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AN INVARIANT-BASED FINITE STRAIN CONSTITUTIVE MODEL ACCOUNTING FOR THE VISCOUS-DAMAGE BEHAVIOUR OF POLYMER COMPOSITES

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The behaviour of unidirectional polymer composites is usually modelled by constitutive equations based on the assumption of infinitesimal strains. However, they may undergo significant deformation when loaded up to the inelastic regime, where dissipative phenomena including plasticity and damage are observed. A kinematic description based on the deformation gradient is well-suited for this kind of situation.

A recently proposed invariant-based constitutive model [1] to describe the finite strain response of polymer composites, accounting for visco-elastic and visco-plastic effects, is presented in this contribution. Transversely isotropic mechanical response is captured by this model, in both elastic and plastic regimes. Additionally, the coupling of this model with the description of damage mechanisms is discussed. For instance, a smeared crack approach can be employed to model matrix cracking [2]. After implementation in a user routine for Abaqus finite element solution, numerical results are presented and validated against experimental data.

REFERENCES

[1] Rodrigues Lopes, I. A., Camanho, P. P., Andrade Pires, F. M., and Arteiro, A. (2021). An invariant-based elasto-visco-plastic model for unidirectional polymer composites at finite strains. *International Journal of Solids and Structures*, 111292. https://doi.org/10.1016/j.ijsolstr.2021.111292

[2] Camanho, P. P., Bessa, M. A., Catalanotti, G., Vogler, M., and Rolfes, R. (2013). Modeling the inelastic deformation and fracture of polymer composites-Part II: Smeared crack model. *Mechanics of Materials*, 59, 36–49. https://doi.org/10.1016/j.mechmat.2012.12.001