2001-06

An Approach to Properly Account for Structural Damping, Frequency-Dependent Stiffness/Damping, and to Use Complex Matrices in Transient Response

MSC.Software Corporation

Transient response analysis in MSC.Nastran is performed using real arithmetic. Structural damping requires a complex stiffness matrix to properly account for its effects. Unfortunately, these two facts mean that when performing transient response analysis in MSC.Nastran, structural damping must be approximated.

Frequency-dependent elements (such as the CBUSH) are available in Frequency Response solutions, but must be linear in Transient Response .

Adding a complex matrix into a transient response solution is not allowed, meaning that the user must come up with a way to "convert" their complex matrices into equivalent real matrices.

This paper provides an approach to properly account for structural damping, frequency-dependent elements, and to include complex matrices in transient response by using the Fourier Transform approach.

In addition, the approach in this paper allows for a dimple solution of a structure with multiple harmonic inputs acting simultaneously (for example a car, which has multiple rotating bodies, each with a different steady-state frequency, acting simultaneously. A list of some of these is:

a) engine crankshaft

b) camshaft(s)

c) the wheels,

d) driveshaft

e) alternator

f) power steering pump

and many more. Solving for a steady-state solution of this model would require a transient solution integrating over an extended period of time. Using Fourier transformations and frequency response can do it quickly and efficiently.