Aircraft structural integrity control technology based on structural damage monitoring

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Aircraft structural damage monitoring technology can directly monitor structural cracks, corrosion and other damages and damage levels through sensors installed on the aircraft, so that structural damage can be repaired in time to maintain structural integrity.
The structural damage monitoring technology can effectively shorten the detection interval period and timely discover the presence and extension of structural crack damage. An aircraft structural integrity control technology based on structural damage monitoring in this paper is proposed firstly, which includes critical part selection, sensor selection and installation, structural damage monitoring, structural repair, management after structural repair, as shown in Figure 1.

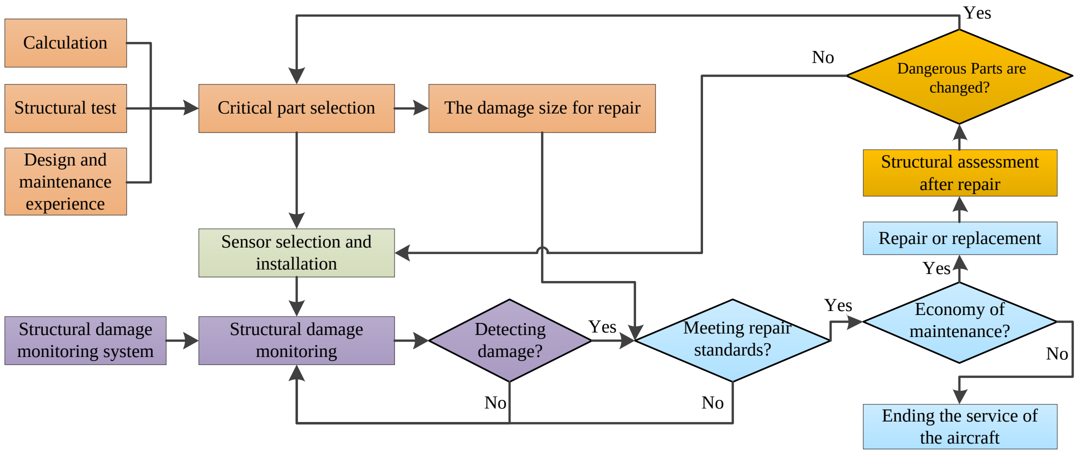

Fig 1. Block diagram of aircraft structural integrity control technology based on structural damage monitoring.

Then, principles and methods of selecting the critical components of aircraft structures are established to determine structural damage monitoring sites.
According to the characteristics of typical monitoring components, methods for the selection of sensors are put forward. Then, the damage maintenance methods commonly used in aircraft structures are expounded, and the management methods of the repaired structures are described. Finally, the challenges faced by aircraft structural damage monitoring technology are analyzed, and corresponding countermeasures are described in detail.
The aircraft structural integrity control technology based on structural damage monitoring proposed in this paper has the following advantages:
(1) Improving inspection efficiency and reducing maintenance costs. After the structural damage monitoring system is installed, the damage state of the structure can be monitored in real time. In the past, inspections that required a lot of crews, equipment, and time to complete can be completed by the monitoring system, which will greatly reduce inspection time and maintenance costs.
(2) Expanding the scope of detection, shortening the inspection intervals, and improving the safety of aircraft structure in service. Structural damage monitoring technology can realize real-time monitoring of difficult-to-access locations in daily maintenance, greatly expanding the scope of inspection, greatly shortening the inspection interval. The enlargement of inspection scope and shortening of inspection cycle can greatly improve the safety of aircraft structure.
(3) Extending the economic life of the structure. The critical parts that needed to be disassembled to be inspected, in the past, can be monitored in real time through the monitoring system. As long as there is no damage in the critical parts or the damage is within a limited range, the aircraft can always be used. This is equivalent to reducing the dispersion of materials and extending the service life of aircraft structures.
(4) Changing the design concept of the aircraft structure. The design and the maintenance procedures of a structure are the result of an optimization of multiple parameters such as loads, material, geometry, weight, manufacturability, maintainability and all associated costs. SHM systems are not expected to have direct

impact on each of them individually, but may yield in a better optimization of structures (e.g., weight, cost, etc.). This benefit is expected in longer term when reliability and durability of SHM technologies will be well established.

Keywords: Structural integrity control, Structural damage monitoring, Critical part selection, Aircraft structural repair