On uncertainty quantification in sandwich structures with spatial random damping behavior

Abstract:
Lightweight structures of multi–layer fiber–reinforced polymer composites and hybrid metal– plastic composites offer high damping capabilities and a high stiffness–weight ratio. The damping properties of such components are influenced by interfaces and local inhomogeneities resulting in uncertainties and non– lineairties of the characterizing parameters. The investigations are focused on the uncertainty quantification of amplitude depending damping by stochastic finite element procedures. Uncertain and locally varying damping parameters are represented with the help of a stochastic field using Karhunen–Lo ` ve expansions. The uncer- tainty is involved into the damping properties of viscoelastic layers. The complex frequencies are represented using generalized polynomial chaos expansion. To verify the developed and extended simulation method, ex- perimental modal analysis is performed on samples of the polymer reinforced composite plates. All investigated samples show a varying damping ratio depending on the displacement amplitude. This helps to identifying prior information on the damping properties of the viscoelastic layer. Knowing the Karhunen–Lo ` ve expansions of the damping properties, a stochastic finite element model is
executed to estimate the unknown coefficients of the polynomial chaos expansions representing the frequencies. The results are compared with the experimental data.

Stichworte: Composite materials, viscoelastic materials, uncertainty quantification, uncertain damping

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