DEVELOPMENT OF A SMALL-SCALE & LOW-COST SHM SYSTEM FOR THINWALLED CFRP STRUCTURES BASED ON ACOUSTIC EMISSION ANALYSIS AND NEURAL NETWORKS

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This study presents the development process of a low-cost & small-scale Structural Health Monitoring System (SHM) for thin walled carbon fiber reinforced plastics (CFRP) structures based on acoustic emission (AE) analysis. It covers the inherent geometric complexity and anisotropic properties of CFRP structures through the implementation of an artificial neural network (ANN). The system utilizes piezoelectric sensors, a data acquisition unit and a microprocessor with a trained ANN in order to localize events that result from artificial sound sources. Besides high precision in localization the system is scalable and adaptive through adequate design and training of the ANN and system hardware. Especially for CFRP, nowadays well established for lightweight applications in the aerospace and automotive industry, such a system helps to overcome their major downside, their sensitivity towards impact loading. Impact sources like bird strikes, tool drops or stone debris can be the cause for delaminations that can result in a severe drop of stiffness and early catastrophic failure. In order to guarantee structural integrity, CFRP structures therefore need to be inspected via non-destructive testing methods on a regular scheme. Due to its passive nature and in-situ capabilities AE-based SHM can reduce cost and down-time that come with regular inspections as an alternative approach that allows for a condition-based inspection scheme.