

Recent Advances in the Modelling of Aircraft Structural Impact Resistance and Crashworthiness

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ABSTRACT

One of the major goals of the French Aerospace Lab is to perform targeted research in the Aeronautics and Space fields, for military and civil use. To propose valuable research and developments it is essential to detect the new emerging knowledge, offering a great potential for the aimed applications. In a context of economic competition, it is also necessary to be able to quantify – and thus prove – the progress that new technologies can bring, as soon as possible in the scientific analysis process. Last the research results must be readable and easily assimilated and used by the industry. People working at ONERA get interested in Material sciences (which concern data and models), in the « technological » Research (which concerns elaborated products), and in Applied Mathematics (which generate tools necessary to understand, solve and design). The research performed in the DADS/CRD research unit at ONERA-Centre de Lille is turned towards this objective, one of its missions being to improve resistance of aeronautics and space structures against extreme aggressions (crash, impact, blast).

The design of structures is one of the main skill of manufacturers and motorists of the aerospace transportation domain, be it aircraft, rotorcraft or spacecraft. Elementary characteristics (weight, strength, etc) are given by materials that the manufacturer has to specify according to a large panel of requirements. For each particular application (military, civil transportation, space) with its own performance objectives, various material properties are often sought for (with different ranking according to the final product). For example high performance metal and composite materials are widely used in different products of the civil aircraft industry (as well as in the military one). One of the ONERA Materials and Structures Branch research aim is to improve aircraft materials. One of the ONERA/DADS/CRD goals is to develop models for these materials to help aircraft manufacturers to numerically design and optimise their products regarding extreme loading conditions. The concern here is to improve vulnerability and survivability by increasing the aircraft structural strength, not for a purpose of durability but in terms of mechanical resistance against crash, impacts and blast. Success in this goal relies on the understanding and simulation of the dynamic behaviour and failure of materials, assemblies and structures when confronted to impact, crash or explosion.



Ballistic impact and crash of airplanes

The presented paper will give an overview of recent numerical and experimental developments performed in the ONERA/DADS/CRD research unit, aiming at improving metallic structures design with respect to crashworthiness, ditching, impact or explosion hardening considerations.

REFERENCES

- [1] Deletombe E., Delsart D., Fabis J., Langrand B., Ortiz R., Recent developments in computer modelling, material characterisation and experimental validation with respect to crash dynamics, International Aircraft Fire and Cabin Safety Research Conference, Lisbon – November 2004.