Towards Space applications of SHM technology relied on EMIS method

D. Enciu¹, I. Ursu¹
¹INCAS – National Institute for Aerospace Research “Elie Carafoli”
Bucharest, Romania
enciu.daniela@incas.ro; ursu.ioan@incas.ro

Summary
This paper is based on a complex tests program in which specimens representing spacecraft structures, defined by aluminum discs with central bonded piezoelectric wafer active sensors (PWAS), were subjected to laboratory simulated harsh conditions of outer space, namely to extreme temperature variations, radiations, and vacuum. A method for online identification of the damages based on neuronal network is presented.

INTRODUCTION

- The temperatures considered in the tests ranged from −196°C ≤+200°C; the pressure was between 1 ÷ 10⁻⁹ Pa
- The maximum irradiation dose per irradiation step was set to 2.35 kGy
- The purpose of these tests was to demonstrate the operability, survivability, and durability of the PWAS in extraterrestrial environmental conditions in order to be used in the structural health monitoring (SHM) technology for future spacecraft

RESULTS

- Resonance frequencies shift to smaller frequencies as the temperature increases
- The radiations does not produce any significant changes on the EMIS (Electromechanical Impedance Spectroscopy) signature
- The mechanical damages leave their fingerprint on the EMIS characteristic: few splittings of the resonance frequencies occur
- The new resonance peaks are more numerous as the distance from the damage to the sensor decrease

DISCUSSION

- The effects on EMIS signature induced by the environmental conditions can be differentiating from the effects specific to the mechanical damage
- Two algorithms for damage identification are proposed
- Using neural networks (NN), the damages can be identified in real time
- Algorithm will give at output a quickly increased of the error, which in fact will mark the appearance of the damage

CONCLUSIONS

- The results show that the sensors, the adhesive, and the disc specimen with bonded PWAS have passed with success the tests in harsh environmental conditions keeping at high standards their capability of structure’s health monitoring
- Moreover, algorithms of real time damages identification were developed
- Acknowledgements. The financial support of the National Authority for Scientific Research–ANCS, UEFISCSU, through STAR research project code ID 188/2012 is gratefully acknowledged