Acoustic emission source characterization

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Citation: The Journal of the Acoustical Society of America **68**, S103 (1980); doi: 10.1121/1.2004511
View online: https://doi.org/10.1121/1.2004511
View Table of Contents: https://asa.scitation.org/toc/jas/68/S1
Published by the Acoustical Society of America

(increased voice duration, increased syllable duration, movement plateaus, increased durations of movements, etc.) are related to the point in the articulatory cycle that feedback occurs. The differences in the effects of 100 and 200 ms delays may be accounted for by the probabilities that feedback will occur during different points of articulatory movement under these different delays. The DAF effect will be discussed in terms of a model of the role of auditory information in speech production rather than in terms of auditory loop times.

[a] Also at Haskins Laboratories, 270 Crown St., New Haven, CT 06510.

FRIDAY MORNING, 21 NOVEMBER 1980 ASSEMBLY ROOM, 9:00 A.M. TO 12 NOON

Session AAA. Shock and Vibration IV: Acoustic Emission

H. H. Vanderveldt, Chairman

Naval Sea Systems Command, Washington, D.C. 20362

Invited Papers

9:00

AAA1. Acoustic emission source identification. R R. E. Green, Jr. (Materials Science and Engineering Department, The Johns Hopkins University, Baltimore, MD 21218)

Acoustic emission, the phenomenon of stress wave release from microstructural alterations in solid materials, has not optimally fulfilled its promise as a nondestructive testing technique since the precise characteristics of the stress waves emitted from specific sources remain unknown. The present work describes an experimental system which overcomes the numerous problems associated with conventional piezoelectric transducers and video tape recorders and permits the precise characteristics of the acoustic emission signal to be determined. This system incorporates a laser beam interferometric surface displacement detector and a high speed digital capture and signal processor. The present work also describes how proper choice of workpiece geometry coupled with analytical calculations yields new insight into the influence of workpiece transfer function on the detected acoustic emission signal. Finally, comments will be made as to the possibility of acoustic emission source identification in practical field situations. [Work supported by Naval Sea Systems Command.]

9:30

AAA2. Notes on acoustic emission source identification. S. D. Hart (Naval Research Laboratory, Washington, DC 20375)

Sources of acoustic emission are often identified in the laboratory through otherwise known mechanical and material properties of the specimens. It is tempting to speculate on the possibility of identification through analysis of the signals (emissions) directly. One approach involves study of the Fourier spectra of the emissions. Recognizing that a signal must undergo any number of transformations in its passage from source to analyzer workers have sought standard or known sources which may be used to obtain the various transform functions involved through a deconvolution process. This paper will describe two proposed standard signals and results of some experiments designed to evaluate them.

10:00

AAA3. Acoustic emission source characterization. H. N. G. Wadley,[a] C. B. Scruby, and J. E. Sinclair (A.E.R.E., Harwell, Oxon, England)

The source function for glissile dislocation loops and microcracks have been modeled in terms of time dependent force dipoles and the acoustic emission waveforms, at the epicentre, evaluated for an isotropic elastic half-space. A specimen geometry has been designed that allows microcracking to occur under the influence of an applied stress but which also approximates to a half-space for a short period of time after operation of an event. The epicentre waveforms of such a specimen have been measured, quantitatively, with a broad band capacitance transducer and the waveforms recorded by Biomation transient recorders and stored on computer disk. The inverse transfer function for the experimental configuration has been calculated and used to determine the source function of carefully characterized brittle cleavage and intergranular microcracking in mild steel and electrolytic iron at 77K. The microcrack lengths deduced from acoustic emission measurements were consistent with fractographic observations. The velocity of microcrack growth, also deduced from acoustic emission measurements, indicated the existence of a limiting microcrack speed of about half the shear wave speed in both materials. [This work has been jointly funded by A.M.T.E., Holton Heath and RAE Farnborough through MOD (Procurement Executive) and by AERE, Harwell.]

[a] On temporary attachment to NBS, Washington, DC 20234.

10:30

AAA4. In-flight crack detection via acoustic emission. J. M. Carlyle (Naval Air Development Center, Warminster, PA 18974)

Ultrasonic waves created by the growth of cracks are termed acoustic emissions. Triangulation techniques can be used to locate the sources of the crack emissions, but benign acoustic noise sources such as fretting bolts and chaffing plates often produce signals which are similar to crack emission signals and which hinder the positive confirmation of crack existence. A current research program is utilizing pattern recognition to distinguish between genuine crack signals and benign structural noises in an effort to develop a flyable acoustic emission integrity monitoring system. The history of the project and recent progress will be reviewed.

11:00

AAA5. On-line weld monitoring with acoustic emission. W. Lichodziejewski (GARD, Inc./GATX Corp., 7449 No. Natchez Avenue, Niles, IL 60648)

Detection of flaws *during* the welding process rather than *after* has many attractive features: reduction in the amount of bad weld, less costly weld repair, less repair disturbance of the welded material, etc. GARD's use of acoustic emission for flaw detection during welding (i.e., listening to acoustic signatures of flaws formed during weld solidification) has progressed significantly during the last few years —from initial attempts at simple detection of flaw presence to microprocessor-based equipment providing on-line flaw detection, flaw location, and flaw characterization (as to type and size). Interest in the technique has become prevalent enough that it is documented in a new ASTM Recommended Practice (E 749-80). This paper reviews some of the considerations in the use of the technique, presents some of the results achieved, describes some of the latest equipment developed and some of the current applications being studied.

Contributed Paper

11:30

AAA6. The response of a rectangular parallelepiped to a simulated acoustic emission burst. E. V. K. Hill (Department of Aerospace, Mechanical and Nuclear Engineering, University of Oklahoma, Norman, OK 73019)

The forced vibrational response of the rectangular parallelepiped is of particular interest in the study of wave propagation in three-dimensional solids and especially in the characterization of acoustic emission sources. There has been considerable interest in studying source mechanisms in order to predict, and perhaps eventually control, flaw growth in structural materials. The acoustic emission source waves generated by flaw growth are thought to be pulselike functions of stress (force) which are produced by the step displacements associated with material yielding. Much of this type of emission in solids is produced internally and can therefore be modeled as a body force phenomenon; as such, this paper presents a normal mode solution for the response of a rectangular parallelepiped to an impulsive body force. The numerical results prior to any reflections from the boundaries show good agreement with the infinite space solution.