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STRUCTURAL HEALTH MONITORING AS AN ENABLER FOR SPACE 4.0

Abstract

Launcher structures are traditionally designed with conservative sizing methodologies, incorporating safety margins and knock-down factors to mitigate uncertainties in the launch environment. However, this approach often results in heavy and costly designs. Alternatively, leveraging Health Monitoring Systems (HMS) offers a promising avenue for optimizing structures throughout their lifecycle. By providing real-time data on environmental parameters such as strain, temperature, pressure, and acceleration, HMS enables tailored structural design, assessment of remaining margins, and efficient issue resolution, and represents a key enabling technology for the development of reusable structures.

This paper presents our strategy for developing a structural health monitoring system, focusing on payload fairings. Through a comprehensive technology trade-off, we identified fiber optical sensors (FOS) as the optimal monitoring technique due to their maturity and versatility in measuring multiple parameters simultaneously. We then evaluated the integration of this HMS into our manufacturing processes, exploring various methods for incorporating FOS in sandwich panels at a coupon level. Our investigation demonstrated consistent results with conventional measurement techniques and no adverse effects on mechanical performance.

Among the integration methods considered, discrete adhesive bonding emerged as the most compatible with our manufacturing processes. This technique was subsequently applied to a section of a real structure, confirming its accuracy in measuring strain, temperature, and pressure. These successful tests validate our approach and signify a significant step towards implementing health monitoring systems in our structures, enhancing value for our customers.

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