3:45–4:00

Break

4:00

7AO9. Enhancement of hydrodynamic flow noise radiation by the regulation of air bubbles in a turbulent water jet. Murray S. Korman (Dept. of Phys., U.S. Naval Academy, Annapolis, MD 21402), Ronald A. Roy (Univ. of Washington, Seattle, WA 98105), and Lawrence A. Crum (Natl. Ctr. for Phys. Acoust., Coliseum Dr., University, MS 38677)

Experimental results show that the near-field hydrodynamic radiated flow noise (generated by a turbulent submerged circular water jet) is enhanced when the turbulent flow is modified to become a two-phase flow containing air bubbles. Acoustic intensity spectra, in the frequency band between 20 and 7000 Hz, are measured using a digital spectrum analyzer from signals generated by a hydrophone placed at the position of $Z = 4d$ and $R = 4d$. Here, Z and R are the axial and radial positions from the nozzle exit, respectively. The water velocity is 12 m/s at the nozzle exit (of diameter $d = 0.635$ cm). An amplification factor defined by the ratio of intensities $I_{\text{two-phase flow}}/I_{\text{fluid flow}}$ is measured as a function of the void fraction β of the air bubbles in an effort to verify the theoretical amplification predictions made by Crighton and Ffowcs-Williams [J. Fluid Mech. **36**, 585–603 (1969)] and more recently by Prosperetti [J. Acoust. Soc. Am. **84**, 1042–1054 (1988)]. A short videotape of the experiment will be shown. [Work supported by the National Center for Physical Acoustics, ONR, and the Naval Academy Research Council.]

4:15

7AO10. Δk-acoustic sensing of the ocean surface. A. J. Palmer, S. A. Frisch, and S. F. Clifford (NOAA Wave Propagation Lab., 325 Broadway, Boulder, CO 80303)

A new acoustic remote sensing method for measuring ocean surface directional wave spectra and currents is put forward. The method is termed Δk sonar or Δk sodar for beneath surface and above surface applications, respectively. The method is analogous to Δk radar. The basis of the Δk method is the use of two coherent beams of slightly different frequencies to project a (moving) fringe pattern onto the surface. This fringe pattern selects a single surface wave vector that will modulate the entire footprint of the beams on the surface. This modulation is revealed by the appearance of a "Δk resonance line" in the autocovariance spectrum of the frequency difference signal in the backscattered fields. Signal-to-noise calculations are presented which indicate that the method should be practical for sensing surface currents and wave spectra out to ranges limited by attenuation of the acoustic signals.

4:30

7AO11. Simultaneous observations of acoustic scattering and ocean microstructure in the arctic. Albert J. Plueddemann (Woods Hole Oceanographic Inst., Woods Hole, MA 02543), Laurie Padman (Oregon State Univ., Corvallis, OR), Timothy P. Stanton (Naval Postgraduate School, Monterey, CA), Jeffrey T. Sherman, and Robert Pinkel (Scripps Inst. of Oceanography, La Jolla, CA)

Intriguing new observations from an ice camp, manned during the Cooperative Eastern Arctic Experiment (CEAREX) on the Northwest flank of the Yermak Plateau, indicate that ocean microstructure may be detectable with "standard" acoustic instrumentation (i.e., acoustic Doppler current profilers) of moderately high frequency (150–300 kHz). The strength of the CEAREX data set is the simultaneous observation of kinetic energy dissipation rate, temperature dissipation rate, and acoustic backscatter from both 160- to 300-kHz Doppler profilers. The turbulence levels observed during CEAREX were particularly strong ($\epsilon > 10^{-7}$ W kg^{-1}) and occurred in well-defined patches. Backscattered intensity anomalies of 2 to 6 dB were found to be coincident in time and space with patches of strong turbulence in the thermocline. It is shown that the acoustic intensity anomalies co-vary with the strength of the turbulent dissipation above a threshold that presumably represents the background particulate scattering level. Theoretical predictions of the acoustic intensity level based on the microstructure measurements are used to support the hypothesis that the enhanced scattering levels are due to temperature anomalies.

4:45

7AO12. Geomorphic parameter estimations with neural networks using bathymetry and backscatter data. Jerald W. Caruthers and Brian Bourgeois (Naval Res. Lab., Stennis Space Center, MS 39529-5004)

A bistatic scattering strength model (BISSM) for low-frequency acoustics, which uses high-resolution geomorphology as input parameters, has been proposed [Caruthers *et al.*, NOARL, SP023:200:90 (1990)]. Included in these geomorphic parameters are (1) deterministic bathymetry and local bottom-facet mean slope and azimuth, (2) the stochastic parameters, rms slopes in orthogonal directions and roughness, and (3) the empirical acoustic parameter, Lambert/Mackenzie scattering coefficient. The issue of how to obtain these parameters to support wide-area applications of the model led to a consideration of the inverse problem using the model itself at higher frequencies and in the backscatter direction. Swath sonar systems, simultaneously providing high-resolution bathymetry and backscattering strength as a function of grazing angle, would appear tractable as survey tools for these parameters, if the inverse problem is solvable. Presented here is a sensitivity analysis using neural networks to determine the potential validity of this approach. The model is presumed to be valid and is used to simulate noise-free backscatter data for different sets of parameters. Presented is the ability of neural networks to be trained to provide estimates of the desired parameters under these ideal conditions. [Work is supported by CNOC.]

5:00

7AO13. Acoustic emissions of toroidal bubbles. Ali R. Kolaini, Michael Nicholas, and Lawrence A. Crum (Natl. Ctr. for Phys. Acoust., Univ. of Mississippi, Oxford, MS 38677)

Toroidal bubbles can be formed by injecting a small volume of air impulsively through a nozzle placed underwater. As the air leaves the nozzle, the front face (which is initially moving with a large velocity) slows down within a short distance and time, and a jet of air moving from the back of the bubble at high speed then penetrates the front face, thus forming a toroidal bubble. These bubbles then move upwards with their plane perpendicular to the direction of motion. The ring radius increases while the cross-sectional area of the air core decreases; simultaneously, the fluid velocity on the surface of the toroid slows down due to viscous effects. The combination of these two effects causes the toroidal bubbles eventually to become unstable and to break into a number of small bubbles. This phenomenon can be observed for a number of