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The influence of channel boundaries on remotely sensed target resonances

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Jacobi equation. The calculation then reduces to a phase screen calculation, with the coefficient of the Green's function appearing as the position at which a ray crosses the screen.

4:05

H12. The influence of channel boundaries on remotely sensed target resonances. G. C. Gaunaurd (Naval Surface Weapons Center, White Oak, R-43, Silver Spring, MD 20903–5000) and M. McCarthy (National University of Ireland, Galway, Ireland)

Target resonances are unique characteristics of scatterers and serve to identify them unambiguously. In the vicinity of environmental boundaries, the way resonances are perceived by sensors is different than in the absence of boundaries. Thus, even though the resonances themselves do not change, the way in which they manifest themselves in the scattering cross section of scatterers as sensed at the receiver, changes near an environmental boundary. A formalism is developed to study this change and to assess the effect of boundaries upon the way elastic scatterers are excited into resonant vibration by incident sound waves. This formalism reduces to an earlier one developed [J. Acoust. Soc. Am. **73**, 1–12 (1983)] for an infinite medium lacking boundaries. In general, the effect of boundaries on the resonance features present in the sonar cross section depends on the azimuthal wavenumber m, even for spherical scatterers. It also depends on the depths H and h of the elastic scatterer and the receiver, beneath the free surface $z = 0$ of the half-space. The boundary's influence is greatest for $m = 0$, or $H \ll 1$, or both. The method relies on addition and translation theorems for various wavefunctions.

4:20

H13. Resonance frequencies and the phase matching of helicoidal surface waves on impenetrable spheroids. Barbara L. Merchant, Anton Nagl, and Herbert Überall (Department of Physics, Catholic University of America, Washington, DC 20064)

The existence of the (complex) resonance frequencies of acoustic scatterers is explained by the generation of surface waves that match phases after repeated circumnavigations of the objects. The resonance frequencies can be predicted [B. L. Merchant *et al.*, J. Acoust. Soc. Am. **80**, 1754 (1986)] for prolate spheroidal objects, in the special case of axial incidence. Here sound-soft, prolate-spheroidal targets subject to *obliquely* incident signals are considered. The generated surface waves propagate along geodesics of helicoidal type, for which we obtain the condition for closing, and the set of discrete "pitch angles" at which closing takes place. An integral condition is formulated for the phase matching of helicoidal surface waves, using local wavelengths of Franz's surface waves. It is solved numerically for the complex resonance frequencies, found to agree closely with the $m > 0$ (i.e., containing azimuthal components) resonance frequencies obtained from an independent T-matrix calculation. This agreement confirms the validity of the principle of phase matching for the general case, and the accuracy of the T-matrix results. [Work supported in part by the Office of Naval Research.]

4:35

H14. Bistatic resonant scattering from elastic spheroidal shells and the resonance order. Michael F. Werby (NORDA, NSTL, MS 39529), Herbert Überall, and Anton Nagl (Department of Physics, Catholic University of America, Washington, DC 20064)

Bistatic scattering at a resonance frequency can determine the order of the resonance, as demonstrated experimentally [G. Maze and J. Ripoche, J. Acoust. Soc. Am. **73**, 41 (1983)] and theoretically [M. F. Werby and H. Überall, J. Acoust. Soc. Am., in press] for elastic bodies of separable geometry (cylinders, spheres). For obstacles of more general shape, mode mixing takes place, but it was found (e.g., for solid prolate spheroids) [H. Überall, M. F. Werby, S. H. Brown, and J. W. Dickey, J. Acoust. Soc. Am. Suppl. 1 **80**, S128 (1986)] that, for moderate aspect ratios (up to 3:1), one mode remains dominant in the bistatic pattern, and may serve to characterize the resonance, even while a crossing of Rayleigh and Whispering Gallery resonances takes place. This method is applied to the resonances of spherical and spheroidal shells, characterized by low-frequency resonances related to the plate Lamb-wave modes. Our application of the bistatic method confirms these relations, showing again that mode-order assignments remain valid for moderate spheroids' eccentricities. [Work supported in part by the ONR.]