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MODEL REDUCTION METHOD FOR THE COMPUTATION OF A LOW FREQUENCY RANDOM VIBRO-ACOUSTIC RESPONSE

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Naval ships of a same production batch generally present significant variations in vibro-acoustic characteristics which affect the performances of the vessels in terms of sound level and comfort. Therefore the path to robust design goes through the consideration of the different sources of uncertainty in the model so to predict their impact on the vibration responses of structures immersed in a fluid.
In a probabilistic context, the computation of the low frequency response requires the resolution of a system of random equations. In the parametric stochastic framework, the stochastic spectral methods [1, 2] offer a robust tool for the accurate prediction of the random response as a function of the input parameters which are actually random variables. However this calculation can be unaffordable in an industrial context when the stochastic dimension is high and a simple deterministic vibro-acoustic calculation is already cumbersome in itself. In [3], a model reduction method has been proposed to significantly reduce the computation cost of Galerkin type spectral approaches for the prediction of the low frequency response of a dry random structure. The method relies on low rank approximation [4, 5, 6, 7] and implements the Generalized Spectral Decomposition (GSD) [8, 9] based on the space-parameters separation of the response for the resolution of the stochastic problem at a given frequency.
The approach is here extended to vibro-acoustic problems with uncertainty on the parameters of the viscoelastic model of the structure. Different formulations of the fluid-structure interaction problem are considered [10] and the performance of the low rank approximation method on these is analyzed. The approach is to be used in an industrial environment

and this work aims at high-lighting the non-intrusive characteristic of the method by implementing it upon an industrial deterministic code [11]. Numerical examples illustrate the fact that an accurate low-rank approximation of the Galerkin approximation can be computed using only a few runs of this deterministic code without strong modification of this code.

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