A COMPONENT-BASED MODELING METHOD FOR THE DYNAMIC ANALYSIS OF BUILT-UP STRUCTURES

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An effective method for the dynamic analysis of built-up structures is of great importance to the structural design of a wide range of mechanical systems. In this presentation, a new component-based modeling method is discussed in which a complex dynamic system is considered as a built-up structure made of some basic structural elements such as beams, plates and shells. The displacements on each component are expressed in the form of a generalized fast-converging Fourier series. The interactions of various components at the junctions are accurately described based on the force equilibrium equations. The analytical representation of the displacements on each structural component allows an easy calculation and manipulations of many other important quantities of concerns. Numerically, this modeling strategy is advantageous in that the total number of degrees of freedom in the system model can be drastically reduced. In applications, such a modeling tool is better suitable for the assessment of concept designs in view of its close resemblance to a CAD model.

Example problems will be solved to demonstrate the applications of this method to various structures including beams, plates and shells with arbitrary elastic boundary supports. Examples involving coupled-beam systems are also given to examine the energy flows between structural components. Excellent numerical characteristics are repeatedly illustrated with regards to the accuracy and convergence of the solutions. Unlike most existing component synthesis methods, the current method not only faithfully preserves the coupling conditions between any two structural components under the actual system configuration, but also requires no secondary derived model parameters, and hence considerably reduces the modeling efforts and errors.

Keyword: structural dynamics, dynamic systems, numerical methods