Hysteresis Behavior Modelling Of Woven Fabric Under Large Strain

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Abstract. The massive use of composite materials in industrial applications involves developing more accurate and rigorous mechanical behavior models. One of the most common process is RTM (Resin Transfer Molding). This process begins to become more and more mastered either in small or large deformation through several works describing elastic, hyperelastic or even viscoelastic models. However, the geometries become more and more complex which can generate cyclic loading (loading + unloading). Furthermore, the existing models do not make possible to characterize and simulate the unloading phase. Indeed, dissipative phenomena of energy through (hyper)elastic models are not considered. Some works in the literature propose an approach to describe the hysteresis behavior under small strain. But, in most cases, the shaping step of the RTM process leads to unavoidable large strain. The study presented here therefore focuses on dry fabrics subjected to cycling loading under large strain. These types of loads require a dissipative approach often described by a hysteretic behavior. The model developed in this paper concerns the in-plane shear mode and use an innovative coupling between the additive decomposition of Green – Nahgdi and the multiplicative decomposition of Kröner – Lee. This allow the use of the intermediate configuration which represents the condition of the woven material once no more loading is applied to it. Hence, the constitutive modelling presented here is formulated in total Lagrangian. This model is finally validated experimentally through a picture frame test. At the end, some finite element simulations of the shaping phase of the RTM process are made.