Characterization of acoustic emission sources, sensors, and propagation structures

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(TTC) systems. Measurement locations included the subway structure, ground surface, and at nearby buildings. The data were analyzed in 1/3 octave bands with a range of 3.15–1250 Hz. The subway configurations tested included circular rock tunnels, circular earth tunnels with steel and concrete liners, horseshoe rock tunnels, and cut-and-cover double box subways. Evaluation of the WMATA continuous floating slab performance characteristics are included, and comparisons are made between the continuous (WMATA Metro) and discontinuous double tie (TTC) floating slab trackbeds which represent the state-of-the-art in rail transit train vibration isolation. Surface ground vibration characteristics of the WMATA Metro system are also compared with those of the TTC system.

FRIDAY MORNING, 1 DECEMBER 1978 HONOLULU ROOM, 8:00 A.M.

Session EEE. Physical Acoustics IX: Acoustic Emission I

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Invited Papers

8:00

EEE1. Characterization of acoustic emission sources, sensors, and propagation structures. N. N. Hsu and W. H. Sachse (Center for Materials Science, National Bureau of Standards, Washington, DC 20234)

Acoustic emission signals carry potentially useful information about the criticality of deformation source mechanisms in materials, but signal processing techniques such as threshold counting, RMS voltage recording, peak detection, and spectral analysis often failed to extract such information unambiguously. The difficulty lies in the determination of the transfer characteristics of the structure and the sensor. We report experimental results of a computer-based test system consisting of a large plate and a capacitive transducer [N. N. Hsu, J. A. Simmons, and S. C. Hardy, Materials Evaluations **35**(10), 100–106 (1977)]. The transient wave propagation behavior of the plate and the transfer function of the capacitive transducer are known. Consequently, unknown sources can be characterized by solving the Töplitz matrix directly. Explicit force–time functions of simulated signals such as breaking glass capillaries, breaking pencil leads, dropping steel balls, electrical arcs, and pulsed piezoelectric transducers have been determined. These force–time functions are then used to determine experimentally the transfer characteristics (impulse-response) of various propagation structures and various ultrasonic transducers.

8:30

EEE2. Studies in the digital analysis of acoustic emission signals. A. G. Beattie (Division 1552, Sandia Laboratories, Albuquerque, NM 87185)

The complexity of the waveforms of acoustic emission signals is strong evidence that much information is contained in these signals. The problems are, however, first, can this information be retrieved in a useable form and, second, does the information relate to the source of the emission or only to the structure in which it is generated. This paper reports the results of an investigation into methods of retrieving this information by means of signal digitization and subsequent computer analyses. Topics covered are signal digitization, spectral computations with a Fast Fourier transform (FFT), the effect of windowing on the calculations, spectral averaging, energy calculations, and attempts to calculate and use transducer transfer functions. The emphasis throughout is on methods and results and not on mathematical rigor. The paper closes with some examples of analysis of experimental data and some speculations on where digital analysis can be useful in acoustic emission tests and experiments.

9:00

EEE3. Calibration of acoustic emission transducers. Hajime Hatano and Eiji Mori (Tokyo Institute of Technology, Nagatsuta, Midori-ku, Yokohama, 227 Japan)

This paper reviews the state of the art on the calibration of acoustic emission transducers, which is essential to establish the basis for the standardization of acoustic emission technology. For this purpose, absolute sensitivity should be determined quantitatively in a sound field similar to that of