Numerical analysis of bird strike resistance of helicopter searchlight

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Abstract  Bird strike is a major threat to aircraft structures, as a collision with a bird during flight can lead to serious structural damage. For helicopters the windshield, forward airframe structure, rotor blades and all exterior equipment parts are exposed to the risk of bird impact. Consequently, aviation authorities require that such structures need to prove bird strike resistance before they are allowed for operational use, which primarily had to be demonstrated in full-scale bird impact tests in the past. Today, as numerical simulation techniques have evolved and proven accuracy, compliance can more and more be shown by sufficiently validated numerical analyses. This study shows such an example of successful simulative demonstration of bird strike resistance of a searchlight and its pod as external equipment of a military helicopter. The finite element model was built up and validated step by step according to the building block approach from coupon level up to the full-scale structural level. The focus was on the accurate non-linear constitutive modelling of the different aluminum alloys and mechanical fasteners of the target structure. The searchlight pod as well as its internal electrical components and attachments were modelled with a high level of detail in order to allow for accurate results evaluations. A validated smoothed particle hydrodynamics (SPH) bird impactor model was used to simulate different load cases and impact positions of this fluid-structure interaction scenario with a water-like soft body projectile. Although plastic deformations and partial fracture of the outer housings of the structure were observed, no critical failure mode, detachment of critical parts or loss of structural integrity occurred (Fig. 1). These analyses were accepted by the authorities as means of compliance and demonstrate today’s progress in airworthiness certification by simulation.

Figure 1 - Photo of helicopter with searchlight and image sequences of bird strike simulations on pod (top) and searchlight (bottom) (photo copyright & permission: VBS)