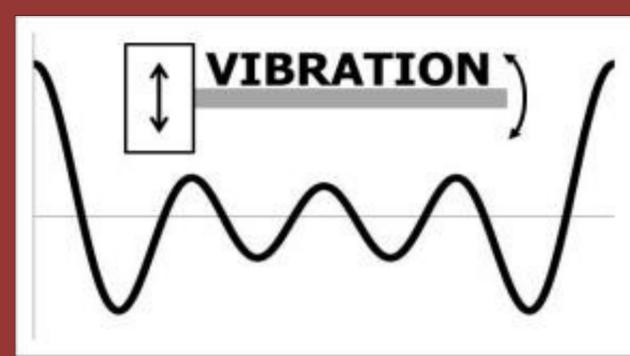# Global in-flight health monitoring platform for composite aerostructures based on advanced vibration based methods

↕ VIBRATION

Introduction

- Composite Materials have a *wide range of applications* in land transportation, aerospace and marine structures.

- They present many advantages compared with metals for the same applications.

- As composites are becoming increasingly popular in aerospace applications the market for Structural Health Monitoring (SHM) will be increasing in the near future.
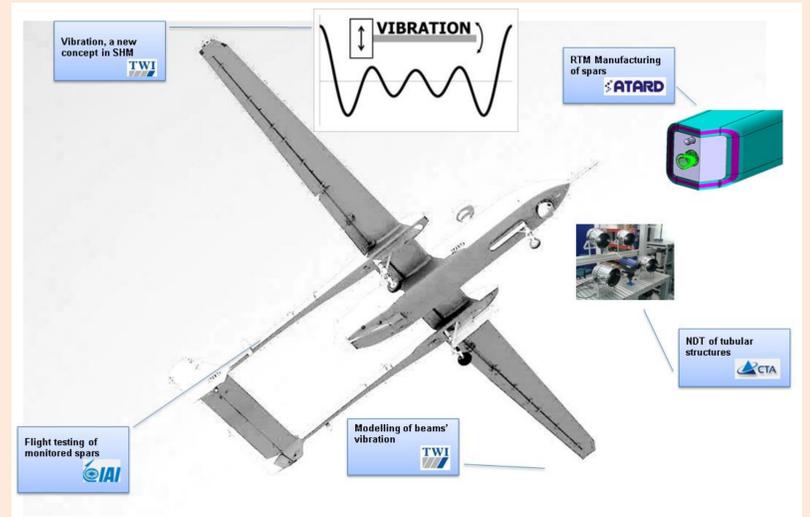

Concept

- Development of an innovative in-flight *SHM* platform for aerostructures based on a small (minimal) number of vibration sensors.
- Global vibration-based SHM methods are developed for assessing the health state of composite structures under significant uncertainty.
- The SHM methodology should work for a population of similar structures and achieve both damage detection and localization.

Novelty of the Research

- The main practical problem for the application of vibration based SHM methods in real world aircraft parts is the high number of "training experiments" that are normally required for a successful fault detection, identification and localization.

- In the present project the real world training experiments are kept to a minimum by various techniques, including the use of simulated experiments using a proper analytical model.

Experimental procedure

SPECIMENS → IMPACT TESTS → NDT INSPECTIONS → PRELIMINARY CONCLUSIONS

- <u>Manufacturing</u>: *40 beams* (CF/Epoxy) were manufactured
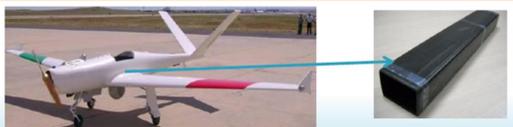
- <u>Impact campaign</u>: 3 impacts were applied with three different energies (5,10,15J) in three different specimens

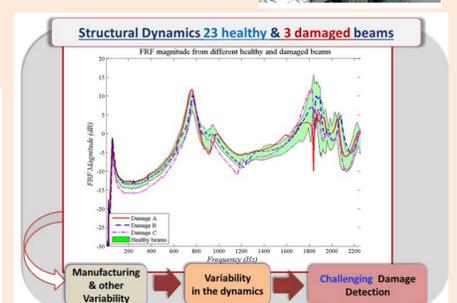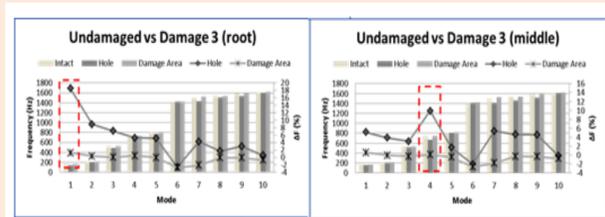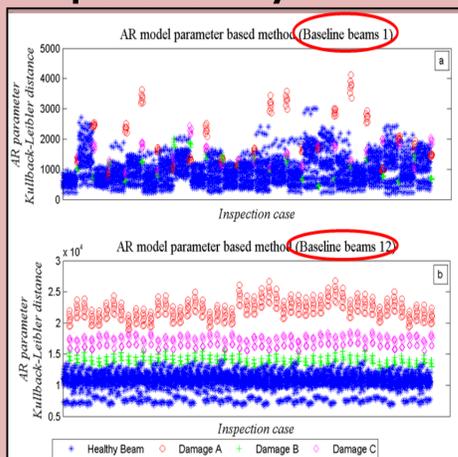- **NDT**: *IRT inspections* were conducted before and after the impacts. Before the impacts no significant defect was detected. After the impacts delaminations were detected.
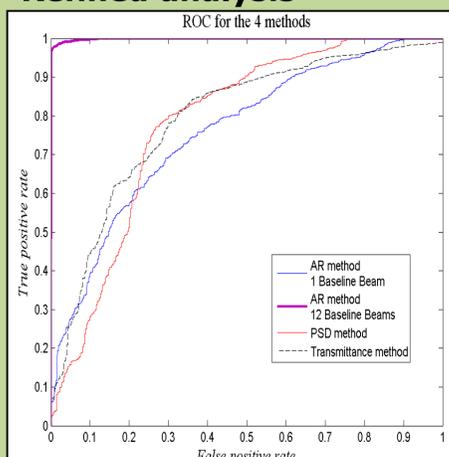
- **FEA**:

Structural Dynamics 23 healthy & 3 damaged beams

Improved analysis

Refined analysis

Foreground produced

- Novel **stochastic SHM methodologies** have been developed for effective diagnosis under uncertainty. The mathematical analysis can provide 100% true positive identification of impact damage

- **Actual aircraft booms** confirmed the success of determining damage in real parts
- **Prototype DAQ system** operated in industrial environment
- **Simplified GUI** for ease of use by engineers

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