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"Relaxation methods and finite element schemes for the equations of visco-elastodynamics"

ABSTRACT : We discuss the numerical modeling of visco- elastodynamics based on finite element schemes for an inherent (singular hyperbolic) relaxation approximation.
Such a system is obtained by diffusive scaling from the standard relaxation model associated with the equations of elastodynamics. That type of approach has been systematically used in the analysis of weak solutions of hyperbolic systems of conservation laws by means of compensated compactness techniques. Stability properties of the relaxation finite element schemes are derived from estimating suitable modifications of the standard energy functional, the so-called "modulated energy", whose form is suggested by the presence of the relaxation terms. Hence we establish strong dissipation estimates involving the corresponding (discrete) norms to the continuous equations. Similar techniques are also applied to prove error estimates and deduce the convergence to (smooth) solutions of the equations of visco-elastodynamics.
The computational performance of these schemes improves when combined with an adaptive meshing strategy, that yields an extra stabilization mechanism against the effects of the nonlinear response over shock regions of the solution. This is a work in progress with C. Lattanzio, A.E. Tzavaras, N. Irani, D. Diaz-Dussan and R. Krenzler.