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PERFORMANCE OF A COMPUTATIONAL COST REDUCTION TECHNIQUE IN LENGTHY TIME INTERVAL ANALYSES

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The true behaviour of structural systems is dynamic, and the conventional analysis methods of dynamic behaviours. i.e. direct time integration and modal superposition, are both involved in time integration. Time integration analyses consider the external forces/excitations as digitized records. Comments exist for the appropriate digitization step size, indeed implying the integration step size. However, there also exit excitations that are inherently available as digitized records, e.g. strong ground motions. In these cases the step size by which the excitations are digitized might be different from the comments regarding integration step size. When the latter is considerably larger than the former, implementation of the existing comments causes disregarding most of the excitation information, and hence, in these cases, the convention is to use integration steps as small as the inherent excitation steps, and accept the considerable additional computational cost. To reduce the computational cost, recently a technique is proposed that can replace the original excitations with excitations digitized at larger steps, by taking into account all the excitation information approximately according to a special convergence-based formulation. With attention to the slight additional errors involved in implementation of the proposed method, this paper discusses whether the additional errors can cause numerical instability, or in other words may the additional errors be accumulated and after considerable number of integration steps lead to very large errors.

The study is carried out both theoretically and also via numerical examples, and as the consequence, the errors will not go to infinity even after infinite number of steps especially in linear problems. The case is somehow different in nonlinear problems, and the amount of errors also depends on the nonlinearity solutions and amount of the nonlinearity residuals, and meanwhile the severity of the nonlinear behaviour. However, for moderately nonlinear behaviours, in time integration analyses, with sufficiently small residuals, the case would be similar to linear analyses.

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