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An energy-based method for vibroacoustic analysis of complex structures in the low- and medium-frequency ranges, a computational model with uncertainties

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ABSTRACT

The aim is to propose a method for low- and medium-frequency vibroacoustic analysis of complex industrial structures. The statistical aspects are introduced by the use of the nonparametric probabilistic approach presented in [1,2]. The method is based on an energy analysis of the system using the statistical properties of the random frequency response functions. It is shown that the frequency response functions can be presented in terms of dimensionless frequency response functions. It is then proven that these dimensionless frequency response functions can be used to construct a simplified model to predict the vibroacoustic responses between two distant parts of the structure.

A first part presents the mean computational model of the vibroacoustic system (see[3]). In a second part, the implementation of the nonparametric probabilistic approach in the mean computational model is presented. The probability distributions of the mass, damping and stiffness matrices of the reduced computational model are explictely constructed. Independent realizations of the frequency response functions of the stochastic system are obtained using the Monte Carlo method. At convergence of the Monte Carlo method, the dimensionless frequency response functions are calculated using the conventional frequency response functions projected on the directions of maximum mobility and then divided by the input and output mobilities of the vibroacoustic system (see[4]). The confidence regions are then estimated using ordered statistics. The energy analysis and the calculation of the dimensionless frequency response functions along with the siplified model obtained are introduced in a third part. Finally, results and conclusions are presented.

To summerize the work, this new proposed methodology is based on three main features. The first one is the introduction of the the stochastic model which is obtained using the nonparametric approach presented in [1,2]. this stochastic model allows statistical avarageing to be introduced. The second feature consists in introducing local coordinates for which the mobility is maximum in one axis and

te calculation of the dimensionless frequency response functions. The last feature is the introduction of a simplified model of the frequency response functions between distant parts of the structure. This method is validated on an automotive vehicle.

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