



## ***“Landing Impact and Water Splashdown Simulations of a Re-Entry Vehicle - Preliminary Analysis”***

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### **Abstract:**

At early 2006, Thales Alenia Space Italia starts the study on landing impact due to the perspective on the design of future entry vehicle. As for every discipline the study starts by simulating the event with the classical crash formula based on impact velocity, no crash absorption by the vehicle structure and considering the ground as infinitely rigid. Furthermore dedicated methodology activities are in progress to build-up the needed skill for the simulation and the testing of the landing impact. Trade-off on available commercial S/W's was carried out and benchmarked as first industrial study case on a typical re-entry capsule (i.e. ESA- EXPERT). The objective was the development of a correct methodology for modelling and simulating re-entry capsule impact using explicit non-linear dynamic finite element codes. Upgrading on the material modelling in order to include also yield stress, strain hardening and the maximum strain to failure was studied. Various failure criteria of the elastic-plastic materials were investigated vs. the EXPERT foreseen materials. Time histories of the various forms of energy as kinetic, internal, hourglass, interface and as well as the total ones was computed and critically examined to see the goodness of the modelling and the simulation approaches. Others industrial application as in the FLPP/IXV and the ExoMars projects which are currently under study in order to analyze the transient behaviour respectively during the water landing splashdown and the touchdown on the Mars surface. In facts the improvement of the know-how for the mechanical design of the future European re-entry vehicle is based on the estimation of the acceleration and pressure loads versus the definition of the design load factors requirement for the whole space vehicle and at its mounted equipments and payloads. The purpose of the paper is to show this methodological evolution done on the simulation aspect. These industrial experiences are considered a milestone for the further improvement on the landing impact simulation.

### **Keywords:**

- Aerospace
- Crash Simulation