ABSTRACT

This dissertation presents a new, wave based prediction technique for the steady-state dynamic analysis of coupled vibro-acoustic systems. The technique is based on a Trefftz approach, in which the field variables are expanded in terms of structural and acoustic wave functions, which are homogeneous solutions of the governing dynamic equations, along with some particular solution functions. In this way, the dynamic equations are exactly satisfied, irrespective of the contributions of the wave functions to the field variable expansions. These contributions result from a weighted residual or a least-squares formulation of the boundary conditions.

It follows from the application of this methodology for various types of coupled vibro-acoustic problems that accurate predictions can be obtained with wave models, which are not only significantly smaller, but also computationally less demanding than corresponding element based models. Due to this enhanced computational efficiency, the practical frequency limitation of the proposed technique is substantially higher than for the existing techniques. In this way, the wave based prediction technique enables accurate predictions in the mid-frequency range, for which the computational efforts, involved with element based models, become prohibitively large.