IDENTIFICATION OF CLIMATE CYCLE INFLUENCE ON MECHANICAL PROPERTIES FOR KNITTED GF/PP TEXTILE COMPOSITES

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Composite materials have significant influence on the design of new structural and functional parts for aeronautics and automotive industry, replacing traditional sheet metal with lightweight laminate from woven fabrics. The use of fiber composites with polymer matrix allows significantly reducing the weight of the structure as well as improving service time. This paper describes two methods for determination of the mechanical properties of GF/PP textile composites from the results of modal tests before and after testing of climate cycle. Total cycle time is 32H with ramp-up/down time 0.5C/min. The first numerical-experimental identification procedure is based on traditional metamodeling approach consisting of design of computer experiments, approximation of the dependency of eigenfrequencies on the elastic properties obtained by the finite element method, and minimization of discrepancy between numerical and experimental modal results [1]. The idea of the second method is based on inverse metamodeling: approximation of dependence of the material properties (modulus of elasticity, internal and external dissipation parameters, Poison coefficient) on the set of eigenfrequencies (thereby exchanging the inputs and outputs of the numerical experiment) [2]. In both cases, designs of experiments, optimized according to mean squared error, and nonparametric approximation methods for metamodel building were used [3]. The main advantage of this approach is significant reduction of the number of FEM computations. Another advantage is non-destructive determination of mechanical properties, thus the current approach may serve as quality control of GF/PP laminate production. For current research, the identification parameters are four elastic constants and two dissipation parameters of the GF/PP textile composite which have been validated with results obtained in mechanical testing. The difference of physically measured eigenfrequencies before and after climate cycle was less than 5%. Eigenfrequencies and identified elastic constants mainly decreased, however, the increase of some eigenfrequencies was also observered, a fact that may be used for diagnostic purposes.

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