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Simulation Techniques for Mid-Frequency Vibro-Acoustics Virtual Tools For Real Problems

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ABSTRACT

The most commonly used numerical modelling techniques for acoustics and vibration are based on element based techniques, such as the nite element and boundary element method. Due to the huge computational eorts involved, the use of these deterministic techniques is practically restricted to low-frequency applications. For high-frequency modelling, probabilistic techniques such as SEA are well established. However, there is still a wide mid-frequency range, for which no adequate and mature prediction techniques are available. In this frequency range, the computational eorts of conventional element based techniques become prohibitively large, while the basic assumptions of the probabilistic techniques are not yet valid. In recent years, a vast amount of research has been initiated in a quest for an adequate solution for the current midfrequency problem. One family of research methods focuses on novel deterministic approaches with an enhanced convergence rate and computational eciency compared to the conventional element based methods in order to shift the practical frequency limitation towards the mid-frequency range. Amongst those techniques, a wave based prediction technique using an indirect Tretz approach is being developed at the K.U.Leuven - Noise and Vibration Research group. This paper starts with an outline of the major features of the mid-frequency modelling challenge and provides a short overview of the current research activities in response to this challenge. Next, the basic concepts of the wave based technique and its hybrid coupling with nite element schemes are described. Various validations on two- and threedimensional acoustic, elastic, poro-elastic and vibro-acoustic examples are given to illustrate the potential of the method and its benecial performance as compared to conventional element based methods. A closing part shares some views on the open issues and future research directions.