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# Numerical modelling of the unstable mode I intralaminar crack propagation in 2D woven composite materials

L.F. Varandas*, D. Dalli, G. Catalanotti, and B.G. Falzon
Advanced Composites Research Group, School of Mechanical and Aerospace Engineering, Queen's University Belfast, Belfast, UK
* Presenting author: L.Varandas@qub.ac.uk

State-of-the-art intralaminar damage models (IDMs) usually require the specification of fracture energy parameters associated to the main failure modes of composite materials, in order to accurately predict damage propagation. Extensive experimental characterisation of both mode I and compressive intralaminar fracture toughness (e.g. [1,2]) has already been conducted. However, these have mostly been conducted for unidirectional (UD) composites, and the experimental campaigns are often hindered by slow production and testing rates. Therefore, this work aims to develop a numerical strategy to analyse fracture in 2D woven composite materials, by making use of a computational mesomechanical framework which has been recently developed by the authors, the appropriate constitutive material models [3,4], and the size effect law proposed by Bažant [5]. Mode I intralaminar crack propagation of 2D woven composite materials is intended to be analysed, thus obtaining the associated crack-resistance curve (R-curve), unravelling the effect of different types of layups on the unstable intralaminar crack propagation of 2D woven composite materials.

Finite Element (FE) models of Double Edge Notch Tension (DENT) specimens are generated and composed of an Embedded Cell (EC), as well as homogenised parts which represent the linear-elastic behaviour of the material. The ECs are composed of pre-compacted homogenised tows that are embedded in an epoxy matrix, as shown in Figure 1. By submitting the FE models to the appropriate Boundary Conditions (BCs) and by generating different scaled sized specimens, the mode I intralaminar R-curve of the material can be obtained for different stacked configurations of the EC.

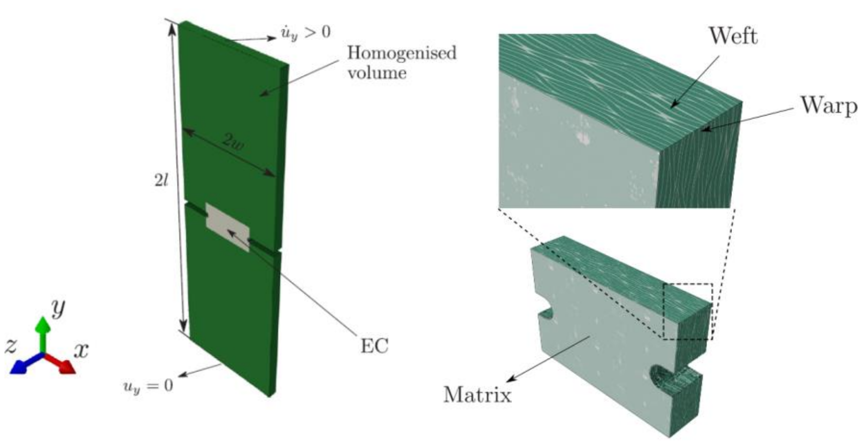


**Figure 1.** Representation of the FE model (left, from [6]), including the EC and the homogenised volume that surrounds the micromechanical cell (right).

[1] Catalanotti *et al*. (2014). *Eng. Frac. Mech.* **118**, 49-65. [2] Catalanotti *et al*. (2014). *Eng. Frac. Mech.* **56**, 300-307. [3] Melro *et al.* (2013). Int. J. of Sol. and Struc. **50**, 1897-1905. [4] Falzon & Apruzzese (2013). Comp. Struc. **93**, 1039-1046. [5] Bažant and Planas (1998). *CRC Press LCC*. [6] Dalli *et al*. (2019). *Eng. Frac. Mech.* **214**, 427-448.