Characterization of artificial defects in carbon fiber reinforced polymers using active thermography methods in combination with a neural network approach

Vitalij Popow[1], Harutyun Yagdjian[1], Martin Gurka[1]

[1]Materials Science, Institut für Verbundwerkstoffe GmbH, Germany

Using carbon fiber-reinforced polymers (CFRP) in series applications, such as aerospace, automotive or energy sector, requires reliable and effective non-destructive testing methods for a quantitative assessment of all defects. As a contactless imaging method Infrared Thermography (IRT) has distinct advantages over scanning-based approaches, as e.g. ultrasonic inspection regarding inspection time and data interpretation. Assessment of the raw images (amplitude- or phase) alone however, as proposed in literature today is often insufficient, because a precise quantification of defects regarding lateral size and depth is interdependent in a complicated way and results depend on many parameters of data acquisition and analysis. Especially for carbon fiber-reinforced composites a precise analysis requires the consideration of three-dimensional heat conduction of inhomogeneous and anisotropic media. In this paper we compare a new approach to determine the depth and lateral size of artificial defects using active infrared thermography in combination with an artificial neural network for data interpretation in comparison with depth and size determination using an analytical model. The specimen under investigation is a multiaxial CFRP laminate with artificial defects, data acquisition was performed in via pulse-phase and lock-in IRT over a broad parameter range and automated data analysis. For selected configurations, experimental results will be compared to theoretical values derived from 1D heat conduction for inhomogeneous media.