Geometrical and material uncertainties for the mechanics of composites

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ABSTRACT

Composite materials contribute to the improvement of structural performance by mixing several materials, thereby obtaining an heterogeneous mixture whose properties are superior to that of each individual constituent.

However, the non-homogeneous nature of these materials naturally introduces strain discontinuities and strong stress gradients which potentially decrease the durability of these materials.

The stress state around heterogeneities is affected by both geometrical and material imperfections and uncertainties. The heterogeneities can be geometrically characterised by imaging techniques and their material properties can be measured by relatively standard mechanical tests. Both types of measurements are subject to noise and measurement errors and manufacturing techniques are imperfect.

In light of the above remarks, it is crucial to be able to assess the effect of material and geometrical uncertainties on the mechanical behaviour of composites. This is the focus of this paper.

Thanks to the flexibility of isogeometric analysis and geometry-independent field approximations, we investigate the impact of geometrical and material uncertainties on the behaviour of composites made up of two different materials.

We also perform a comparative study between IGA, geometry-independent field approximation (GIFT), conforming FEM, XFEM and CutFEM [1]-[4].

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