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Quantitative analysis of QSI and LVI damage in GFRP unidirectional composite laminates by a new ultrasonic approach

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Abstract

Our work is focused on a new experimental approach for the comparison between Quasi Static Indentation (QSI) damage and Low-Velocity Impact (LVI) damage in polymer composites starting from the results of ultrasonic goniometric immersion tests. In particular, the comparison is performed through the analysis of the additional anisotropy induced by the damage in unidirectional Glass Fiber-Reinforced Polymer (GFRP) composites due to QSI and LVI damage tests performed with a low level of the employed energy. To this aim, we ultrasonically reconstruct the acoustic curves (velocity curves and slowness curves) before and after the damage. Ultrasonic experiments are performed by using a goniometric ultrasonic immersion device designed and built at our laboratory, aimed at the mechanical characterization of anisotropic materials. We highlight differences and similarities between QSI and LVI damage starting from the analysis of the variations of the acoustic behavior and by using a suitable anisotropic damage model developed in the framework of the Continuum Damage Mechanics theory. The proposed experimental approach can be suitably developed for in situ investigations on low-velocity impact damage in polymer composite components.

Keywords:

- A. Low Velocity Impact test*
- B. Quasi Static Indentation test*
- C. Damage induced anisotropy*
- D. Continuum Damage Mechanics*

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