SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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INFLATABLE MANNED MODULES: DEVELOPMENT OF A SMART INTERNAL BARRIER FOR BLADDER PROTECTION AND HARNESS ROUTING

Abstract

The inflatable structures are one of the emerging space technologies that can potentially enable the evolution of large space infrastructures, including manned habitats. Many of the future missions will potentially need inflatable structures to achieve reduced volumes and mass at launch, coupled with high on-orbit deployable volumes. As a matter of fact there is a growing demand for large space structures to cope with the increasing challenges posed by future exploration missions. In Thales Alenia Space are under development the technologies for the realization of new generation manned inflatable modules. These innovative modules are envisaged to provide a valid alternative to the use of traditional metallic modules, with the aim of enhancing the comfort of the astronauts. The various application spans from ISS expansion to long range exploration, allowing the establishment of outposts on Moon and Mars. A typical manned inflatable module is a multifunctional complex system composed by several layers in which each one of them has to accomplish a specific function. The following layer stratification is the basic design approach:

- Internal barrier (the innermost layer in contact with the habitable volume for fire and puncturing protection);
- Bladder (air containment);
- Structural restrain (pressure containment);
- MMOD micro meteoroids and orbital debris protection;
- MLI Multi-layer insulation (thermal and atomic oxygen protection).

The R&D here presented is focused on the Internal Barrier, in particular, it has been investigated the possibility to embed wires inside this barrier during the very same fabric weaving process, to be used for

small power or/and signal delivering in almost any part of the internal surface of the inflatable manned module, to feed for examples pressure, temperatures, humidity and leak detection sensors. The objective is to give added value to the purely initial passive function of this barrier evolving towards a "smart" multiple functions barrier. Starting from a Kevlar fabric, three different cables typologies have been embedded during weaving process:

- Traditional copper cables
- Conductive Kevlar yarn
- Optical fibres

The performances of the cables have been tested pre and post weaving and the results have been compared. The copper cables and the conductive Kevlar have maintained a good performance even after weaving, resulting in a flexible conductive internal barrier. The optical fibre performance has been affected by the weaving process, making too risky the application of this technology without improving some aspects of the current design and implementation.