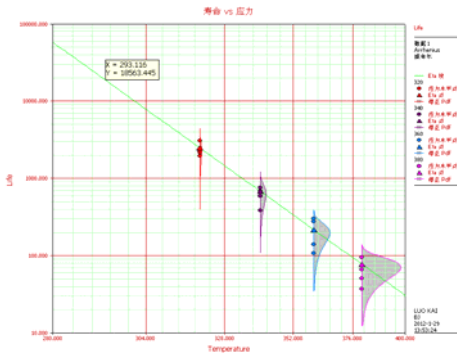


Figure 3. Life-Stress

B. Life Prediction Based on PACE

In PACE, we use the $|D(Y)y|$ of gyroscopes as degradation of performance to build up the degradation paths. Because the 40°C test data have no failure time, so we increased the failure threshold which gyroscopes have arrived the failure threshold under every stress. The Initial performance of gyroscopes is shown as below.

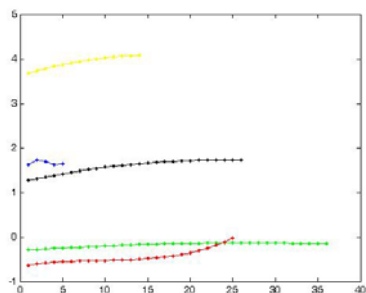


Figure 4. five gyroscopes' performance curves

For each gyroscope, we used the extrapolated performance as the target system to construct the kernel function and

calculate the weights. One of the gyroscopes' degradation path was built up as follow.

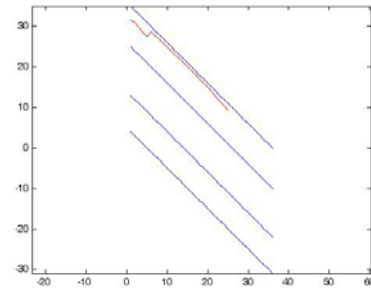


Figure 5. One gyroscope's degradation path

As Fig.5 shown, we can see that the pink curve is the target gyroscope's degradation path, and the blues are the other four gyroscope's degradation paths. At last, we got that the RUL of the five gyroscopes are respectively 20.3813, 64.6029, 35.4745 and 43.1495 months.

VII. CONCLUSION

Based on our research work, it is concluded that the traditional statistics methods can't solve the small samples products and give RUL of every product's. PACE can solve the problems above. More precisely, the traditional statistics distribution is just life evaluation method. At the same time, PACE life prediction method is not verified in this paper for lacking of the practical failure gyroscopes' performance and failure time. In the further, we will use the practical gyroscopes' historical failure data under normal stress to build the degradation paths and finish the verification work. With verified result, it is needed to improve PACE method in order to meet the engineering application needs.

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