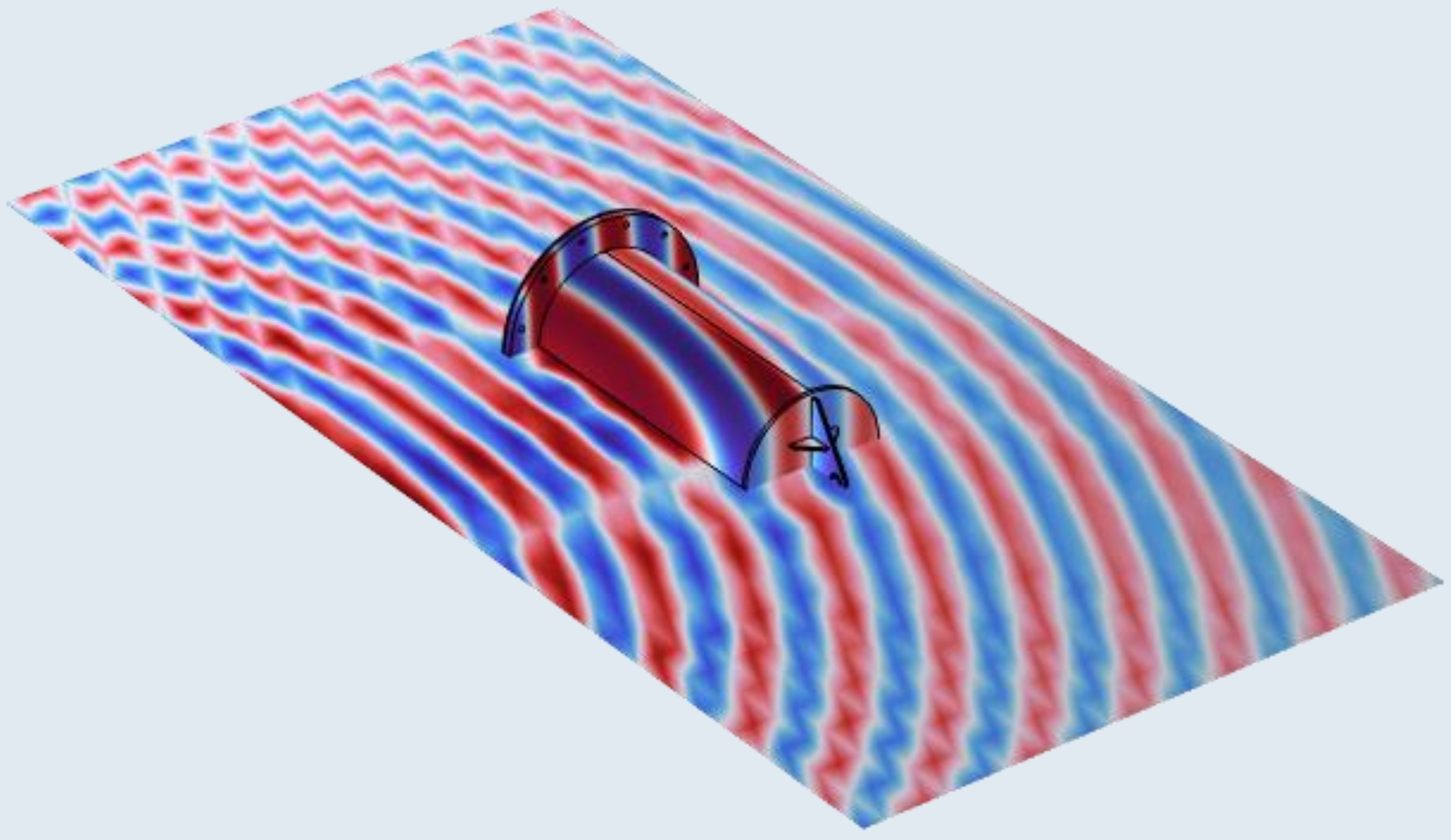

Acoustic scattering study of sub-sea pressure housings using finite element method

Finite element (FE) model of the scattering study of cylindrical pressure housings made of different metallic alloys such as aluminum, stainless steel 316L and titanium.

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Abstract

Understanding the acoustic scattering behavior of underwater objects helps in improving target detection and classification. In case of Vector sensor array-VSA (being developed by NIOT) to be used as surveillance system, it needs to have less scattering signature underneath the water. The mooring system contains a pressure housing that is used to accommodate electronics and power pack of the system. The knowledge of the way acoustic waves are reflected from the scattering object is required in order to minimize it's equivalent reflecting area and to keep the system hidden during operation. This information serves as a useful resource for selecting the optimum enclosures for underwater acoustical research activities.

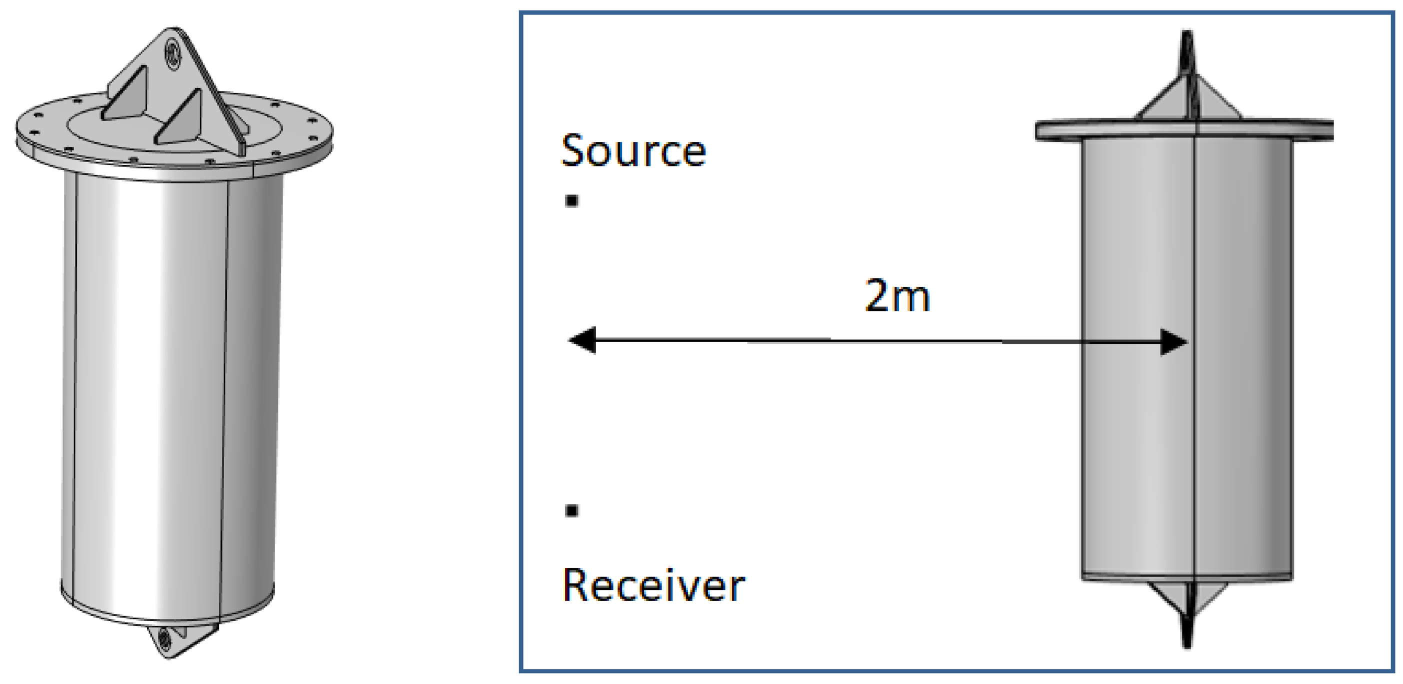

FIGURE 1. SS Pressure housing . Right: Simulation layout

Methodology

The model has been made using pressure acoustics-asymptotic scattering (paas) physics of COMSOL. This physics interface, models the scattering problems at high frequencies using the Kirchhoff–Helmholtz integral formulation. All the three cylindrical pressure housings are modeled in 3D and considered as scattering object. The backscattering was measured as a function of rotation angle about an axis perpendicular to the surface for frequencies from 2 to 30 kHz. The intensity of the scattered pressure wave exerted when insonified by a planar wave is expressed by the target strength (TS):

$$TS(f,\theta) = \lim_{r\to\infty} 20\,\mathrm{Log}_{10}\left(\frac{r|p_s|}{r_0|p_{inc}|}\right)$$

Results

The scattering object was insonified by a spherical wave (background pressure field of known amplitude) and the evaluated scattered pressure helped to compute the target strength (TS) for the orientation 0° to 90°. The results can be seen in Figure 2, which shows the acoustic template (3D plot of TS w.r.to angle θ and ka, where *k* is the wave number of the incident sound in water, and *a* is the cylinder radius), target strength plot (TS v/s angle θ), acoustic pressure 3D plot and directivity plots.

Though, all three housings are geometrically similar, variation in scattered pressure is observed due to the different material composition and reflection capabilities.

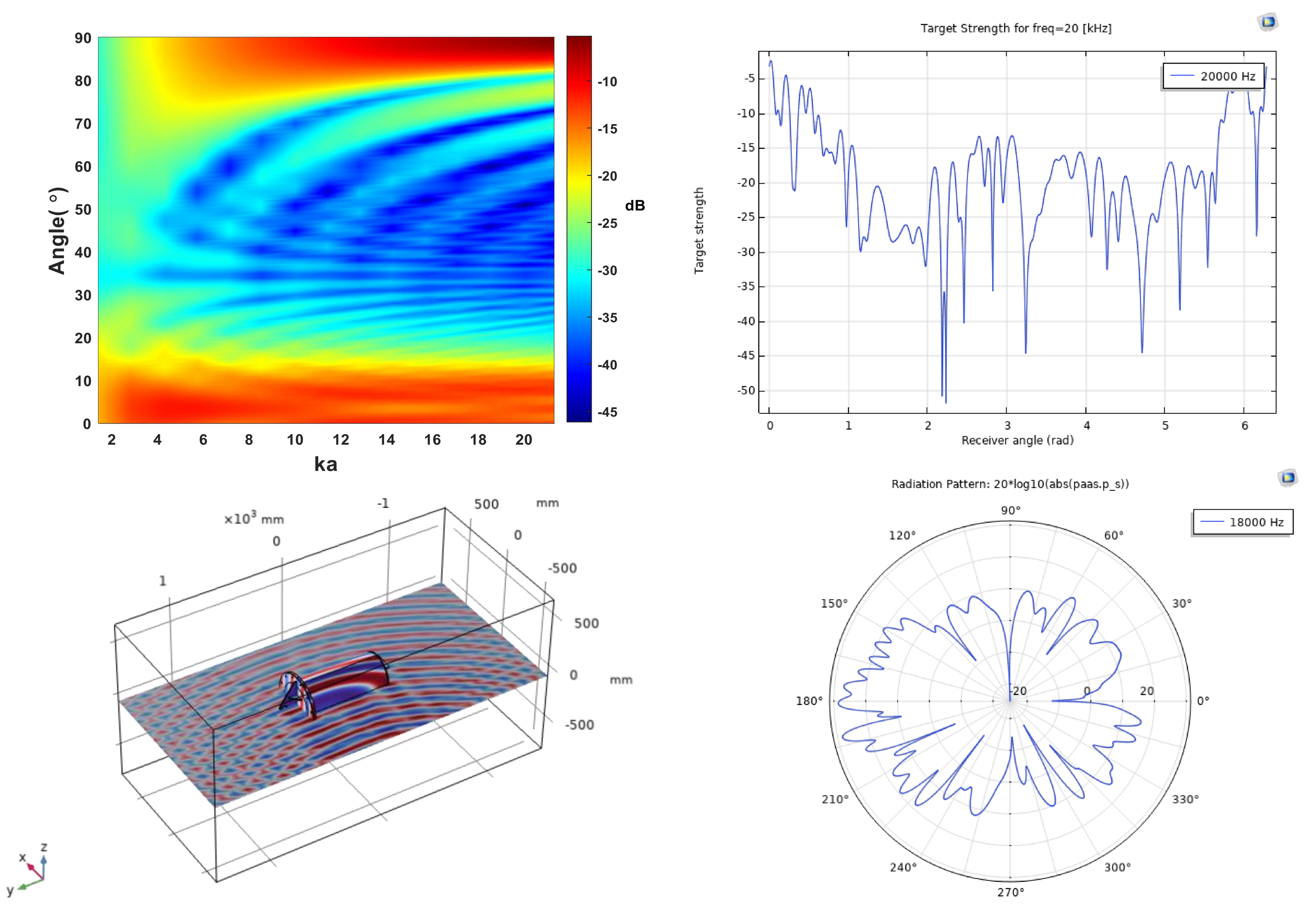

FIGURE 2. Acoustic template, TS plot, acoustic pressure 3D plot and Directivity plots

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