Abstract

This dissertation considers the development of a wave based prediction technique for the steady-state dynamic analysis of three-dimensional structures. The finite element method is a commonly used prediction method for these dynamic simulations. A major disadvantage of this method is its practical frequency limitation as its application involves prohibitively large computational efforts at higher frequencies. The wave based method is an alternative deterministic prediction technique based on the indirect Trefftz method. Thanks to its enhanced computational efficiency, the wave based method pushes up the frequency limit of the deterministic techniques. This dissertation reports on the development of the wave based method for the dynamic analysis of structures consisting of flat plates. A detailed performance study shows that the wave based method exhibits an enhanced computational efficiency as compared to the finite element method, allowing accurate predictions at higher frequencies. However, the efficiency of the wave based method is most pronounced for problems of moderate geometrical complexity. To improve the general applicability of the method, a hybrid coupling with the finite element method is proposed, which combines the computational efficiency of the wave based method with the geometrical flexibility of the finite element method. Numerical validation examples prove the feasibility and enhanced computational efficiency of the hybrid method.