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Error assessment for timeline-dependent quantities of interest in transient elastodynamics

Francesc Verdugo[*], Núria Parés[†] and Pedro Díez[*]

[*] Laboratori de Càlcul Numèric (LaCàN),
Universitat Politècnica de Catalunya (UPC),
Jordi Girona, 1-3, E-08034, Barcelona, Spain.

[†] Laboratori de Càlcul Numèric (LaCàN),
Escola Universitària d'Enginyeria Tècnica Industrial de Barcelona (EUETIB),
C/ Compte d'Urgell, 187, E-08036, Barcelona, Spain.

Emails: {francesc.verdugo,nuria.pares,pedro.diez}@upc.edu, - Web page: www-lacan.upc.edu

ABSTRACT

This work presents a new approach to assess the error in specific quantities of interest in the framework of linear elastodynamics. In particular, a new type of quantities of interest (referred as timeline-dependent quantities) is proposed. These quantities are scalar time-dependent outputs of the transient solution which are better suited to time-dependent problems than the standard scalar ones available in the literature [1]. The proposed methodology furnishes error estimates for both the standard scalar and the new timeline-dependent quantities of interest. The key ingredient is the modal-based approximation of the associated adjoint problems which allows efficiently computing and storing the adjoint solution.

The adjoint solution is readily post-processed to produce an enhanced solution, requiring only one spatial post-process for each vibration mode and using the time-harmonic hypothesis to recover the time dependence. The recovery procedure of the vibration modes is very simmilar to the one presented in [2]. The proposed goal-oriented error estimate consists in injecting this enhanced adjoint solution into the residual of the direct problem. The resulting estimate is very well suited for transient dynamic simulations because the enhanced adjoint solution is computed before starting the fordward time integration of the direct problem. Thus, the cost of the error estimate at each time step is much reduced.

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