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IMPACT DAMAGE DETECTION IN COMPOSITE LAMINATE PLATES USING AN INTEGRATED PIEZOELECTRIC SENSOR AND ACTUATOR COUPLE COMBINED WITH WAVELET-BASED FEATURES EXTRACTION APPROACH

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Summary: The identification of impact damage in composite laminates is a crucial issue for any structural health monitoring (SHM) program. In this paper, an experimental campaign developed for the delamination detection in carbon fiber composite plates (CFRP) due to low velocity impacts (LVI) is presented. The damage identification concerns the detection of different damaged plates impacted with various energy values. The experimental procedure starts with the analysis of the position for dedicated piezoelectric (PZT) patches, both regarded for actuation than for sensing purposes. A finite element model (FEM) of the laminated plate is implemented for the analysis of suitable areas for the location of the PZT devices. Then an algorithm based on the Wavelet packet transform (WPT) is applied to the vibrating dynamic response of the plate in order to extract Wavelet-based damage sensitive features, showing its considerable benefit with respect to Fourier-based damage detection . A Linear Discriminant Analysis (LDA) is then applied on the extracted features in order to build an efficient configurations classifier. A damage indicator based on the Euclidean distance is hence assessed by comparing the undamaged and damaged states. Results obtained show that the proposed pattern recognition procedure constituite a relevant SHM technique for structures subjected to LVI.