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ELASTIC SCATTERING FROM SUBMERGED OBJECTS NEAR BOUNDARIES – MODELING, EXPERIMENTS AND THOUGHTS ON THE WAY AHEAD

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At low to mid frequencies (on the order of about 1 kHz to a few tens of kHz for meter-sized objects), the echo of a submerged target is dominated by elastic effects. In this regime, the sound can penetrate the outer shell of the target and interact with its interior structure. This makes it possible to attempt a classification of the object not based on the geometrical features of the echo, but on the structural response. Low frequencies are also particularly relevant when the object is buried in the sediment. In those cases, the target cannot be reached well by high frequency sound, which is rapidly attenuated with depth. Low frequency pulses, instead, can illuminate the target with sufficient energy to enable the detection, even at sub-critical incidence. The application of finite element based modeling techniques has made it possible to extend earlier studies in this field, which were mostly limited to spherical shells, to more complex objects, such as for example cylindrical shells with internal fluid and solid partitions. The acoustic interactions between the sea floor and the target are taken into account by including the Green's function of the layered medium in the Helmholtz-Kirchhoff integral, with which the acoustic field computed in the vicinity of the target is propagated coherently to the physical location of the receivers. Comparison with other models on specialized test cases provides a verification of the computational tool. The comparison with experimental data, collected both in tank experiments and at sea, provides the validation and makes it in turn possible to use the model to explain echo features found in the data. A number of open questions, which will need to be addressed in the future, are presented in the concluding part of the talk.