# The problem of shear in finite elasticity: an alternative formulation to simple shear and pure shear

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The problem of shear at large strains deserved a lot of interest because of its relevant applications in engineering. The most popular formulations adopted to analyse finite shear are known as "simple shear" and "pure shear". Both these layouts have been widely investigated due to their (apparent) simplicity [1]. However, the abovementioned schemes lead to some inconsistencies as the corresponding Green-St.Venant strain tensor contains components related to extensional deformations also, thus violating the pure shear strain condition. Likewise, the related Cauchy stress tensor does correspond to a pure shear stress state as it involves normal stress components. As a consequence, both "pure shear" and "simple shear" schemes lead to ambiguities, and they provide different results in matching experimental data [2].

In the present work, we proposed an alternative kinematical model to study finite homogeneous shear deformations. The proposed formulation, called herein "angular shear", involves only shear strains due to pure angular variations of fibers. An extension to 3D (3D angular shear deformation) has been also formulated. The absence of Poynting effect [3] in the proposed layout is also proven. As shown through experimental investigations performed on rubber-like prismatic samples, the proposed shear model allows understanding better the main aspects related to the nonlinear response of hyperelastic bodies under shearing forces and, in turn, it permits more reliable material characterization of the elastic parameters than the previous formulations would do.

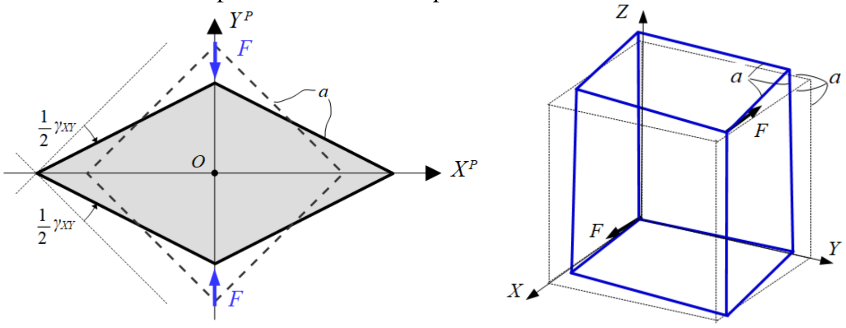


*Fig. 1: Sketch of the biaxial angular shear setup: 2D and 3D settings.*

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