Bird Impact Analysis of a Typical Transport Aircraft Wing

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Abstract

Bird striking event is one of the most dangerous risks to the safety of aircrafts. Although most of the bird strike events involve relied small birds which do not cause risk, there is a possibility of severe damage to critical aircraft components such as shield of the wind, leading edges, empennages, engine structure and front, rear blades. In this aspect, a numerical study can help in identifying the parameters which influence the behaviour of the aircraft structure during bird impacts. The current project involves impact analysis carried out at the leading edge of the wing of a large passenger aircraft model. The project

work focuses on developing a model to simulate a bird impact analysis on the leading edge of the wing using the explicit dynamics method in Ansys 15.0 workbench. Explicit dynamics simulates the response of structures to loadings involving short duration and severe loading which cause large material deformation. Explicit dynamics can be classified into Eulerian, Lagrangian and smooth particle hydrodynamics method. Lagrangian method is associated with the material of the structure and therefore each node of the mesh follows the material under motion and deformation. Smooth particle hydrodynamics method is a meshless Lagrangian technique where the bird model deformation is covered fully without the distortion of mesh by the interfacing particles are occurred independently. A large-scale passenger aircraft wing is used as a reference wing required for this analysis. The wing and the bird are modelled using unigraphics NX 10 software. Numerical simulations were performed in the commercially available explicit solver Ansys AUTODYN. The important parameters of the bird model include mass, structure, velocity of bird, angle of impact, and impact location. The bird model was assigned to impact the wing at three different velocities. The deformation, stress and strain values for different velocities are compared. Results of impact simulation give an understanding of the failure of leading edge of the wing under bird strike, where the influence of parameters such as angle of impact, impact velocity, and the dynamic behaviour of aircraft wing leading edge can be effectively understood. Reliability, safety and airworthiness of the aircraft can be increased by adopting new high strength and lightweight materials.

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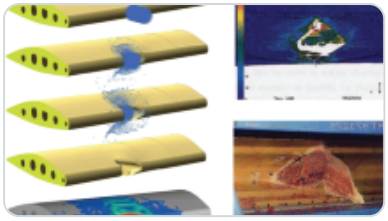

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References

1. Sinha AK, Erikiananda K, Johnrajan A (2015) Flutter analysis of an aircraft wing using computational fluid dynamics. Appl Mech Mater, 817–827. https://doi.org/10.4028/www.scientific.net/AMM.754-755.817

2. Katukam R (2015) Comprehensive bird strike simulation approach for aircraft structure certification. Cyient white paper

Google Scholar

3. Sharma R, Sharma S (2014) Bird strike simulation of an aircraft wing. Int J Aerosp Mech Eng, ISSN: 2393-8609 1(1)

Google Scholar

4. Grimaldi A (2011) SPH high velocity impact analysis of a bird strike windshield application. department of aerospace engineering, University of Naples Federico II

Google Scholar

5. Walvekar V (2007) Bird strike analysis on leading edge of an aircraft wing using a smooth particle hydrodynamics bird model

Google Scholar

6. Guida M, Marulo F, Meob M, Grimaldi A, Olivares G (2011) SPH lagrangian study of bird impact on leading edge wing composite structures

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7. Lavoie MA, Gakwaya A, NejadEnsan M, Zimcik DG (2011) Review of existing numerical methods and validation procedure available for bird strike modelling, ICCES

Google Scholar

8. Guida M, Marulo F, Meo M et al (2008) Analysis of bird impact on a composite tail plane leading edge. Appl Compos Mater 15(4–6):241–257

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9. Wang FS, Yue ZF (2010) Numerical simulation of damage and failure in aircraft windshield structure against bird strike. Mater Des 31(2):687–695

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10. McCallum SC, Constantine C (2005) The influence of bird-shape in bird strike analysis, 5th European LSDYNA users conference, Birmingham

Google Scholar

11. Wildlife Strikes to civil aircraft in the united states 1990, Federal aviation administration, National wildlife strike database, Serial report number

Google Scholar

12. Kavitha Mol S, Salem SC (2012) Projectile parametric studies on bird impact behaviour of aircraft leading edges, National Aerospace Laboratories, Bangalore

Google Scholar

13. Sai Kiran Goud T, Sai Kumar A, Srinivasa Prasad S (2014) Analysis of fluid structure interaction on an aircraft wing by

Google Scholar

14. Gakwaya A, NejadEnsan M, Zimcik DG (2012) Review of existing numerical methods and validation procedure available for bird strike modelling by M-A Lavoie

Google Scholar

15. Heimbs S (2018) EADS, Innovation Works. Bird strike simulations on composite aircraft structures by

Google Scholar

16. Ericsson M (2019) Simulating bird strike on aircraft composite wing leading edge

Google Scholar

17. Heimbs S (2016) EADS, innovation works computational methods for bird strike simulations: a review

Google Scholar

18. Chuan KC (2006) Finite element analysis of bird strikes on composite and glass panels, National university of Singapore

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