8th ECCOMAS Thematic Conference on the Mechanical Response of Composites: COMPOSITES 2021
M. Fagerström & **G. Catalanotti** (Editors)

HOMOGENIZATION OF NONLINEAR VISCOELASTIC THREE-PHASE PARTICULATE COMPOSITES

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We aim at modeling the mechanical behavior of a nonlinear viscoelastic heterogeneous material having an "inclusions-matrix" type microstructure. The different phases of this material may experience differential shrinkages or swellings (like thermal expansion) and we want to model the internal stresses induced by this loading. With homogenization, these internal stresses are correctly estimated when the behavior of the constituents is linear elastic – see in particular [1] – or even aging linear viscoelastic [2].

A modified secant formulation has been recently introduced in [3] to deal with nonlinear viscoelastic behaviour. The general formulation can handle stress-free strain. For a two-phase particulate composite, closed-form expressions of the time evolutions of the effective behaviour as well as phase-averaged fields have also been reported in [3]. We propose here to extend these closed-form expressions to three-phase particulate composites.

Results of this model are compared to full-fields computations of representative volume elements. The effect of the third phase (inclusions) is particularly studied. The formulation is also used as a behaviour law in solid mechanics simulations including non-radial and anisothermal evolutions.

References

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