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TREND, ISSUE AND POTENTIAL ON OPTIMIZING PATH OF COMPOSITE MATERIALS

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The indicators governing the powerful of technological development envelop the rating of use the composite materials in nature components. So, composites are designed andmanufactured to be applied in many different areas, taking the place of materialsregarded as typical, such as steel and aluminium[1]. Such, the growing use of composite materials has arisen from their high specific strength and stiffness, when compared to the more conventional materials, and the ability to tailor their structure to produce more efficient structural configurations[2].The route of composite materials covers the automotive, aerospace, civil, marine, and sports areas. In key industry as aeronautics application it is considered that in the futurethe composites materials can contribute more than 50% of structural mass.

Nevertheless very good development of composites application, these materials entails complex mechanical mechanism when are submitted to loading condition (i.e. pressure, thermal load, hard environments and so on). The prediction of mechanical behaviour leads to a multi-objective approachsettled within a robust strategy. This strategy settled on analytical, numerical simulation, and/or experimental tests can bring important solutions for damage mechanisms (i.e.raised from static strength, delamination failures, interlaminar fracture mechanics, matrix cracking, porosity growth and other manufacturingrelated defects that also can introduce nucleation sites for failure). Typically solutions cover the simple situations to complex modelsfrom first initiation to final failure. For example, the mechanical loading applied in the axial tension, on the composite material displays progressive failurethrough several damage mechanisms that willtake place sequentially. A cross-ply laminate, Figure1,present the action of axial load applied in the longitudinal(L) direction,consequently the 0^0 ply is loaded along its reinforcing fibers, whereas the90^0 ply is loaded across the fibers. In this complex conditiona multi-damage mechanisms (delamination, matrix cracking, splitting of L lamina, interface cracking) is activated emphasizing an early failure database.

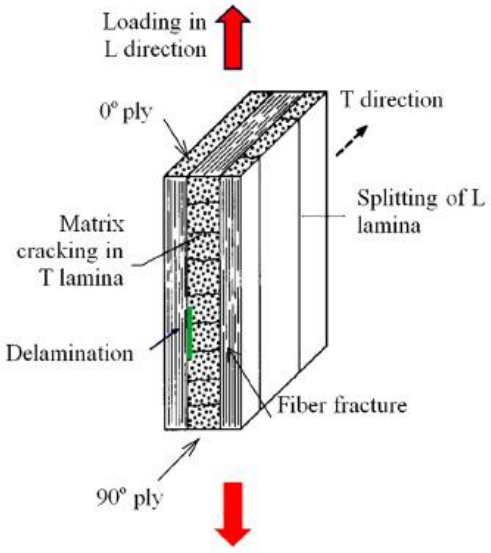

Figure1.Longitudinal tension of a 0/90 composite laminates; Highlight of several damage modes: matrix cracking in transverse(T) lamina, splitting of longitudinal (L) laminae, and delamination between T and L[3]
In relation to these phenomena, the selection of proper set upcircumstances for predictions and explanation of the mechanistic damage approaches candictate to suitable prediction models. Besides, in-depth understandings of individual damage mechanics may pave the road towards further material optimization with respect to fatigue, failure and durability[4].
Tserpes and Koumpias[5] have developed a numerical algorithm to optimizing the geometry of composite structural parts to reduce the failure and obtain a superior product. The algorithms combine the optimization module of the ANSYS FE code and a progressive damage modelling module.The algorithm of the numerical optimization methodology is described by means of the flowchart shown inFigure 2. The methodology proposedwas divided into three basic packages: PDM of initial geometry, optimization and verification.

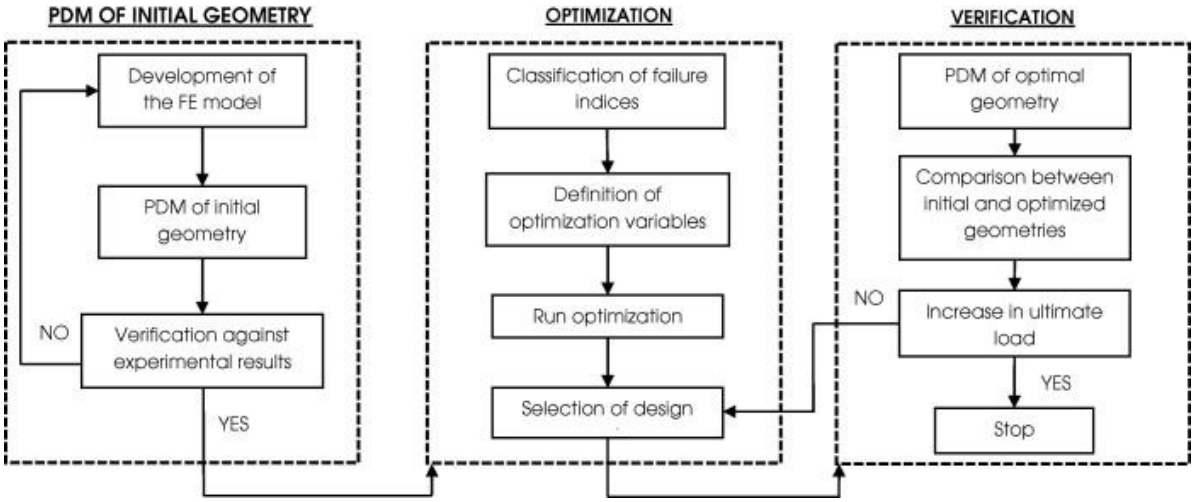

Figure 2.Flowchart of the numerical optimization methodology

Obviously, taken into account this proper model of optimizationthe processes we may obtain an effective solutions thatcan led to a considerable increase in joint's strength for composites materials[5].

This paper provides a strong outline of principal application of composite materials, bring in attention typical damage mechanism that occur in composites and finally show an approach to optimize the mechanical properties of these materials.

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