TENSILE RESPONSE OF AUTOMATED FIBRE PLACEMENT (AFP) COUPONS INCLUDING GAPS AND OVERLAPS

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While Automated Fibre Placement (AFP) enables the manufacturing of large and geometrically complex composite structures in relatively short cycle times, the robots induce singularities that may impair the structural integrity of the component [1-2]. The aim of this study is to characterize and predict the tensile response of composite coupons including "gaps" and "overlaps". Several AFP carbon/epoxy laminates were manufactured and subsequently cured in the autoclave. To gain insight into the microstructure and wrinkling patterns associated to each AFP-configuration, non-tested coupons were inspected using an *EasyTom 230* X-ray computed tomography (CT) system located at IRT Saint-Exupéry (e.g. Figure 1a). To characterize their mechanical response, a tensile experimental campaign was carried out at ONERA (plain and open-hole coupons assisted by digital image correlation and acoustic emission) combined with ex-situ X-ray tomography inspections at incremental stress levels. In parallel to the experimental campaign, a numerical methodology was developed to predict the ultimate strength of AFP-coupons. The finite-elements models relied on a realistic description of the coupon's geometry based on the CT results (e.g. Figure 1b), and were performed using Abaqus/Standard coupled with Onera's Progressive Failure Model (OPFM) [3].

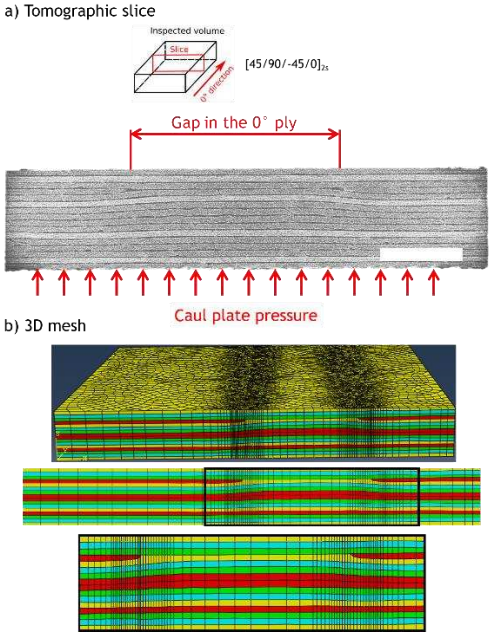

Figure 1a: X-ray tomography of an AFP coupon with a gap in the fourth-ply; 1b: 3D finite-element mesh.

References

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