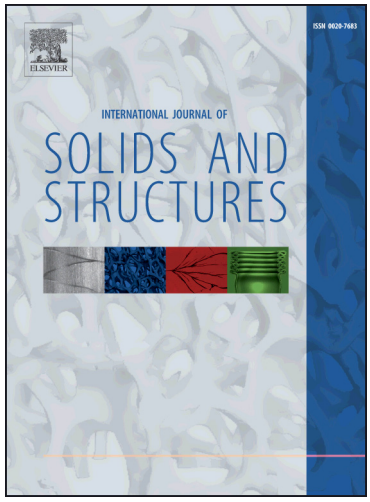

A new approach to modeling isotropic damage for Mullins effect in hyperelastic materials

Mar Miñano, Francisco Javier Montáns

PII: S0020-7683(15)00200-0
DOI: http://dx.doi.org/10.1016/j.ijsolstr.2015.04.027
Reference: SAS 8757

To appear in: *International Journal of Solids and Structures*

Received Date: 22 February 2015
Revised Date: 19 April 2015

Please cite this article as: Miñano, M., Montáns, F.J., A new approach to modeling isotropic damage for Mullins effect in hyperelastic materials, *International Journal of Solids and Structures* (2015), doi: http://dx.doi.org/10.1016/j.ijsolstr.2015.04.027

A new approach to modeling isotropic damage for Mullins effect in hyperelastic materials

Mar Miñano, Francisco Javier Montáns*

Escuela Técnica Superior de Ingeniería Aeronáutica y del Espacio
Universidad Politécnica de Madrid
Plaza Cardenal Cisneros, 3, 28040-Madrid, Spain

Abstract

In this work we present a new approach to damage mechanics in hyperelastic materials and an efficient numerical procedure for modelling the Mullins effect in isochoric, isotropic materials. The formulation is based on the idea that both the virgin loading and the damaged unloading-reloading behavior may be measured, but only the unloading-reloading curve corresponds to hyperelastic behavior. The damaged unloading-reloading curve is the true hyperelastic behavior and may be described by any suitable hyperelastic constitutive model. We employ a spline-based formulation which is known to exactly capture the behavior. The virgin loading curve, which does not correspond to hyperelastic behavior and involves damage evolution is only employed to compute the energy release rate. The procedure does not employ any material parameter (and hence no parameter-fitting procedure) or any explicit damage evolution function. We highlight similarities and differences of the present model with usual damage mechanics models and with pseudo-elasticity. As a result of the detailed computational procedure which simply involves the solution of a nonlinear

*Corresponding author. Tel.:+34 637 908 304.
Email addresses: mar.mnunez@upm.es (Mar Miñano), fco.montans@upm.es (Francisco Javier Montáns)