1:35

1pSP2. Acoustic Bessel bullets: Where did they come from and where are they going. Peter Stepanishen (Dept. of Ocean Eng., Univ. of Rhode Island, Kingston, RI 02881)

Acoustic Bessel bullets (BB's) are a new class of band-limited transient localized waves. A brief review of the development of acoustic BB's using space–time methods is first presented where the roots are traced back to the well-known plane-wave solution of the 1-D wave equation. Although ideal three-dimensional acoustic BB's which maintain their spatially dependent shape and time history as they propagate in free space can be generated from an infinite planar aperture, edge diffraction effects play an important role in determining the space–time characteristics of the acoustic BB's generated by a finite planar aperture. A generalized modal impulse response approach is proposed to investigate the characteristics of acoustic BB's and other localized wave fields generated from finite planar apertures with radially symmetric space–time source distributions. Numerical results are presented to illustrate the general space–time characteristics of the modal decomposition of the source distributions, the generalized impulse responses, and the associated acoustic BB fields. These results will illustrate the trade-offs between the radial extent of the acoustic BB's and the near-to-far-field transition. Several interesting characteristics of the far field will also be discussed.

2:05

1pSP3. Limited diffraction beams and their applications on signal processing. Jian-yu Lu (Ultrasound Lab., Dept. of Bioengineering, The Univ. of Toledo, Toledo, OH 43606, jilu@eng.utoledo.edu)

Limited diffraction beams such as Bessel beams and X waves have been studied recently. These beams have many potential applications in medical imaging, tissue identification, blood flow velocity vector estimation, nondestructive evaluation of industrial materials, optical communications, and other physics related areas such as electromagnetics and optics. In this talk, fundamentals of limited diffraction beams will be presented. Results of applications of X wave theory on high-frame rate medical imaging will be shown. Applications of these beams in other areas, especially, in signal processing will be discussed. [This work was supported in part by grant HL 60301 from the National Institutes of Health.]

2:45–3:00 Break

Contributed Papers

3:00

1pSP4. Broadband processing using localized waves in a shallow ocean environment. David H. Chambers, James V. Candy, and D. Kent Lewis (Lawrence Livermore Natl. Lab., POB 808, Livermore, CA 94551)

In this paper the MPS localized wave pulse is used as the basis for designing a broadband signal processor to discriminate between two point sources. The nonseparable nature of the MPS pulse requires a "best fit" approach to processor design. This approach illustrates the kinds of problems one would encounter when using localized waves in a processor. The processor design is described, then applied to simulated acoustic signals generated in a shallow ocean environment. The results show that the MPS-based processor can discriminate between the two sources at least as well as a more conventional broadband beamformer. No attempt is made to estimate the positions of the sources. [This work was performed under the auspices of the Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.]

3:15

1pSP5. Localized wave beam forming tests. D. Kent Lewis, James V. Candy (Lawrence Livermore Natl. Lab., 7000 East Ave., Livermore, CA 94550), and Richard W. Ziolkowski (Univ. of Arizona, Dept. of Elec. and Computer Eng., Tucson, AZ 85721)

Much has been reported about work done creating the localized wave (LW) acoustic pulse using active beam creation. This presentation will show work done in passive beam forming using the LW source signals as array filter coefficients. The simple tests which were performed showed that the LW filter can detect wide bandwidth signals in an idealized medium, and that there is an apparent increase in signal resolution. These results suggest that there may be applications for other low-diffraction beam techniques in passive signal processing. [This work was performed by the Lawrence Livermore National Laboratory under the auspices of the U.S. Department of Energy under Contract No. W-7405-ENG-48.]

3:30

1pSP6. Acoustical helicoidal wave transducers with applications for the alignment of ultrasonic and underwater systems. Brian T. Hefner and Philip L. Marston (Dept. of Phys., Washington State Univ., Pullman, WA 99164-2814)

A simple four-panel transducer capable of producing a beam with a screw-dislocation along its axis was constructed and evaluated. A screw-dislocation in a wave front is characterized by a phase dependence about the dislocation axis that varies as $\exp(-im\phi)$, where m is an integer and ϕ is the angle about the axis. At the axis the phase is indeterminate and as a result there is a corresponding null in the pressure magnitude. To generate a wave front with these characteristics, a four-panel 3-1 composite piezoelectric transducer was driven with the appropriate phasing of the panels to create dislocation along the beam axis. As a result the beam does not possess cylindrical symmetry, however, the dislocation is found to exist in both the far and near fields of the transducer. This null then clearly indicates the axis of the beam at all distances and has the potential to be used as an aid in the alignment of objects in sonar experiments or other similar applications. A related transducer was summarized previously [J. Acoust. Soc. Am. **103**, 2971 (1998)] and is also discussed here for the purposes of comparison. [Work supported by the Office of Naval Research.]