High frequency acoustical scattering problems analysis by boundary element method

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Abstract

High frequency acoustical scattering problems (HFASP) analysis has much important affection on nondestructive testing of structures and anti-submarine of navy. The boundary element method (BEM) is based on the boundary integral equation. Comparing the finite element method (FEM), the BEM has the advantages of reducing dimension, high precision. In the exterior acoustical problems, the Sommerfeld boundary condition can be automatically satisfied at infinity by the boundary integral equation, thus it is more suitable to solve the exterior acoustic problems. However, the BEM has two difficulties for solving the HFASP, there are the high sensitive of wave number in the sound pressure variables and the high oscillatory integrals. Thus, few research work has been done on this aspect based on BEM.

Nevertheless, the high oscillatory integrals can been evaluated with new methods since 2004 [1,2]. On the same time, the boundary integral equation method (BIEM) has been used to deal with the high frequency acoustical scattering problems, and can analyze acoustic scattering problems with the wave number more than 10, 000 in a few minutes[3]. However, the presented BIEM does not have the full dimension reduction advantage.

In this paper, an efficient BEM will be presented to solve the HFASP. The plane wave approximation theory is introduced to reduce the sensitive of wave number in the sound pressure variables. An efficient method, which is an improment of the asymptotic method in Ref.[2], will be developed to treat the high oscillatory integrals in high frequency acoustic BEM. Numerical examples show the results obtained by the present method can agree with the analytical solution very well.

Keywords: Boundary element method, high frequency acoustical scattering problems, the high oscillatory integrals

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