Scattering field calculation for directional source with wave superposition method

Lei Bo, Yuanliang Ma, Kunde Yang, Dahai Zhang
Northwestern Polytechnical University, Xi'an , China

Abstract:

There has been much interest over the last several years in modeling the wave field scattered by half-buried or buried objects in the sediment. There are many approaches to deal with this problem. Boundary integral equation (BIE) and plane-wave decomposition methods are appropriate for scattering problem embedded in plane-layered media. But when the environment is complex, it is difficult to establish these scattering models.

In this paper the wave superposition method is used to calculate the scattering field. This method assumes that there are several harmonic point sources distributed in the scattering object, which are called virtual sources. On the surface of the object, the field generated by the virtual sources is the same as the scattering field. From this boundary condition the virtual source strengths are determined. Then the virtual sources are used to replace the scattering object. The total field of the real and virtual sources could be computed by FFP algorithm. In contrast to other methods, it allows the object to penetrate any interface in a horizontally stratified ocean environment, and can deal with the irregular scattering object.

In this paper, a beam is generated by a vertical source array composed by a number of equidistantly spaced line sources. The beam direction is varied by phasing the source elements appropriately, and the intensity distribution across the beam can be selected by applying an amplitude weighting across the array. The scattering field is calculated at different frequency utilizing the waveguide Green function. Then the change of the scattering field at all directions is analyzed. Furthermore, the transmission loss between the source and the receiver is estimated at different frequency, especially when the source and receiver are at the same position.

The organization of the paper is as follows. In section I, the scattering problem in the waveguide is introduced and the general conception of the wave superposition is presented. In particular, when the object is soft spherical and the environment is Pekeris waveguide, the calculation process is given. In section II, the numerical example for directional source is given. The scattered pressure at certain distance to the object is analyzed, and the transmission loss between the source and receiver is calculated. The final section summarizes the results of the paper.