NASA TECH BRIEF

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Mass Loading Effects on Vibrated Ring and Shell Structures

Efficient methods for predicting the effects of attached masses on the vibration characteristics of ring and shell structures have been developed and substantiated with experimental data. Analytically, the series expansion technique is used in solving the mass-loaded shell problem, while both the finite-element and transfer-matrix methods are employed in the analysis of mass-loaded ring structures. Experimentally, aluminum ring and shell structures loaded with discrete masses are excited by an electrical induction force, and the vibratory motion is measured by an automatically revolving proximity gage. The influences of the masses of the exciter and of the instrumentation are thus eliminated. Response data are obtained with miniature accelerometers and with a proximity gage for comparison purposes. The studies show, in addition to the amplitude changes of the local vibration response caused by the addition of the discrete masses, the frequency shifts, the change of modal behavior, and the transmissibility characteristics resulting from the increased discrete mass on the structure. The results show (1) that the response attenuation for the first mode is somewhat similar to the procedure currently recommended by NASA/MSFC for predicting the amplitude reduction of the local vibration response of unloaded structure to account for the influence of the addition of the mass; (2) that for higher modes, much more amplitude reduction progresses very rapidly; and (3) that the transmissibility characteristics in a function of normal modes, indicate some differences for beams, plates, honeycomb plates, rings, and shells.

Note:

Documentation for the innovation is available from:
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No patent action is contemplated by NASA.

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