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Brief 71-10251

NASA TECH BRIEF

Lewis Research Center

Variable Sweep-Rate Shortens Dynamic Testing Time

The problem:

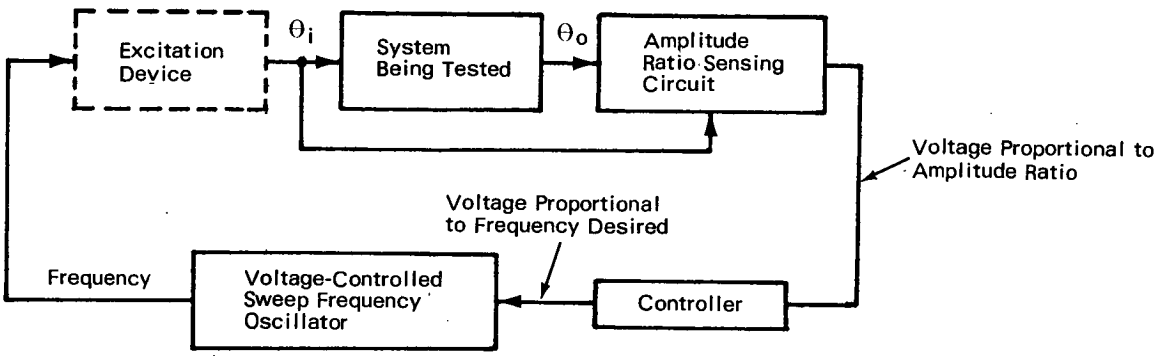
To develop methods for obtaining data of the desired accuracy, in a minimum time, for the dynamic study of large systems, such as complex structures subjected to vibration-testing involving hundreds of measurements. Data analysis can take several hours when the data are derived by conventional sweep-frequency methods. If the same accuracy can be maintained while the sweep time (and hence, the analysis time) is appreciably reduced, significant cost reductions could be effected.

The solution:

A testing method that adjusts the sweep frequency of the system being tested such that the sweep is slow (nominal) when a selected dynamic event (such as system resonances, corner frequencies, nodes, etc.) occurs, but is rapid otherwise. Since system resonance was chosen in this case, testing is performed at a variable sweep rate, using a closed-loop controller that senses when the system under test is going into resonance. As that occurs, the controller appropriately slows the sweep. With this variable sweep rate, the total testing time is considerably reduced.

How it's done:

The basic variable sweep-rate control scheme is shown in the figure. Essentially, one item—the controller—has been added to the conventional frequency-response measurement setup. The controller closes the feedback loop. The oscillator included provides an output frequency that can be set by an external voltage. The absolute value of the amplitude ratio, $\frac{\Theta_o}{\Theta_i}$, (where Θ_o and Θ_i are appropriate system output and input variables, respectively) and its rate of change are the indicators of system resonance. As these increase, the sweep rate is reduced from its high nominal value.



Using this technique, time reductions of 7.5:1 were achieved in measurements on a simulated test system, while an accuracy of 0.5% was maintained in the results.

Notes:

1. Possible industrial applications of this technique include routine dynamic and vibration tests on numerous systems, subsystems and products. These would include vibration tests on electric motors, gasoline engines, automobiles, etc. Further, the

(continued overleaf)

technique appears applicable to the frequency response testing of circuits in the electronic industry and to signature testing for maintenance purposes.

2. The following documentation may be obtained from:

   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference:
   NASA-TN-D-7022 (N71-12734), Variable Sweep-Rate Testing: A Technique to Improve the Quality and Acquisition of Frequency Response and Vibration Data.

3. Technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B71-10251

Patent status:

No patent action is contemplated by NASA.

Source: C. F. Lorenzo
Lewis Research Center
(LEW-11238)