mums in this spectrum, correspond to the times which IS passes the sound field ray cycles. A relationship between F-spectrum and acoustic frequency is illustrated by showing Frequency-frequency ($F-f$) diagram. It is shown that depending on the sound field frequency ($f$), different mode pairs give the most pronounced contribution to the sound intensity fluctuations. At the same time invariant frequency, $F$, of maximal fluctuations remains approximately the same for all sound frequency ($f$) bands. For example in the case of the SWARM95 experiment, $F$ is about 0.0015 Hz for sound frequency, $f$ in the range of 30–150 Hz. Generally, $F$ depends on waveguide parameters and velocity of IS. In this paper, the physical meaning of the invariant frequency and its relationship to the sound frequency is discussed. In addition, the experimental setup for observation of $F$ in future shallow-water acoustic experiments is proposed. [Work supported by CRDF, PFBR and ONR-321OA.]

**11:20**

**4aAO11. Environmental influence on acoustic impulse responses across the New Jersey Shelf in the winter.** Peter C. Mignerey (Acoust. Div. 7120, Naval Res. Lab., Washington, DC 20375-5350)

In December 2003 as part of the RAGS03 experiment, the Naval Research Laboratory moored three vertical arrays at ranges of 10, 20, and 30 km distant from fixed 300- and 500-Hz LFM acoustic sources. Data were recorded continuously for approximately 20 days, which covered periods of severe storms and various phases of internal tides. Associated temperature profile data show the internal tide arriving as either an internal jump or series of elevation waves superimposed on a bottom layer associated with the foot of a shelf-break front. Impulse responses derived from acoustic data received by the vertical arrays provide insight into the acoustic modal structure within the ocean for various sea states and phases of the internal tide. Results to date show significant loss of high modes during those time periods when either the internal tide is present or the sea state is high in comparison with periods of low sea state and absent internal tide. The extent of mode stripping increases with down-slope range. Apparently high acoustic modes are being scattered and stripped by near-boundary interactions. Evidence for these interactions will be presented along with a discussion of stripping processes. [Work supported by ONR.]

**11:35**

**4aAO12. Acoustic sampling volume of a bistatic sonar.** Kenneth G. Foote (Woods Hole Oceanogr. Inst., Woods Hole, MA 02543)

The expression for the acoustic sampling volume of a monostatic sonar [K. G. Foote, J. Acoust. Soc. Am. **90**, 959 (1991)] is generalized to the case of a bistatic sonar, with separate, non-collocated transmitting and receiving transducers. The bistatic sampling volume is the integral of a counting function over the physically accessible space. The argument of the counting function, a Heaviside step function, is the difference between the scattering amplitude, or other measure of scattering strength, and a noise-dependent threshold. When this difference is positive, the integrand is unity; when zero, one-half; when negative, zero. Both the sampling volume and a related quantity, the equivalent beam angle, are evaluated numerically for several bistatic geometries, transducer shapes, and narrowband frequencies for the cases of point scatterers and directional scatterers. The application of the bistatic acoustic sampling volume to the quantification of suspended particulate matter and aquatic organisms is discussed.

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THURSDAY MORNING, 20 OCTOBER 2005

CARVER ROOM, 8:15 A.M. TO 12:00 NOON

Session 4aBB

# Biomedical Ultrasound/Bioresponse to Vibration and Physical Acoustics: Acoustic Radiation Force Methods for Medical Imaging and Tissue Evaluation

Mostafa Fatemi, Chair

*Mayo Clinic, Physiology Biophysics, 200 First St., SW, Rochester, MN 55905*

**Chair's Introduction—8:15**

*Invited Papers*

**8:20**

**4aBB1. Principles of radiation force.** Oleg Rudenko (Blekinge Inst. of Technol., Karlskrona, Sweden and Moscow State Univ., Russia, rudenko@acs366.phys.msu.ru)

A brief review of general problems of radiation force (RF) is given. RF was discovered by Lord Rayleigh in 1902 and further fundamental contributions to the RF phenomenon were made by Brillouin and Langevin. In spite of century-old history, RF has not been studied exhaustively and there are many grey areas. The difference between the Rayleigh and Langevin RF appearing in fluids, the difference between averaging procedure in Lagrange and Euler representations, the connections between mean characteristics of the RF-induced streaming (velocity, pressure, mass transfer) and acoustic parameters are still under discussion. Everyone knows that RF is produced by a change in the density of ultrasonic wave energy due to the absorption or due to the reflection from obstacles and inhomogeneous inclusions. However, can RF appear in lossless homogeneous medium or not? The pumping effect of sound beam caused by hydrodynamic nonlinearity was first discussed more than 50 years ago, and similar effects in biomedical applications RF produced by high-intensity focused ultrasound are being discussed now. The talk reviews recent progress in investigation of the problems concerning RF in fluids, biological tissues, and solids with account for specific properties of wave field like nonlinearity, diffraction, absorption, focusing, and scattering.

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