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Research and innovation for industry

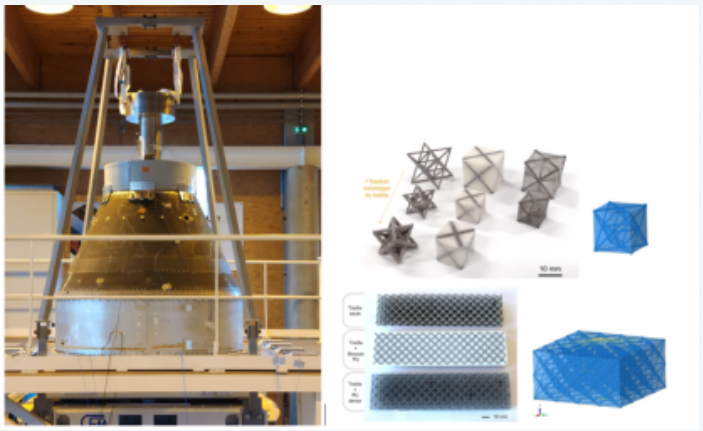
Partnership Ingenierie@Lyon & Energies du Futur Carnot Institutes - AVNIR Engineering

New high-tech vibration absorbers that boost the reliability of sensitive on-board equipment

AVNIR Engineering has carried out experiments to validate innovative vibration absorbers that cater to the needs of the aerospace industry. Mateis lab (Carnot Ingénierie @ Lyon) has developed and enhanced the technological readiness level of a new hybrid material that dampens vibrations when satellites are being put into orbit (a requirement of Ariane Group).

Supporting Innovation

On-board equipment is very sensitive to vibrations and this tends to shorten its lifespan. To compensate for this and avoid having to design oversized structures, we need high-performance vibration isolators or — better still — to integrate the damping function into the structure itself. The INCAS collaborative project, coordinated by AVNIR Engineering, has come up with a hybrid composite that dampens vibrations in the upper stages of future Ariane Espace launchers. It consists of a stiff wire mesh obtained using additive metal manufacturing techniques and filled with a light polymer foam with a damping effect. Thanks to the foam, this material dampens vibrations by a factor of 10 compared with an equivalent module while limiting any increase in mass. Mateis lab, which is part of Carnot Ingénierie@Lyon, has managed to obtain TRL4 validation (on a nine-level technological readiness scale) based on multi-scale characterization of the composite and its constituent elements, and on small-scale, followed by larger-scale testing. The project also enabled AVNIR Engineering to design and build a scale 1 test bed for TRL6 experimental validation of innovative elastomeric and wire rope vibration isolators.



The client needs

The INCAS project has brought together four major groups, four SMEs (including AVNIR Engineering, which heads up the project), and two research labs — Mateis (Carnot Ingénierie@Lyon) and SiMaP (Carnot Energies du futur) — to devise solutions that cater to the needs of four major aerospace corporations especially those of Ariane Group by securing the low-frequency vibrational environments of satellites on future launchers. Dampening low-frequency vibrations (i.e. 5 Hz - 100 Hz) on satellite launchers is key to mission success and, in order to comply with all specifications and limit the number of iterations, structures have now become far too big. AVNIR Engineering, an SME with around fifty employees, tasked with experimentally validating the damper systems on an operational demo, devised and conducted validation testing of the vibration isolators developed in the frame of the project. Moreover, to ascertain the process engineering potential of the new hybrid composite material, characterization testing performed by Mateis indicated a technological readiness level of TRL4. This is the first step in the tricky process of integrating the vibration damping function into the components of satellite launchers themselves.

Partnership

Mateis (Carnot Ingénierie @ Lyon), part of INSA Lyon engineering school specialised in materials science, provided AVNIR Engineering with all of its expertise in analysing the microstructure and mechanical properties of composite materials. Mateis also modelled the innovative co-continuous hybrid material, composed of an open wire mesh structure filled with a lightweight polymer foam whose damping properties comply with Ariane Group technical specifications. Mateis came up with the materials for the wire mesh structure and foam while SIMaP (Carnot Energie du futur) harnessed all of its expertise in Electron Beam Melting 3D printing and in the architectural design of the metal structure.
Thanks in part to a joint thesis conducted by the two research labs, this fruitful venture has come up with a new material whose vibration damping performance has been validated (i.e., at TRL4 level) by larger-scale testing. Moreover, scale 1 benchmark testing has enabled AVNIR Engineering to demonstrate the TRL6-level damping properties of the vibration isolators. The results of all of these different tests have convinced Ariane Group programme managers of both the usefulness and the technological readiness of the solutions in question.

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