World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:11, No:12, 2017

A Study of Fatigue Life Estimation of a Modular Unmanned Aerial Vehicle by Developing a Structural Health Monitoring System

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Abstract : Unmanned aerial vehicles (UAVs) have now become of predominant importance for various operations, and an immense amount of work is going on in this specific category. The structural stability and life of these UAVs is key factor that should be considered while deploying them to different intelligent operations as their failure leads to loss of sensitive real-time data and cost. This paper presents an applied research on the development of a structural health monitoring system for a UAV designed and fabricated by deploying modular approach. Firstly, a modular UAV has been designed which allows to dismantle and to reassemble the components of the UAV without effecting the whole assembly of UAV. This novel approach makes the vehicle very sustainable and decreases its maintenance cost to a significant value by making possible to replace only the part leading to failure. Then the SHM for the designed architecture of the UAV had been specified as a combination of wings integrated with strain gauges, on-board data logger, bridge circuitry and the ground station. For the research purpose sensors have only been attached to the wings being the most load bearing part and as per analysis was done on ANSYS. On the basis of analysis of the load time spectrum obtained by the data logger during flight, fatigue life of the respective component has been predicted using fracture mechanics techniques of Rain Flow Method and Miner's Rule. Thus allowing us to monitor the health of a specified component time to time aiding to avoid any failure.

Keywords : fracture mechanics, rain flow method, structural health monitoring system, unmanned aerial vehicle
Conference Title : ICSHMST 2017 : International Conference on Structural Health Monitoring Systems and Technologies
Conference Location : Rome, Italy
Conference Dates : December 11-12, 2017

Open Science Index, Structural and Construction Engineering Vol:11, No:12, 2017 publications.waset.org/abstracts/80617.pdf