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ABSTRACTS

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DYNAMIC ANALYSIS OF MODIFIED STRUCTURAL SYSTEMS

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The subject of this study is the development of a set of methods for the calculation of the changes in the frequency of vibration and mode shape of a structure due to changes in the physical system. Such changes may consist of variations of the structural properties of a given system or even of the addition of new degrees of freedom.

One family of iterative methods that has been used effectively for improvement of modes and frequencies is based on an application of the Newton-Raphson technique to the equations defining modes and frequencies. The method is applicable to cases with multiple or close frequencies as well as to cases where they are widely separated. However, in their original statements, these methods are not capable of handling additional degrees of freedom arising from changes in the structural system. The current work extends these techniques to the cases of added degrees of freedom and, moreover, allows for considerable reduction in computational effort even when there are no additional degrees of freedom.

The original vibrating system is replaced by an augmented system, which may have more degrees of freedom than the original one. The augmentation is described by mass and stiffness matrices, and the original matrix expression of the system may have to be rewritten with suitable rows and columns of zeros to make the two sets of matrices conformable for addition. The augmentation mass and stiffness matrices are taken proportional to a single parameter which can vary from just larger than zero to sizable positive values. A perturbation analysis is then performed on this augmented system.

The iterative character of the basic method for improving frequencies and modes is modified so that each step now corresponds to a calculation of the next order of perturbation. This modification eliminates the difficulty of dealing with very light additional masses and results in successive solutions of linear matrix equations all having the same coefficient matrix. Unlike in the original method, which requires a new triangularization at each step, the expensive repeated triangularizations are not needed in the perturbation scheme.

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