VIBRATIONS

Towards an Optimal Multi-query Framework based on Model-order Reduction for Non-linear Dynamics

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Predicting the probability of failure for a structure subjected to uncertain loading conditions requires conducting a large number of highly non-linear simulations, up to structural failure, across a wide range of plausible loadings.in order to make failure prediction readily accessible, it is crucial to reduce the numerical cost of these studies.This thesis presents a strategy for efficiently solving numerous low-frequency non-linear dynamic problems. The proposed strategy relies on an efficient solver to find solutions to part of the problem's equations using the Proper Generalised Decomposition (PGD) model reduction method in the frequency domain. This minimises the number of global spatial problems to be solved while utilising current parallel architectures for handling the temporal part of the motion equations. Particular attention has been paid to mitigating Gibbs phenomena in cases where the structure does not return to its initial state (irreversible phenomena, transient regimes, etc.), and hence, the solution is not periodic. To address this, an artificial damping-based method is proposed.The second aspect of the methodology involves utilising data from previously conducted calculations to speed up subsequent computations, thereby reducing the overall study's computation time. To maximise the benefits of such an approach, a robust and systematic method is employed to determine the order in which different simulations are chained together. The entire method is suited to a framework where the numerous loadings are non-parametric. Therefore, the choice of reusing previous data and the sequence of calculations rely on a physics-based indicator and do not require prior parametrisation of the loadings imposed on the structure. The method has demonstrated time savings of up to a factor of three and memory storage savings of up to a factor of twenty.