Asociación Argentina de Mecánica Computacional

Mecánica Computacional Vol XXXIII, págs. 1313-1313 (resumen)
Graciela Bertolino, Mariano Cantero, Mario Storti y Federico Teruel (Eds.)
San Carlos de Bariloche, 23-26 Setiembre 2014

LINEAR-COMPARISON HOMOGENIZATION ESTIMATES FOR NONLINEAR VISCOELASTIC SOLIDS REINFORCED BY RIGID INCLUSIONS

Martin I. Idiart

Departamento de Aeronáutica, Facultad de Ingeniería, Universidad Nacional de La Plata, Avda. 1 esq. 47 S/N, La Plata B1900. Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), CCT-La Plata, Calle 8 Nº 1467, La Plata, B1904, Argentina, martin.idiart@ing.unlp.edu.ar

Abstract. This work reports new homogenization estimates for the overall response of nonlinear viscoelastic solids reinforced by rigid inclusions derived by means of the incremental variational principle of Lahellec & Suquet [Int. J. Plast. 42 (2013), pp. 1—30]. In this principle, the local behavior is characterized by convex stored energy density and dissipation potential functions in accordance with the theory of generalized standard materials, and an implicit time-discretization scheme is used to generate a variational representation of the overall response in terms of a single incremental potential. In the case of nonlinear viscoelastic solids, the single-potential problem can be linearized making use of any of the linear-comparison schemes already available for nonlinearly viscous solids.

Recent works have reported an unexpected time-step dependence on predictions obtained by means of the tangent second-order linearization scheme of Ponte Castañeda [J. Mech. Phys. Solids 44 (1996), pp. 827—862]. It is recalled that this scheme is expected to be superior to the secant linearization schemes previously used in other works in view of its exactness to second order in the heterogeneity contrast. In this work we show that such time-step dependence is in fact a consequence of estimating field statistics directly from the linear comparison composite. More specifically, we show that by estimating field statistics through the overall potential as argued by Idiart & Ponte Castañeda [Proc. R. Soc. Lond. A 463 (2007), pp. 183–202], the time-step dependence disappears. New predictions are reported for two-dimensional systems composed of a power-law viscous matrix reinforced by a random distribution of rigid inclusions. Monotonic as well as non-monotonic radial loadings are considered. The accuracy of the predictions are assessed by confronting them to the exact response of two-phase composites with sequentially laminated microgeometries. Good agreement is found for low to moderate viscous nonlinearities. For strong nonlinearities, however, the predictions show an unrealistic softening in the transition from elastic to viscous regimes. Possible reasons for this anomaly are discussed.