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Structural Health Monitoring in an Operational Airliner: An Intermediate Report on Leakage Monitoring with Percolation Sensors

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Materials in aircraft that are prone to corrosion need to be protected from a wet environment. But as a result of the intensive use of aircraft, respective coatings and seals can be damaged and aqueous liquids arising from spillage, condensation or rain can enter the confined spaces causing heavy corrosion of the respective structures. The presented SHM solution is intended to predict and eventually prevent corrosion by indicating the presence of corrosive liquids in those respective confined spaces.

A sensor was developed and implemented in operational airliners for detecting aqueous liquids that is interrogated in time intervals of app. 100 flight hours. The functionality of the sensor is based on the collapse of the percolation conductivity in an organo-ceramic composite containing a conducting compound which is embedded in a hydrophilic matrix. A typical sharp increase of resistance due to the ingress of liquids can be monitored in different ways, and it is even possible to read out the data during line maintenance using a simple multimeter.

Since April 2011, three operational airliners from Lufthansa were equipped with those percolation sensor networks (Boeing 737-500, Boeing 747-400) protecting the floor structure below galley and service doors areas. Already now, results are so convincing that Lufthansa-Technik was able to adapt maintenance procedures for floor structures. Moreover, first results also indicate that those sensor networks could essentially help reducing the maintenance and repair costs.

Even for the case that the fluid cannot be removed immediately, information on wetness provides a big added value to the maintenance operations, which leads to the possibility of an early allocation of repair resources - a realistic final target is the replacement of scheduled seal inspections.

In the meanwhile, the concept of the percolation sensor was extended to other liquids that are frequently used in an aircraft. An important application is e.g. the detection of hydraulic liquid or mineral oil-based lubricants and kerosene. For all those liquids, appropriate sensors were developed and implementation is partially under preparation. Finally, a small outlook will be given to the use of percolation sensors for crack detection as well.

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Ключевые слова:

Structural Health Monitoring, leakage monitoring, percolation threshold, corrosion prevention.

Содержание

Abstract

Introduction

Design of a percolation sensor for floor structures

Acknowledgement