# Structural state awareness of composite structures by blending passive and active acoustic-based health monitoring methods

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**ABSTRACT**

Structural state awareness implies that existence, location, type and size of damage should be known at any given time of a structure's life, enabling the engineering team to assess the structural integrity and make proper decisions about the structure's maintenance plan. Sensing equipment should be embedded or permanently attached at the structure in order to provide health monitoring data. It is well known that one technique cannot solely perform all the measurements required to describe the state awareness of a composite structure and a combination of at least two techniques is needed.

This study aims to demonstrate the effectiveness of blending passive and active acoustic-based health monitoring methods. A composite plate was subjected to a low velocity impact by performing quasi-static indentation tests where a loading-unloading-reloading test profile was adopted. Acoustic emission (passive method) was used to determine if damage occurred and its type, while lamb waves (active method) were used to locate and size the damage. Two acoustic emission broadband sensors and two series of 5 PZT sensors each were attached at the surface of the plate. Acoustic emission was employed during the loading and reloading phases of the indentation tests while scanning of the plate with the lamb waves took place when the structure was unloaded. Multiple actuator-receiver paths were selected and each PZT emitted a five-cycle hanning window signal of several frequencies.

Results showed that acoustic emission successfully provided information, whether and at which load damage occurred, indicating its severity. It was found that results about location and size, provided by lamb waves, were sensitive on the selected frequency and the employed signal processing methods. Overall, it is concluded that acoustic based methods have the potential to provide useful information about the state awareness, however a fine-tuning on selected input parameters, especially when it comes to sizing and localization, is needed.