NASA TECH BRIEF
NASA Pasadena Office

Simultaneous Processing of Vibration Test Data

Specifications for conducting vibration qualification tests on large objects (e.g., aircraft structures) require that determination be made of the forces actually applied to the test object by analyzing recordings of the output of sensors disposed either on the test object or test fixture to which the object is attached. Typically, recordings of the outputs of sensors, such as accelerometers, are made on multichannel magnetic tapes, utilizing one channel for each of the sensors and one for the frequency spectrum.

Generally, data are transferred from each of the tracks in sequence and transcribed by means of an X-Y recorder to obtain a visible record of the forces sensed by each accelerometer. As each channel output is transcribed, it is superposed on one X-Y recording to form a master graphical representation of the test results. Considerable time is required to produce the master record because each channel must be recorded separately, but in recent work it has been found possible to reduce the time required by injecting data from the record tracks of all of the accelerometers simultaneously into electronic circuits which convert inputs into a single, composite graphical representation. Three methods of processing the data have been found adequate.

Method I: Peak acceleration at a frequency. The ac waveforms from analog FM-recorded tapes of eight control channels are played into an eight-channel detector-averager which converts the ac waveform into a proportional dc voltage level. Each of the eight channels is patched into an analog computer board which provides buffering and amplification. The channels are then fed into a circuit of eight cascaded comparator relays; sensitivity of the relays is set so that a difference of 10 mV between channels will trip a relay and direct the higher voltage to the next comparator set. The output of the last comparator is the highest voltage present in the eight input channels. Final scaling is performed by an output amplifier which provides suitable voltage inputs to the Y axis of an X-Y recorder for plotting the output. The X axis of the X-Y recorder represents the shaker sweep frequency as recorded on a separate tape channel and converted to a dc voltage by a frequency-to-voltage meter.

Method II: Average of all channels. To determine the average of the inputs from the control channels with respect to frequency, data from the analog control channels are fed into detector-averagers and converted into equivalent dc levels; each channel input is brought into the analog computer via a buffer amplifier. The individual voltages are summed and divided by the number of channels to determine the average value; the output is also plotted by an X-Y recorder.

Method III: Quad-mean of all channels. The inputs from eight control channels are detected and then patched to an analog program board. Inputs are again buffered and, in this case, the individual voltages with respect to frequency are squared, summed, divided by the number of channels, and the square root is then taken. The output is plotted on an X-Y recorder.

The average and the quad-mean of eight channels are usually plotted simultaneously during a single pass of the analog tape. The analog computer inputs are paralleled to perform the calculations and to provide both average and quad-mean outputs for separate

(continued overleaf)

plotters. Plots can be scaled in engineering units for peak, rms, or average terms. Plots can also be displayed logarithmically on the Y axis.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 73-10139

Patent status:

NASA has decided not to apply for a patent.

Source: Eugene E. Reddeman of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11616)