Research on Structural Damage Identification Method for Aircraft Full Scale Fatigue Test

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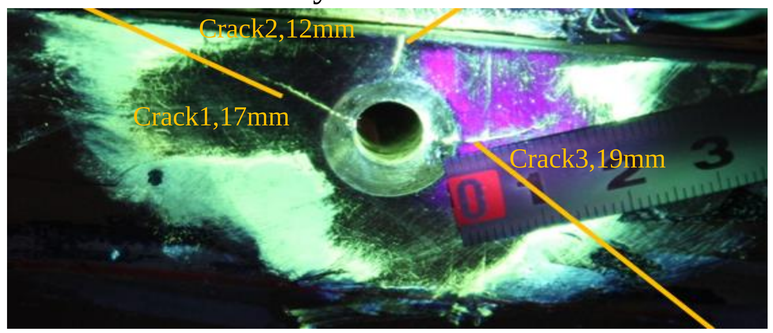
Problems

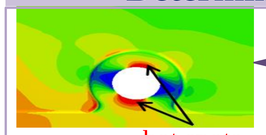
The size of structural fatigue cracks found by regular non-destructive inspection (NDI) for full scale fatigue test(FSFT) always was too large.

- Efficiency of direct damage monitoring is poor for complex structures.
- Strain monitoring is widely used for damage identification, but traditional methods lack sensitivity for short cracks.



Methods

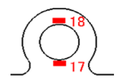
Determine hot spots



Determining hot spots by FEM simulation

hot spots

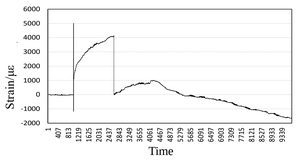
Optimizing gauge locations



Detect failure gauge

Feature:

- outrange;
- no response;
- always increasing /decreasing under random load



Data cleaning

- **Step1:** eliminating macro outliers using likelihood filtering method
- **Step2:** clustering data into k classes using K-means method so that avoid feature losing
- **Step3:** eliminating local outliers in each class using 3σ rule

Damage identification

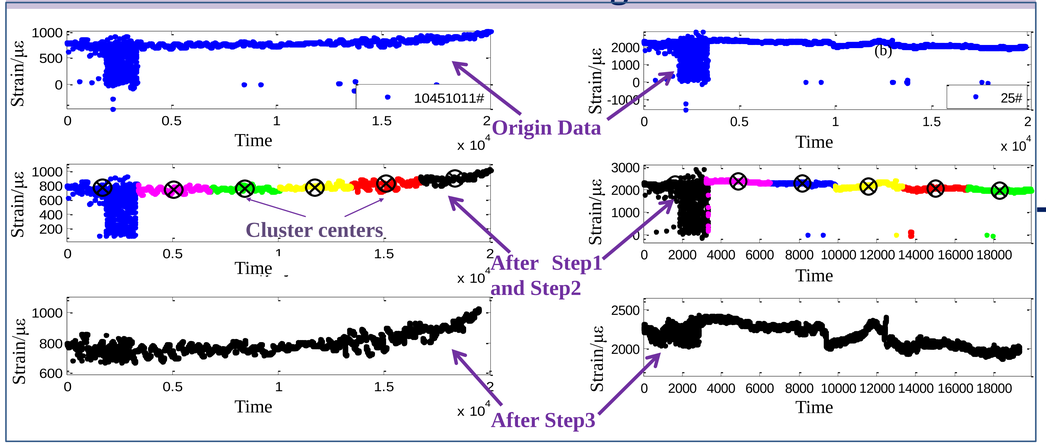
- a damage identification method based on the statistical characteristics of strain data
- deviation degree and deviation rate were took as quantitative indexes
- a self-adaptive dynamic damage criterion

Objectives

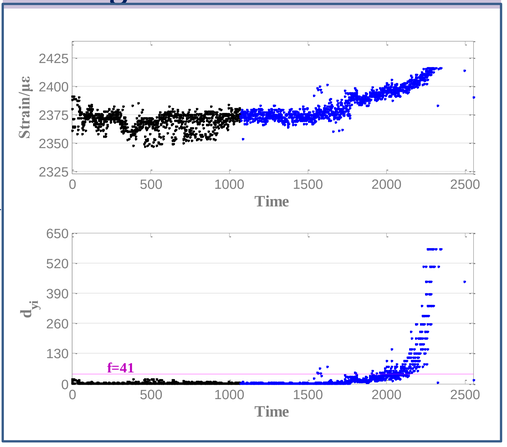
- **Establish a structural damage identification method for aircraft FSFT**
- **Avoid false alarm caused by failed strain gauge and poor data quality**
- **Improve the universality, sensitivity, and accuracy**

Results

Data cleaning



Damage identification method



Application

Applied and verified in aircraft FSFT, agree well with NDI results:

- several cracks were identified
- timelier and smaller in size

NDI verification