World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:9, No:09, 2015

Vibration Analysis of a Solar Powered UAV

Authors : Kevin Anderson, Sukhwinder Singh Sandhu, Nouh Anies, Shilpa Ravichandra, Steven Dobbs, Donald Edberg

Abstract : This paper presents the results of a Finite Element based vibration analysis of a solar powered Unmanned Aerial Vehicle (UAV). The purpose of this paper was to quantify the free vibration, forced vibration response due to differing point inputs in order to mimic the vibration induced by actuators (magnet in coil generators) used to aid in the flight of the UAV. A Fluid-Structure Interaction (FSI) study was performed in order to ascertain pertinent deigns stresses and deflections as well as aerodynamic parameters of the UAV airfoil. The 10 ft span airfoil is modeled using Mylar as the primary material. Results show that the free mode in bending is 4.8 Hz while the first forced bending mode is in the range of 16.2 to 16.7 Hz depending on the location of excitation. The free torsional bending mode is 28.3 Hz, and the first forced torsional mode is in the range of 26.4 to 27.8 Hz, depending on the location of excitation. The FSI results predict the coefficients of aerodynamic drag and lift of 0.0052 and 0.077, respectively, which matches hand-calculations used to validate the Finite Element based results. FSI based maximum von Mises stresses and deflections were found to be 0.282 MPa and 3.4 mm, respectively. Dynamic pressures on the airfoil range of 1.04 to 1.23 kPa corresponding to velocity magnitudes in the range of 22 to 66 m/s.

Keywords : ANSYS, finite element, FSI, UAV, vibrations
Conference Title : ICTAM 2015 : International Conference on Theoretical and Applied Mechanics
Conference Location : Los Angeles, United States
Conference Dates : September 28-29, 2015