# Lamination-Based Efficient Treatment of Weak Discontinuities for Non-Conforming Finite-Element Meshes

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When modelling discontinuities (interfaces) using the Finite Element Method, the standard approach uses a conforming finite element mesh in which the nodes lie directly on that interface. However, this approach can prove cumbersome if the geometry is complex, in particular in 3D. Some methods use a finite element mesh that is independent of the geometry (a non-conforming mesh), but they are challenging to implement and may require user intervention in the finite-element code, for instance, adding extra global degrees of freedom. In this work, we propose a new, efficient method for non-conforming finite-element treatment of weak discontinuities by using laminated microstructures. The method is inspired by the composite voxel technique [1] that has been developed for FFT-based spectral solvers in computational homogenization. The idea behind our method is simple – each finite element that is cut by an interface is treated as a simple laminate. The volume fraction of the phases and the lamination direction are determined by considering the actual geometrical arrangement of the interface within the element. The approach is illustrated by several computational examples relevant to the micromechanics of heterogeneous materials. Elastic and elastic-plastic materials at small and finite strain are considered in the examples. The performance of the proposed method is compared to two alternative, simple methods showing that the new method is in most cases superior to them while maintaining the simplicity. The finite-element implementation and computations have been carried out in the AceGen-AceFEM environment.

**References**

[1] Kabel, M., Merkert, D., Schneider, M., Use of composite voxels in FFT-based homogenization, *Comput. Methods Appl. Mech. Eng.* 294, 168–188 (2015).