An Experimental Investigation of Subharmonic Generation in an Acoustic Interferometer

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EE9. An Experimental Investigation of Subharmonic Generation in an Acoustic Interferometer. NAI-CHYUAN YEN, *Naval Underwater Systems Center, New London, Connecticut 06320.*—In our previous study [J. Acoust. Soc. Amer. **49**, 119(A) (1971)], we showed that the nonlinear properties of the medium can induce coupling among the modes in a multiresonant system and the theory is able to predict the threshold and the steady-state response of subharmonic components. Such a mechanism is further illustrated by observing the subharmonic generation phenomenon in an acoustic interferometer. The experimental investigation was conducted with a 1.5-mHz driving signal and used filtered and degassed water as the medium. Data concerned with the actual modes of the interferometer, the loss factor associated with the subharmonic modes, and the threshold of subharmonic generation, with length of the interferometer and the driving frequency varying, are consistent with the analytic results provided that cavitation is carefully avoided. [The work was carried out at Harvard University and supported by the Office of Naval Research.]

EE10. Effective Length of Horns. R. W. PYLE, JR., *Bolt Beranek and Newman, Inc., Cambridge, Massachusetts 02138.*—Some authors, writing about brass musical instruments, have loosely used the term "effective length," usually meaning the length of a cylindrical tube with the same resonance frequencies as a given horn, but possibly with different end conditions. In this paper, an attempt is made to define effective length in a precise way that is still consistent with the intent of previous workers who have used the term. Within the framework of plane-wave horn theory, a nonlinear first-order differential equation is derived that yields effective length as a function of frequency and horn contour. This formulation appears well suited to calculating the effect of small changes in the bore of a brass instrument by using a perturbation technique. The differential equation has been solved for some horn contours resembling brass instruments. The solutions display good qualitative agreement with the effective lengths of actual instruments, determined from measured resonance frequencies.

EE11. Seeding the Field of Acoustical Signal Processing. VICTOR C. ANDERSON, *University of California, San Diego, Marine Physical Laboratory of the Scripps Institution of Oceanography, San Diego, California 92132.*—This is an historical look at the contributions to the field of acoustical signal processing which originated under the nurture of F. V. Hunt at the Harvard Acoustics Research Laboratory. The early research is highlighted by the work of Faran and Hills on the use of correlators for space–time processing. This early work was followed by research in the use of multiple element arrays and by the development of real-time processors for correlation and beamforming applications. The impact of these contributions can be seen in the expanding field of signal-processing research today. Upon retirement, Hunt transferred the pursuit of his last research interest, "Sic Transit Sonitus"—a ship transit detector, to the Marine Physical Laboratory, where a real ocean investigation of the technique is currently underway.

(Session ends 5:15 P.M.)

FRIDAY, 13 APRIL 1973 — PARLORS B AND C, 9:00 A.M.

Session FF. Physical Acoustics III: Nonlinear Dispersive Waves

ALLAN D. PIERCE, *Chairman*

School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332

Invited Papers (30 minutes)

FF1. Perturbation Theory of Nonlinear Wave Propagation. JOSEPH B. KELLER, *Courant Institute of Mathematical Sciences, New York University, New York, New York 10012.*—The usual perturbation method yields some results about nonlinear wave propagation, but they are limited by the occurrence of secular terms. The modified perturbation method, to be described in this lecture, eliminates these terms, and thereby leads to much more useful results. These results show how the frequencies of free vibration depend upon the amplitude of vibration and how the wavelength of a periodic wave motion depends upon its amplitude. They also show how the amplitude of a forced vibration remains finite but becomes large at a resonant forcing frequency. In addition, they show that the forced vibration is often not unique, but that there are usually several possible states of motion with different amplitudes. As a consequence, jumps in amplitude can occur when the forcing frequency is varied, and different amplitudes can be reached by increasing and by decreasing the frequency. Some examples illustrating these considerations will be presented.

FF2. Solitons and "Synacetics." NORMAN J. ZABUSKY, *Bell Laboratories, Whippany, New Jersey 07981.*—The soliton, a localized wave entity, has successfully described long-wave propagation in a a class of one-dimensional, nonlinear, dispersive, continuous, and discrete systems. We demonstrate how "synacetics" (synergetic amalgam of analysis, computation, and experiment) has led to new in-