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Mechanics of hyperelastic composites reinforced with fibers resistance to extension and flexure

*Chun-il Kim[1)] , Suprabha Islam[2)] ,Seyed Ehsan Bolouri[2)]

[1), 2)] *Department of Mechanical Engineering, University of Alberta, Canada*
[1)] cikim@ualberta.ca

ABSTRACT

A model for the mechanics of a soft hyperelastic material reinforced with long fibers is presented in finite plane elastostatics. The strain energy potential of the composite is refined by the Mooney Rivlin model to accommodate the hyperelastic behaviors of the matrix material. Within the framework of the strain gradient theory, the kinematics of the fibers is formulated and subsequently integrated into the model of continuum deformation. A rigorous derivation of the Euler equation and the associated boundary conditions are presented by virtue of variational principles and a virtual work statement. We demonstrated that the presented model successfully predicts rapid strain-stiffening behavior of the *Ecoflex 00500-fiber* composite at low strain level. Further, the deformation profiles and shear angle distributions of the composites are computed which demonstrate good agreement with the in-house experiment and the existing results in literature. In particular, the obtained model directly predicts the resultant stress-strain responses of the composite via the integration of the known modulus of matrix materials and fibers [1].

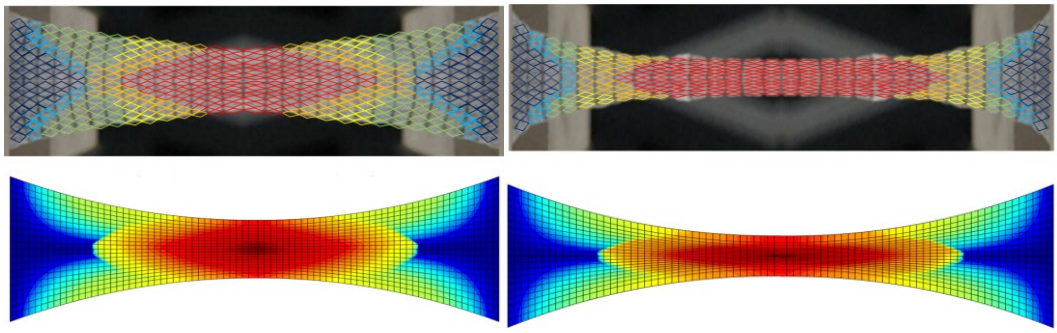

Fig. 1 Shear angle distributions: PES-3 at 50% (Left) and 100% (Right) elongation

REFERENCES

Suprapha, I., Dinara, Z., Hyun-Joong, J., Chun-il, K. (2020), “A model for hyperelastic materials reinforced with fibers resistant to extension and flexure”, Int. J. Solids Struct., **193-194**, 418-433

[1)] Professor