car body shell doors and interiors

An initial acousto-ultrasonic experimental investigation of defects in composite specimens used in the transportation domain

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Recently, the transport industry has been moving away from metal parts in vehicle-bodies, rather employing composite materials for certain elements. In particular, composites are the new trend in the aviation and transport industry because of their properties such as increased strength, higher stiffness and reduced weight.

Because of these properties, composite materials can be beneficial also in the railway industry: the adoption of these new materials in the stage of product design and development could improve the already top-notch environmental sustainability of railway transport, one of the cleanest transport modes. The reduced weight of composites is especially noteworthy, as the lower the weight of the train carbodies, the lower the train energy impact.

Because of this reason, reducing the rail carriage mass by changing the steel parts with composite components is the primary action taken for the next generation of trains to introduce energy savings.

However, it is necessary to develop inspection and monitoring tools to detect, identify and measure occurred damage or deterioration state of transport means and infrastructure such as Non-Destructive Testing (NDT) and Structural Health Monitoring (SHM). While NDT is used to inspect engineering structures in order to detect and identify flaws (cracks, inclusions, internal voids etc.), inhomogeneity in microstructures, loss in thickness, deformation and so on, a typical SHM system consists of an array of connected sensors, which collect data during the service life of the means and infrastructure in a continuous manner.

The main objective of such system is to locate, detect and identify any occurred damage or decay state that takes place over the service life.

Acousto-ultrasonics is a non-destructive testing which can be characterised as a type of Acoustic Emission simulation with ultrasonic simulation of stress waves to assess defect states in certain materials, a widespread methodology within the SHM research.In this paper, the researchers performed two sets of experiments using the Mistras Micro-SHM system on composite material specimens.

The first set of experiments comprised the measurement of the attenuation of Acoustic Emission produced by Pencil Lead Breaks (PLB), indicating the impact of the reflection from its edges.

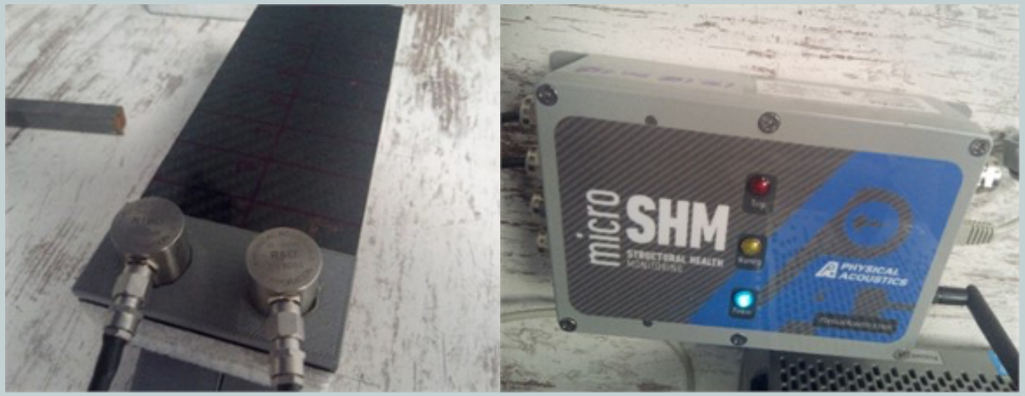

Fig. 1 – Overview of the experimental layout with specimen and sensors; mistras micro-SHM wireless AE acquisition system

The second set of experiments included trials with no defect and two configurations of defects, in order to show that the defects could be identified using two features of the signal.

The authors showed that the defects can be identified by one Acoustic Emission sensor, since the energy count and the amplitude are reduced in the presence of defects. These findings are indeed promising for future works on Non-Destructive Testing and Structual Health Monitoring, opening the way for the possibility of detecting defects – and improve railway safety – through innovative systems.

Link to the entire paper

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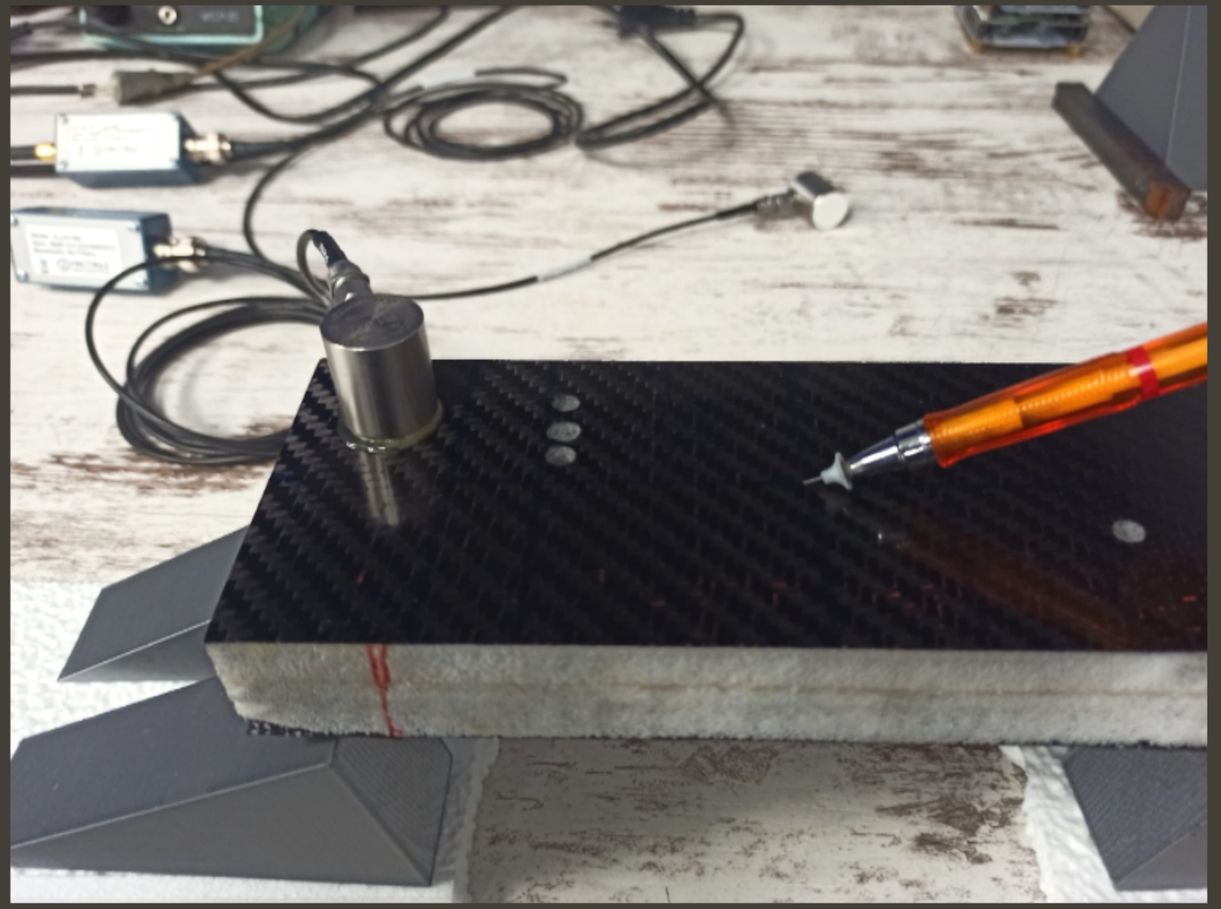
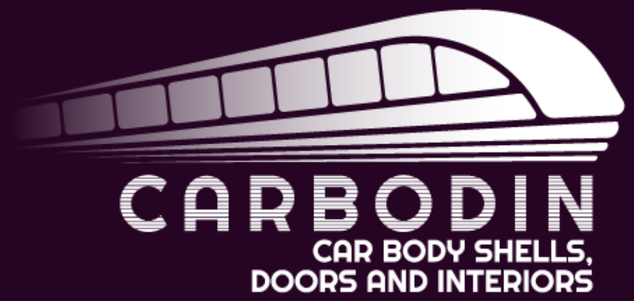


Fig. 2 – Model of defect experiment



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