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Fiber reorientation behavior of bioinspired Bouligand architectures with functional graded fiber orientation

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Naturally-occurring composite materials with stiff fibers embedded in a soft matrix are commonly known to achieve a good balance between compliance, strength and toughness. In particular, Bouligand laminated and brick-and-mortar composite materials have been shown to exhibit enhanced damage tolerance. Due to the geometry mismatch and dissimilar mechanical properties, off-axis rotation of the stiff fibers takes place when the material is subjected to uniaxial loading conditions. In this work, we carry out an experimental and computational analysis of the fiber reorientation in different architectures, including the Bouligand and single layer laminates. We found that the fiber reorientation in Bouligand architectures is influenced by the shear resistance between layers and the in-plane shear deformation. On the other hand, the restriction between layers in fiber reorientation significantly affects the compliance of the material.