# *Experimental and numerical study of delamination in composite laminates with bending-twisting elastic couplings*

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The objective of this study is to characterize, both experimentally and numerically, the delamination process in multidirectional carbon/epoxy composite laminates with stacking sequences exhibiting bending-twisting elastic couplings. Laboratory specimens with artificial delamination were tested in Mode I using a Double Cantilever Beam (DCB) set up according to ASTM D5528. Critical Energy Release Rate (ERR) values were determined using three different data reduction schemes: modified beam theory, compliance calibration method and modified compliance calibration method. Delamination initiation was detected in two ways: by visual observation of the crack tip using a high-resolution camera and by acoustic emission.

Numerical analyses were performed using SIMULIA ABAQUS Finite Element (FE) software. The FE model consisted of SC8R continuum shell elements and the Virtual Crack Closure Technique (VCCT) was used to evaluate the energy release rate. The experimental results showed extensive fiber bridging (Fig. 1), which significantly affected the propagation values of ERR and the load-displacement curves. Nevertheless, the numerical results obtained by the VCCT at the initial stage of delamination were in good agreement with the experimental results.

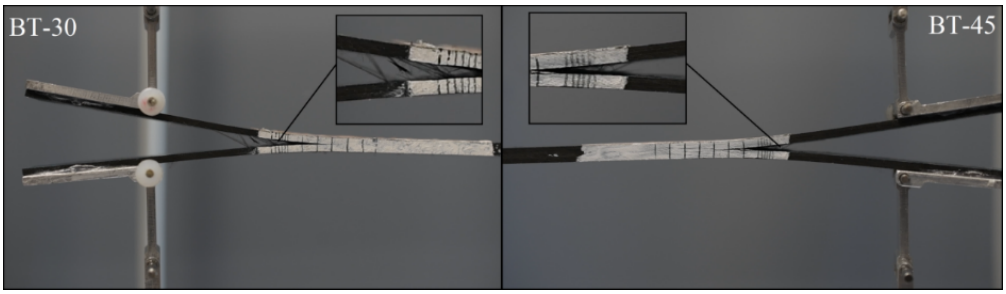


Figure 1: Experimental DCB tests conducted on elastically coupled composite laminates.

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## References

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