TRACK 5: AVIATION TRAINING / MRO

"SELF-HEALING TECHNOLOGY FOR AIRCRAFT COMPOSITE STRUCTURE REPAIR"

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ABSTRACT

There is a considerable interest towards the achievement of self-healing properties in composite materials. Traditionally, once damage has been detected within a composite structure, the approach has been to undertake cosmetic temporary structural repairs, ranging from simplistic external patches to complex intrusive tapered or stepped scarf repairs with the aim of restoring some of the material stiffness and strength. However, engineers have started to design structures that have some form of damage tolerance, which is ability for the structure to sustain representative weakening defects under representative loading and environment without suffering reduction in residual strength for a period of aircraft service.

Fibre-reinforced composite materials are widely used, especially in the aerospace industry. The concept of repair by bleeding of enclosed functional agents serves as the biomimetic inspiration of synthetic self-repair approaches which are mainly depending on advancement in polymeric materials. In general, this process is the inspiration for the application of self-healing fibres within the composite materials.

One of the common techniques for aircraft repair involves removal of the damaged area with extensive machining operations, followed by replacement, usually with wet prepreg laminate and bagging. Such repair technique can be effective and may last long on an aircraft skin, but it is less efficient and time-consuming to carry out and not very environmentally-friendly due to the nature of composite material, resin and adhesives in disposal. Some successful self-healing systems have been tested in the past which are usually based on a media contained within the structure and bleeding into the structure plies as a result of damage. The healing medium may be stored within the structure by incorporating into either individual particles or capsules or into a Micro-vascular system.

The extensive usage of carbon-fiber composites in aircraft offers the opportunity to develop and improve a new clean technology for aircraft structural repair. This technology may well draw upon the successful outcomes of this research project which is conducted in this field.

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BIOGRAPHY OF SPEAKER

Having an educational background spanning various countries, Dr Hamid received his PhD and MSc degrees in Aerospace Eng. from University of Manchester, two MBS Postgraduate Certificates in International Business and Banking & Finance from Manchester Business School, and a 1st-class BEng in Mechanical Eng. from Tehran University. He has been working in UK, Iran, UAE, Malaysia and Singapore as an aircraft design engineer, lecturer, technical manager and consultant over the past 20 years.

Hamid has been teaching at several higher-education institutions such as UK's University of Manchester, Iran's Amir-kabir University of Technology, University of Science Malaysia (USM), Taylor's University/College in Kuala Lumpur, Singapore Institute of Technology (SIT), Republic Polytechnic and UK's Newcastle University International Singapore (NUIS).

Dr Hamid was Deputy Director in Aircraft Design for both Avcen Limited UK and Malaysia for four years. Hamid has been Associate Dean of American Degree Transfer Program at Taylor's University /College in Kuala Lumpur before joining Republic Polytechnic in Singapore as Senior Academic Staff on Feb 2011.

Hamid has been working on several R&D projects related to civil aircraft design and manufacturing, thrust-vectoring technology and experimental aerodynamics. He had a joint research with UK's Cambridge University and Imperial College in London on "Advanced Materials in Extreme and Hostile Conditions" funded by UK's Department of Trade and Industry. He is the co-principal in a technology innovation fund from Singapore's Ministry of Education for a joint research with NUIS, titled 'In-situ healing of damaged composite aero-structures'.

Dr Hamid has a total of 45 papers and technical reports in Engineering and Technology and 27 in Management and Education.