Decohesion and Sliding between Contacting Yarns in 3D Woven Composite based on Implicit Geometries

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ABSTRACT

Decohesion is an important failure mechanism for complex 3D woven composites. It includes both debonding between reinforcing yarns and matrix, and debonding/sliding between contacting yarns in complex woven architectures. Recent works [1] have proposed an automated methodology to generate a smoothed RVE geometry without yarns interpenetration based on implicit geometries described by distance fields. In its current implementation, this methodology requires the insertion of a small gap between contacting yarns to allow its discretization by finite elements, see Figure 1. However, this leads to large problems with an element size governed by the thickness of the introduced gap that needs to be rather small to yield realistic results.

As a result, there is an interest in extending this approach to represent contacting surfaces by cohesive zone elements. This contacting surface is however arduous to find due to the implicit geometry used by the generation method. This contribution will present a methodology to extract from the distance fields the geometry of the contacting surfaces between yarns that can support cohesive zones. This identified surface can subsequently be used in a conformal meshing methodology for the RVE extended with cohesive zones [2]. The scheme will result in a more realistic geometrical model for finite elements damage simulation.

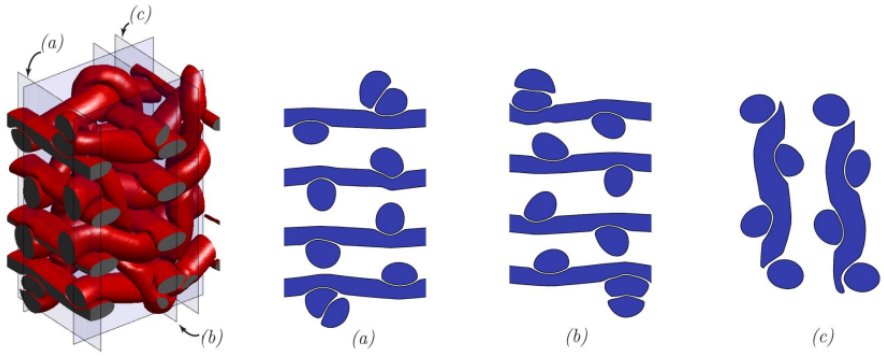

Figure 1: Internal structure geometry after level-set post-processing for a 3D woven composite illustrated by 2D cuts showing the gaps between yarns in order to suppress interpenetrations.

REFERENCES

[1] B. Wintiba, B. Sonon, K. Ehab Moustafa Kamel, T. J. Massart (2017) An automated procedure for the generation and conformal discretization of 3D woven composites RVEs. *Composite*

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[2] K. Ehab Moustafa Kamel, B. Sonon, T. J. Massart (2019) An integrated approach for the conformal discretization of complex inclusion-based microstructures. Submitted.