10:45

MM12. The acoustic scattering by a submerged, elastic spherical shell: High-frequency limit. Roger H. Hackman and Gary S. Sammelmann (Naval Coastal Systems Center, Physical Acoustics Branch (Code 2120), Naval Coastal Systems Center, Panama City, FL 32407-5000)

This presentation represents the third in a series devoted to the analysis of the analytic structure of the acoustic scattering amplitude of an elastic spherical shell. In previous meetings [J. Acoust. Soc. Am. Suppl. 1 **83**, S94 (1988); **84**, S185 (1988)], a fundamentally oriented analysis of the pole structure of the scattering amplitude in the low- to mid-frequency region was presented. The most surprising result of this investigation was the demonstration that the fluid-loaded antisymmetric Lamb wave bifurcated near the frequency that the vacuum dispersion curve transitioned from a subsonic to a supersonic phase velocity. In this presentation, the previous analysis of both the behavior of the acoustic scattering amplitude of a thin spherical shell and the pole structure of the S matrix is extended to the high-frequency region ($100 < ka < 1000$). The appearance of behavior that has a strong analogy with that of the higher-order flat plate Lamb waves is demonstrated. In particular, the appearance of strong thickness resonances, regions of anomalous dispersion, and regions of negative group velocity analogous to those observed by Tolstoy and Usdin [J. Acoust. Soc. Am. **29**, 37–42 (1957)] in their study of the dispersion properties of higher modes on a plate is discussed.

11:00

MM13. An analysis of the modes of an elastic prolate spheroid: From a spherical to cylindrical geometry. Gary S. Sammelmann and Roger H. Hackman (Naval Coastal Systems Center, Physical Acoustics Branch (Code 2120), Panama City, FL 32407-5000)

The acoustic scattering from a solid prolate spheroid is studied as a function of frequency and aspect ratio. The emphasis of this study is on the nature and the coupling of the elastic excitations of a solid prolate spheroid in the transition from a spherical to what is essentially a cylindrical geometry. The aspect ratio of the spheroid from the spherical limit to the almost cylindrical limit is varied. In this manner, it is possible to classify the elastic excitations of low-aspect ratio prolate spheroids in terms of the elastic modes of vibration of a sphere and to study how these modes undergo transformation to the modes of a cylinder with respect to increasing aspect ratio. A qualitative comparison of the behavior of these low-frequency elastic excitations of a prolate spheroid and their quasicylindrical mode interpretation is made.

11:15

MM14. Total scattering cross section of an elastic spherical shell: Comparison of exact computations with a GTD model that includes Lamb wave resonances. Steven G. Kargl and Philip L. Marston (Department of Physics, Washington State University, Pullman, WA 99164-2814)

The optical theorem, relating the total scattering cross section $\sigma_t(ka)$ to the forward scattering function $f(\theta = 0,ka)$, is used to study the rich structure contained in $\sigma_t(ka)$ for an elastic spherical shell in the frequency range $7 < ka < 100$. The partial-wave series (PWS) for $f(0,ka)$ does not facilitate a direct understanding of the physical mechanisms causing this structure. Hence, a model for $f(0,ka)$ is developed from an elastic generalization of the geometrical theory of diffraction (GTD) [P. L. Marston, J. Acoust. Soc. Am. **83**, 25–37 (1988)]. The generalized GTD is based on the Watson transformation of the PWS. The GTD model includes explicit contributions from ordinary forward diffraction and from individual Lamb waves excited on the shell. Calculations of $\sigma_t(ka)$ with $f^{PWS}(0,ka)$ and $f^{GTD}(0,ka)$ show good agreement between the exact PWS result and the GTD model for the ka range investigated. The agreement confirms the GTD model and demonstrates the relevance of Lamb waves guided by the shell and forward glory scattering. Finally, these calculations verify the correctness of the numerical methods by which the Lamb wave parameters were obtained [S. G. Kargl and P. L. Marston, J. Acoust. Soc. Am. **85**, 1014–1028 (1989)]. The numerical computations presented are for a stainless steel shell with an inner-to-outer radius ratio $b/a = 0.838$. [Work supported by ONR.]

11:30

MM15. An application of the forward-scattering theorem to elastic wave attenuation in inhomogeneous materials. Kurt P. Scharnhorst (Naval Surface Warfare Center, White Oak, Silver Spring, MD 20903-5000), Roger H. Hackman, and Raymond Lim (Naval Coastal Systems Center, Panama City, FL 32407)

The forward-scattering amplitude of two adjacent scatterers $f(2)$ may be used to construct an effective medium theory of inhomogeneous media containing random distributions of scatterers. The amplitude $f(2)$ may be thought of as the lowest-order approximation of the amplitude $f(n)$, of an interacting cluster of n scatterers contributing to the formation of the coherent elastic wave. Since the elastic wave encounters all orientations of pairs, the averaged nearest-neighbor forward-scattering amplitude is studied. Specific orientations that are dictated by the dynamics of the scattering processes are also considered. The average forward-scattering amplitude is analyzed in terms of the direct σ_{pp} mode conversion, σ_{ps}, and absorption cross sections for random distributions of viscoelastic spherical scatterers in elastic matrix materials. Estimates of longitudinal wave attenuation due to these three mechanisms in specific materials are presented.

11:45

MM16. Acoustic sampling volume. K. G. Foote (Institute of Marine Research, 5024 Bergen, Norway)

Knowledge of the sampling volume is necessary in many quantitative applications of acoustics. In general, the sampling volume is not merely a characteristic of the transmitting and receiving transducer or transducers, but also depends on the concentration and scattering properties of the target, the kind of signal processing performed on the echo, and the detection threshold. These dependences are stated explicitly in formulas for the sampling volume and a differential measure, the effective equivalent beam angle. Numerical examples are given for dispersed and dense concentrations of both point scatterers and directional fish scatterers.