Numerical simulation of mechanical behavior of knitted textiles at meso- and macro- scales

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Abstract

Within our digital workflow of optimal design and manufacture of 3D knitted textiles, we present a meso- and macro- scale modelling and simulation framework for prediction of the mechanical behaviors of the material. At the meso-scale, representative volume elements consisting single interlocked yarn loops, modeled as geometrically exact, elastic Simo-Reissner beams, are homogenized to replicate their effective material behaviors. At macro scale, knitted fabrics are modelled as Kirchhoff–Love shell elements with the constitutive material that is parametrized into B-Spline response surface model from the meso-scale homogenization. This research aims to generalize the multi-scale approach towards geometric modelling different stitch types at the meso-scale and more complex loading cases with bending deformation at macro-scale of 3D knitted textiles.

Keywords: knitted textile, multi-scale modelling, homogenization, response surface model