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Development of a New Bio-Inspired Mobile Sensing System

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Sensing system (such as fiber, strain gauge, piezoelectric wafer) is a core component for a health monitoring system. Generally, sensors in any sensing system that transmit and /or receive diagnostic information are often adhered on the surface of structure, or embedded into the structure. Therefore, once established, the sensing system can not be changed. Both installation methods have the following problems: 1) the location of sensors are predefined and fixed, which means that lots of sensors are required to monitoring the whole structure area and results in the increase of structural weight and the system cost. 2) The life of sensors bonded on or embedded into the structure would be shorter than that of the structure, which would lead to the loss of monitoring capability in the service life. 3) The structural integrity would be affected, especially in the service process.

To overcome above shortcomings, this study focuses on the guided wave structural health monitoring to develop a new concept of mobile flexible sensing system based on piezoelectric wafer. This new idea is inspired by the nature species, such as that the gecko can randomly fixed on and flexibly move in a vertical wall on the basis of the negative pressure. The presented mobile sensing system is fitted for the inspection or monitoring of large structures, especially, a large aircraft structure such as wing, fuselage, and tailplane. This study discusses three key issues on designing mobile sensing system. The first issue involves with how to design a structure with vacuum absorbability or negative pressure. The second issue is how to make the piezoelectric wafer couple with the hot structure to excite the uniform diagnostic wave. The last issue is concerned with how to make the device to flexibly move. The preliminary experimental results show that the proposed mobile sensing system is feasible in an Aluminium plate. The contribution of this study is that the mobile sensing system can flexibly move on the structural surface anytime, and fixed at the desired location anywhere, meanwhile, the proposed mobile structural health monitoring system can be used not only in the flight process, but also in the ground maintenance stage to improve inspection efficiency.

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Ключевые слова:

Содержание

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