Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 4, No. 12, December, 2018

Versions of Fiber-Optic Sensors for Monitoring the Technical Condition of Aircraft Structures

Nikolai L. Lvov [a*], Stanislav S. Khabarov [a], Alexander V. Todorov [a], Alexander A. Barabanov [a]

[a] *Research and Innovation Center "Institute for the Development of Research, Design and Transfer of Technologies", 119049, Moscow, Krymsky Val, 3, Building 2, Russian Federation*

Received 02 October 2018; Accepted 09 December 2018

Abstract

It is necessary to monitor the technical condition of various equipment due to the increased requirements for the safe operation of complex technical objects, such as bridges, structures, aircraft, cars and others. Monitoring systems based on the use of fiber-optic sensors measuring various physical quantities (temperature, deformation, pressure, vibration, etc.) are increasingly used for these purposes, since they have significant advantages over electrical sensors. The aim of the study is to compare the various options for the implementation of fiber-optic strain sensors to monitor the stress-strain state of the monitored object. A theoretical and experimental comparison of three types of fiber-optic sensors was carried out: on a mechanical fastener, sensors glued to the surface of a monitored design, and sensors embedded in a polymeric composite material at the stage of its manufacture. The requirements for the elements of the onboard systems of the aircraft according to the document "Environmental conditions and test procedures for airborne equipment QR-160D" are selected as comparison parameters. To assess the characteristics of various types of fiber-optic strain sensors, comparative bench mechanical and environmental tests were carried out. According to the test results, it was concluded that each type of sensor has its own advantages and disadvantages in comparison with each other, and in general, each of them can be used to create new standard systems for structural health monitoring of various units and structures of the aircraft (SHM systems). Also, the article proposed a new method of gluing a fiber-optic sensor to a controlled structure. This method - the use of specialized equipment, providing convenience and stability of gluing.

Keywords: Helicopter; HUMS; SHM; FBG; Fiber-Optic Deformation Sensor; Composite Material; Deformation.

1. Introduction

At the stage of testing the structures of the aircraft in order to determine their physico-mechanical characteristics, various methods of destructive and non-destructive testing are used, such as ultrasonic, acoustic, thermal, optical and other methods [1].

Measurements of individual parameters of the structure, such as stress-strain state, temperature, acoustic density of the material, changes in the linear dimensions of the structure and others, during the tests allow to determine the technical condition of the structure and assess the stability and susceptibility of the structure to external influencing factors (load, temperature, pressure, vibration, etc.). This information is necessary both when developing a new design and when confirming the characteristics of existing structures during their operation (qualification, type tests, etc.).

* Corresponding author: v_vikulov@nicirt.ru

http://dx.doi.org/10.28991/cej-03091206