Non-destructive Characterization of Fibre Reinforced Thermoplastic Components with embedded Piezoceramic Modules

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ABSTRACT

Fibre-reinforced polymers (FRP) show a high potential for innovative function-integrating lightweight constructions. In the case of textile-reinforced composites the textile structure, the layered build-up, and the associated specific production processes offer the possibility for the integration of functional elements, like sensors, actuators or even electronic circuit boards [1, 2]. This integration can be done already during the manufacturing process of the composite structures. Such components can be used for e.g. ultrasonic based radiation or measuring tasks, condition monitoring or structural health monitoring [3, 4]. The contribution presents a manufacturing technology for the integration of piezoceramic modules in fibre-reinforced thermoplastic parts ready for series production. In regard to the assessment of the integration quality and the damage of the piezoceramic modules non-destructive testing methods like computed tomography and ultrasonic microscopy were used. In the case of acoustic microscopy, a novel 3D-scanning measuring system is introduced, which enables the scanning of curved surface structures. Commercial acoustic microscopes are only designed for the investigation of plane surfaces. In order to achieve sufficient results in the image, the ultrasound transducer axis has to be orientated orthogonally to the specimen surface for every scan position [5]. For this purpose, a 6DoF hexapod robot system was used to perform a matched angle adjustment. Acoustic microscopy is suitable for high-density materials and provides 3D data of the investigated area.

The results show that a precise detection of cracks in the piezoceramic layers, trapped air between the fibre reinforced composite and the piezoceramic modules as well as the localization of conductive paths and electrodes are possible. Furthermore, the ultrasound imaging data show a good accordance to those of the computed tomography.

REFERENCES