3:50

2pEA8. The application of acoustic standards to sound sources and the subsequent levels in the ocean. William M. Carey (Aero and Mech. Eng., College of Eng., Boston Univ., Boston, MA 02215)

The American National Standards on Acoustics are applied to common sound sources used in both acoustics research and in naval sonar systems operation. Metrics are quantified for both continuous and transient sources of sound. The standard definitions are reviewed with theoretical sound source models and applied to examples of energy sources of sound such as transients from a small omni explosive, an air gun, a light bulb, and a dolphin. A qualitative model of a typical surface ship sonar system is discussed and active sonar transmissions are analyzed with the requisite quantitative metrics required to characterize these emissions. The relative role of peak pressure, time spread, intensity, and energy flux is discussed for deep- and shallow-water environments. These results should be useful in environmental assessments, biological experiments, and in the system design.

Contributed Papers

4:10

2pEA9. Calibrating parametric sonars for backscattering applications. Kenneth G. Foote (Woods Hole Oceanogr. Inst., 98 Water St., Woods Hole, MA 02543)

The status of parametric sonar calibration is reviewed. For backscattering applications, the standard-target method, which is widely used in calibrating ultrasonic scientific echo sounders and multibeam sonars that provide the water-column signal, can be adapted. Two problems generic to parametric sonars are addressed. (1) The virtual nature of the array may require controlled measurements at a number of ranges, spanning the near field in the general case. (2) Calibration at rather low difference frequencies requires a suitably powerful target. Both measurement protocols and target design are considered for a particular parametric sonar based on primary frequencies in the band 15–21 kHz, with difference frequencies in the band 0.5–6 kHz and sum frequencies in the band 30–42 kHz. Solid elastic spheres are specified for both frequency bands. For the lower band, this is an aluminum sphere of diameter 280 mm, with immersed weight of 190 N.

4:25

2pEA10. Evaluating the significance of interface nonlinearity for shallow-water parametric array sonar. Roger Waxler and Thomas G. Muir (NCPA, University, MS 38577)

Difference frequency generation in shallow water is considered for the case in which wave steepening in the primary beam is not significant. A general formula for the effective difference frequency source strength is presented. The Pekeris shallow water model, in which sound speeds and densities in both the water column and sediment are assumed to be constant and both interfaces are assumed to be planar, is considered. In this model, the propagating difference frequency pressure field is computed. Contributions from the interface nonlinearity are compared to those from nonlinearity in the water column.

4:40

2pEA11. High frequency acoustic wave propagation. Mohsen Badiey (Ocean Acoust. Lab., Univ. of Delaware, Newark, DE 19716)

A program studying high frequency acoustics was established in the mid-1990's by the Office of Naval Research that is still going on and has evolved into a substantial basic and applied research initiative to study many areas, including underwater communication. This abstract explains the genesis of that program, and Joe Blue's involvement in making it happen. During the course of the initial experiments under that program, a series of issues were raised dealing with the effects of acoustic transmissions on marine mammals. Again, Joe was a key person in resolving those issues, which could have brought the program to a halt. His insight into the technical problems, as well as, his calm nature helped to bring an excellent new program in acoustic research into being.

4:55

2pEA12. Ship strike acoustics: A paradox and parametric solution. Edmund Gerstein, Joseph Blue (Leviathan Legacy Inc., 1318 SW 14th St., Boca Raton, FL 33486), and Steve Forsythe (Naval Undersea Warfare Ctr., Newport, RI 02841)

Marine mammals are vulnerable to ship collisions when are near the surface. Here, acoustical laws of reflection and propagation can limit their ability to hear and locate the noise from approaching vessels. Defining the physics of near-surface acoustical propagation as it relates to ship noise and hearing is central to understanding and mitigating ship strikes. Field data from controlled ship passages through vertical hydrophone arrays demonstrate a confluence of acoustical factors that poses detection challenges including (i) downward refraction; (ii) spreading loss; (iii) Lloyd's mirror effect; (iv) acoustical shadowing; and (v) masking of approaching ship noise by ambient noise and distant ships. A highly directional, dual-frequency parametric sonar has been developed to mitigate these challenges and alert marine mammals of approaching vessels. The system projector is a planar array, comprised of 45 elements, band centered to transmit a high carrier frequency along with a lower sideband signal. The nonlinearity of water is used to demodulate the mixed high-frequency carrier into a lower-frequency waveform audible to both manatees and whales. The bow-mounted arrays project a narrow beam directly ahead of vessels, and fill in acoustical shadows in an effort to alert marine mammals of the approaching danger. [Research supported by DOD Navy Legacy Program.]