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DYNAMICS OF CURVED THIN-WALLED COMPOSITE BEAMS: UNCERTAINTY QUANTIFICATION DUE TO RANDOMLY DISTRIBUTED THERMAL/HYGROSCOPIC ASPECTS

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Abstract. In this paper we analyze the dynamic behavior of curved thin walled composite beams considering hygroscopic and thermal effects in the constitutive equations. A model of curved thin walled beam is employed as the basis for deterministic calculations which are performed in the context of finite element approaches. This model takes into account shear deformation due to bending and non-uniform torsion, also it incorporates the effect of hygro-thermal stresses and strains in the classical way, however considering them as uncertain due to the randomness associated with the material of the matrix resin (normally sensitive to the absorption of humidity) while the composite beam is constructed or while the structure is under service. The variability of the stiffness and mass properties of the composite beam is assumed as a random field along the structure taking into account the elastic coupling between bending, twisting, shear and axial motions together with the thermal and hygroscopics terms. The probabilistic model is constructed appealing to the Maximum Entropy Principle in order to derive the marginal probability density functions, according to increasing levels of entropy, i.e. with less number of constraints or less information. The analysis is performed in the frequency domain and the buckling loads by comparing the probabilistic models with different levels of information (i.e., given the mean and/or the bounds, etc.) with previously developed probabilistic approaches such as the ones with parametric uncertainty. Also the Entropy of the response is evaluated in order to quantify the propagation of uncertainty in the information of the model. A number of different hygroscopic sensitive composites are evaluated and the dynamic response of the structure constructed with them is compared with the homonymous case of a perfectly dry specimen of the same volumetric fraction of reinforcement.