UAS Airborne Collision Severity Evaluation

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Abstract

According to the latest industry forecast studies, the Unmanned Aerial System (UAS) market volume is expected to reach 4.7 million units by 2020 [1]. Consequently, the likelihood of airborne collisions between a UAS and manned aircraft and the consequent outcomes have become a concern to the public and government officials. The primary goal of regulating UAS operations within the National Airspace System (NAS) is to assure an appropriate level of safety. Therefore, research is needed to define airborne hazard severity thresholds for collisions between unmanned and manned aircraft.

This document presents the development of a physics-based finite element model of a small quadcopter UAS following the Building Block Approach. The validated model was later used to assess the hazard/severity outcomes of mid-air collisions with manned aircraft. This research will help determine airworthiness requirements for unmanned aircraft based on their potential hazard/severity to other airspace users in the NAS. The resulting severity thresholds will be based on UAS characteristics (kinetic energy, structure, shape, materials, etc.) under credible encounter scenarios, and will provide for test criteria to evaluate applicable operational and airworthiness standards.

Numerical analyses were conducted to evaluate the damage level to different areas in a commercial aircraft resulting from defined UAS collisions. Corresponding to what was observed in component-level ballistic testing, the simulations predict that most of the damage is produced by the relatively dense and stiffer parts (e.g. motors) of the UAS. Additional parametric studies were conducted to analyze the effect of projectile mass, impact velocity, and UAS construction. Finally, the impact behavior between the UAS and a validated bird projectile of the same mass was compared. The results show that UAS impacts are likely to cause more damage than bird strikes for an equivalent initial kinetic energy. The UAS impacts were generally associated with greater damage levels due to the hard-bodied mechanical construction of the UAS (its components made of dense, rigid materials) and the specific nature of its discrete distribution of subject masses.

References

[1] “Rise of the Drones. Managing the Unique Risks Associated with Unmanned Aircraft Systems”, Allianz Global Corporate & Specialty, 2016.