include, but are not limited to: center frequency, bandwidth, sensitivity, ringdown, angular response, time-of-flight, and lateral focus. By applying random numbers within the tolerance range to the variations in input parameters, the automated set of simulations is performed. First, critical input parameters for components of the transfer function are identified by sensitivity analysis. Next, the statistical range of parameter values that yield a transducer model with a certain performance level is determined and the limit of variations in each factor for acceptable degradation of images is set. Finally, the creation of many "what if" cases to predict yield and statistical performance of a transducer and the imaging simulation are performed based on Monte-Carlo method. [Work supported by Sound Technology Inc.]

TUESDAY AFTERNOON, 17 MAY 2005 GEORGIA A, 1:00 TO 4:05 P.M.

Session 2pEA

Engineering Acoustics, Acoustical Oceanography and Underwater Acoustics: Underwater Acoustic Sensor Technologies

Dehua Huang, Cochair
Naval Undersea Warfare Center, 1176 Howell St., Newport, RI 02841-1708

Thomas R. Howarth, Cochair
NAVSEA Newport, 1176 Howell St., Newport, RI 02841

Chair's Introduction—1:00

Invited Papers

1:05

2pEA1. Injection-molded 1-3 piezocomposite sensor development: The last ten years. Kim C. Benjamin (Naval Sea Systems Command Div. Newport, 1176 Howell St., Newport, RI 02841)

The past ten years have seen several interesting demonstrations of 1-3 piezocomposite when used as the active component in sonar sensors. Initially considered receive only by most in the field, piezocomposite has evolved into a proven broadband transducer material with both receive and transmit capability. From large aperture single element calibration transducers, to parametric mode projectors, the material has surprised many experts with its power handling capability. Its polymer constituent provides an amazing degree of versatility by allowing the thermoforming and shaping of transducer substrates for packaging into todays undersea vehicles. This talk will review the last ten years of piezocomposite transducer and array development focusing on both the materials transmit behavior and fabrication benefits for future sonar applications. [Work supported by the U.S. Navy.]

1:30

2pEA2. Engineering applications of limited diffraction beams. Jian-yu Lu (Ultrasound Lab, Dept. of Bioengineering, The Univ. of Toledo, Toledo, OH 43606, jilu@eng.utoledo.edu)

Limited diffraction beams (LDBs) are non-divergence and non-dispersive solutions to isotropic-homogeneous wave equations. These beams have a common characteristic of X-shaped branches and thus are also called X waves. Because of their highly directional propagation property, they have potential applications in medicine, underwater acoustics, and nonlinear optics (Charles Day, Phys. Today, October, 2004, pp. 25–26). In this talk, an overview of the development of LDBs will be given. This includes the conversion of any existing solutions to homogeneous or non-homogeneous wave equations to LDB solutions using Lorentz-related transformation, and a discussion of the orthogonal properties of the X wave transformation pair in representing any physically realizable waves. Experiments on applications of LDBs using our newly developed general-purpose ultrasound system will also be reported. (The system is capable of 128-channel simultaneous ultrasound data acquisitions at 12-bit/40 MHz rate and can hold real-time radio-frequency (RF) data up to 64 GB in one acquisition operation. Arbitrary ultrasound waveforms can be simultaneously produced by 128 12-bit/40 MHz D/A converters and then be linearly amplified to drive 75-Ohm loads or an array transducer at about ±150 V.)

1:55

2pEA3. Fiber optic acoustic sensor technology. James Cole, Clay Kirkendall, and Anthony Dandridge (Naval Res. Lab, 4555 Overlook Ave., SW, Washington, DC 20375)

Fiber optic sensor technology has been under development for over 25 years, recently a major milestone has been reached- the introduction of the Fiber Optic Wide Aperture Array on the first Virginia class submarine. This paper will review the development of this technology, outlining the principles of operation and the technological developments that led to fiber optic interferometric sensors becoming viable for production in an advanced sonar system. The Fiber Optic Wide Aperture array is a large channel count planar array mounted on the side of the submarine, but fiber sensor technology is also being developed for both towed arrays (as a replacement for the Navy's thin-line towed arrays) and for bottom mounted acoustic arrays for a number of Navy applications. This

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