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Numerical Calculation and Analysis of Fine Echo Characteristics of Underwater Hemispherical Cylindrical Shell

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Abstract : A finite-length cylindrical shell with a spherical cap is a typical engineering approximation model of actual underwater targets. The research on the omni-directional acoustic scattering characteristics of this target model can provide a favorable basis for the detection and identification of actual underwater targets. The elastic resonance characteristics of the target are the results of the comprehensive effect of the target length, shell-thickness ratio and materials. Under the conditions of different materials and geometric dimensions, the coincidence resonance characteristics of the target have obvious differences. Aiming at this problem, this paper obtains the omni-directional acoustic scattering field of the underwater hemispherical cylindrical shell by numerical calculation and studies the influence of target geometric parameters (length, shell-thickness ratio) and material parameters on the coincidence resonance characteristics of the target in turn. The study found that the formant interval is not a stable value and changes with the incident angle. Among them, the formant interval is less affected by the target length and shell-thickness ratio and is significantly affected by the material properties, which is an effective feature for classifying and identifying targets of different materials. The quadratic polynomial is utilized to fully fit the change relationship between the formant interval and the angle. The results show that the three fitting coefficients of the stainless steel and aluminum targets are significantly different, which can be used as an effective feature parameter to characterize the target materials.

Keywords : hemispherical cylindrical shell;, fine echo characteristics;, geometric and material parameters;, formant interval
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