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Abstract

To establish a reliable virtual testing strategy for composite design, the damage mesomodel for laminated composites has been developed at LMT-Cachan since the 1980s. Nevertheless, the predictions using the mesomodel could be too conservative in particular situations such as composite structures involving extensive splitting. Indeed, the predicted splits appear thicker than the extremely thin ones experimentally observed. In this work, a split detection criterion is proposed and cohesive interfaces are introduced for representing extremely thin splits in addition to delamination interfaces. Comparisons between the classical approach and the proposed enhanced mesomodel version are presented, showing a very good accuracy of the second one with experiments.

Keywords: Laminates, Transverse cracking, Damage Mechanics

1. Introduction

The last quarter-century has witnessed considerable research efforts in the mechanics of composites in order to understand and predict the behavior of these materials, the ultimate goal being the design of the materials/structures/manufacturing processes. Even in the case of laminated composites, the prediction of the evolution of damage up to final fracture remains a major challenge which is at the heart of the virtual structural testing's revolution engaged in by the aeronautical industry. Virtual structural testing consists, whenever possible, in replacing the numerous experimental tests used today by numerical simulations.

An answer to this question is what is called the "damage mesomodel for laminated composites", developed at LMT-Cachan since the 1980s [1, 2]. The main assumption to build this model is that the behavior of any laminate under any loading up to final fracture can be described using two elementary entities: the ply and the interface. It is derived from today's understanding of the damage mechanisms and their evolution at the micro, meso and macroscales

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