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New high energy absorbing material against bird-strike

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Experimental studies for bird's impacts have a major cost in aeronautics. So, this original study presents the development and the justification of a high-energy absorbing material against bird strike, positioned on the front nose of an aircraft. The orthotropic nature of the material, its behavior law, as well as its strain rate sensitivity and his densification are analyzed. The material sensitivity to different strike speeds –from 0 to 160 m/s – is studied. Due to the transient and highly non-linear nature of a crash, it is very difficult to predict bird-strike in aeronautics. A major concern of the manufacturers is the development of a reliable modeling and numerical simulation of the bird-strike phenomenon. Three components must be modeled: bird, structure and impact. To model the impactor, different schemes can be used: lagrangian, eulerian, arbitrary lagrangian eulerian (ALE) and smoothed particle hydrodynamics (SPH). SPH is preferred because the bird fragmentation is well modeled by a set of hydrodynamics particles. The structure is classically modeled by finite element method integrating laws of damage. The impact is modeled by boundary conditions, the mass, momentum and energy conservative laws. For appropriate step sizes, it is well-known that the explicit time- marching scheme is stable. Two kinds of test are realized: the first tests the behavior law at the scale of the coupon. The second tests the bulkhead system against bird-strike. Experimental studies are specific at high speeds impacts. Test plan and test design have been established and validated. This study shows that the definition, preparation and analysis of material characterization tests and validation of the demonstrator are paramount. The methodology and the defined solution can be applied to cases of severe applications in other high-tech sectors such as space and defense.

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