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# Feasibility Study of Rayleigh Backscattering Optical Fibre Strain Measurement Technique for Determining the Thermal Expansion of Lightweight Composite Structures

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The determination of the thermal expansion of lightweight composite structures, such as honeycomb panels is of great interest for various high added value industries. However, those measurements are challenging, as they are typically not possible with with well-established methods due to their complex geometries. In this study, we investigate the feasibility of using the Rayleigh backscattering optical fibre strain measurement technique to determine the thermal expansion of composite structures.

To determine strain using Rayleigh backscattering technique, an optical fibre is attached to a surface. When the surface experiences deformation, the deformation causes strain in the fibre, which leads to changes in the backscattered light intensity. However, in this study, we propose a novel approach where the fibre is only bonded in two points, allowing to decouple thermal effects over the fibre by comparison with an unstrained fibre. To validate the feasibility of this technique, CTE measurements obtained with Rayleigh backscattering technique over well-known materials, as invar, were compared with measurements over the same materials performed with a horizontal push-rod dilatometer. Our results show that this novel approach is a practical method for determining the thermal expansion of assembled composite structures. The technique is non-destructive, requires minimal sample preparation, and can provide high-accuracy measurements. These findings have significant implications for the design and optimization of composite structures in various applications, such as particle detectors, aerospace, and automotive industries.

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