High-performance composite T-joints: topological design strategy towards strength improvement and weight reduction

A topological concept is presented in order to create novel designs for carbon fibre reinforced polymer (CFRP) T-joints resulting in enhanced structural performance. The topological optimization allows optimum performance without any increase in the mass of the joints in comparison with the traditional T-joint. Finite element analyses (FEA) was conducted to evaluate the performance of the new topological design concept under different loading conditions. A rigorous set of experiments were conducted through pulling, bending and fatigue tests for the newly designed and traditional T-joints. The empirical results are in very close agreement with FEA analyses. The results indicate a significant improvement in the energy absorption both in elastic, i.e. damage free region, and plastic region, after the damage initiation compared to a traditional T-joint design. The improvement in the new T-joint design is correlated to the activation of new damage mechanisms.