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The Complete Modal Derivatives

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Abstract : The use of basis projection in the structural dynamic analysis is frequently applied. The purpose of the method is to improve the computational efficiency, while maintaining a high solution accuracy, by projection the governing equations onto a small set of carefully selected basis vectors. The present work considers basis projection in kinematic nonlinear systems with a focus on two widely used basis vectors; the system mode shapes and their modal derivatives. Particularly the latter basis vectors are given special attention since only approximate modal derivatives have been used until now. In the present work the complete modal derivatives, derived from perturbation methods, are presented and compared to the previously applied approximate modal derivatives. The correctness of the complete modal derivatives is illustrated by use of an example of a harmonically loaded kinematic nonlinear structure modeled by beam elements.

Keywords : basis projection, finite element method, kinematic nonlinearities, modal derivatives
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