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NASA TECH BRIEF

Marshall Space Flight Center

Real Time Statistical Analysis of Acoustic Emission Signals for Flaw Monitoring Systems

The problem:

Acoustical signals are a useful means for detection of flaws in physical structures. Small structures are checked this way by monitoring the samples for acoustical signal count or count rate. Any flaws in the structure are located by observing the relatively high acoustical activity within a given area of the sample. Large structures, however, are more difficult to analyze this way because of the greater areas that must be monitored.

The solution:

Based on the technique used in small structures, acoustical monitoring has been extended to large structures by dividing the large samples into small areas and then by monitoring each individual area separately.

How it's done:

The sample used in this development is a 105-in. (263-cm) diameter tank which consists of 3480 areas each approximately 10 in.^{2} (63 cm^2). The tank surface is proportioned to allow the layout of 20 equilateral triangles in the form of a slightly distorted icosahedron. Twelve transducers are equally positioned on the tank surface at the vertex of each of these triangles. The equilateral triangles are slightly elongated to account for the small cylindrical section of the tank, but are otherwise identical in size and shape. The system is divided into two distinct data handling segments, an analog and a digital.

The first segment operates in the analog mode and continuously monitors input signals from each transducer. Approximate location of the acoustic event is obtained by processing signal detection sequences and delay. This data is packed in the binary form and passed to the digital computer for further processing.

The second segment operates in the digital mode. Delay information from the analog unit is processed to provide an exact location of the acoustic event. The surface of the tank is divided into 3480 areas. A digital computer contains separate storage locations corresponding to each of these areas. A running sum of all acoustic activity is maintained in these storage locations by the digital computer. System operation is controlled through a standard teletypewriter. The data received and stored in the computer can be requested by the operator at any time and in any form that he desires.

Although noise rejection is used throughout the system, i.e., dual element transducers and bandpass filters, a constant background or random noises uniformly raise the totals of a large number of signal counts from all the storage areas. In this technique, a growing flaw area is localized and easily identified using the statistical capabilities of the on-line computer. For example, mean averages can be obtained of desired specific sub-areas of the entire tank at any time. The rate of emission signals for any given time can also be obtained. Statistical calculations are obtained from all input data in less than one second.

(continued overleaf)

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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