AN INTEGRATED COMPUTATIONAL MATERIAL-STRUCTURE MODELING FOR LAMINATED COMPOSITES

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Focus Material: Composites

Focus of the Presentation: *(iv) Structure-material integration and design.*

Abstract

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 and including final fracture remains a major challenge which is at the heart of today's virtual structural testing revolution engaged in by the aeronautical industry. Virtual structural testing consists, whenever possible, in replacing the numerous experimental tests used today by virtual tests.

First, the talk will emphasize our own modeling answer, and its derivation from today's understanding of the mechanisms of damage and their evolution on the micro and meso scales. The proposed multiscale damage approach is based on a Virtual Reference Material written at the microscale, with two constituents, the ply and the interface *i.e.* a material database which is also a tool for material design. Today, one tends to get a unified micromodel also involving fatigue, high-velocity, oxidation... The corner stone is a general bridge between micro- and meso-mechanics that we have built to derive the damage mesomodel used for structure computations as a homogenized model.

Finally, the current capabilities and limits of this multiscale approach are pointed out as well as computational challenges that accompany Virtual Structural Testing.