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Method development for full aircraft crash simulation at different levels of modeling detail

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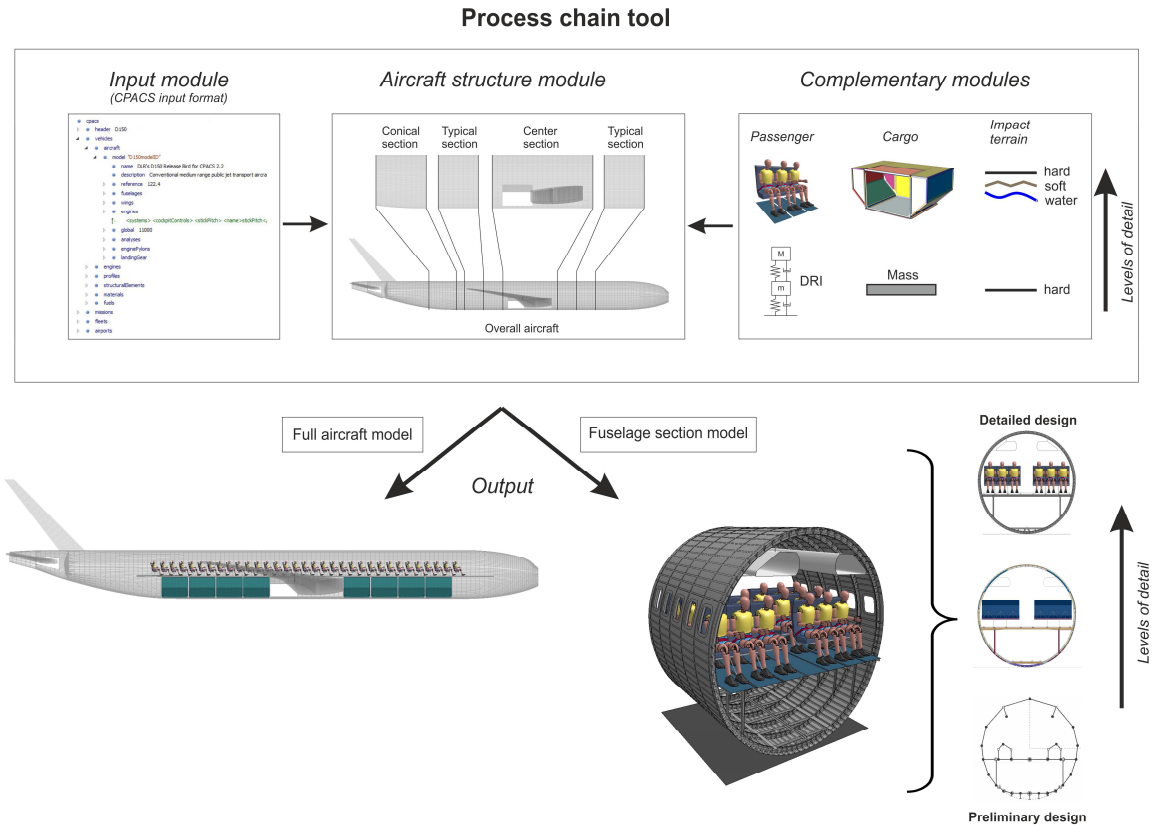
This paper presents a current status of research work at DLR on full aircraft crash analysis. Motivated by the safety aspect, this research work shall enable a deeper insight in the phenomena of typical (full) aircraft crash events and might contribute to future improvements in the crash safety of transport category aircraft.

A process chain tool is developed for numerical analysis of full aircraft finite element models under static and transient-dynamic load cases. Using a parameterized modeling strategy, different levels of modeling detail can be automatically generated with the same set of input data. The input data for the process chain tool is based on the Common Parametric Aircraft Configuration Schema (CPACS) parametric file format which is developed by DLR. This file format includes basic design characteristics which are necessary for modeling of an aircraft.
Also, the tool is able to generate both a full aircraft model and individually defined sections of an aircraft fuselage. These options for automated model generation will pave the way for method developments of full aircraft crash simulations which are the main focus of this research work.

Following the building block approach, the method development will first concentrate on vertical drop impacts of typical and non-typical fuselage sections. Hereafter, the full fuselage will be considered before the modules will finally be assembled to a full aircraft model. Further modules will be included for representation of passengers on their seats, cargo loading, and impact terrain, as well as for systems and miscellaneous installations. Each module will provide different levels of modeling detail allowing a method development for different application cases (preliminary design, detailed design, etc.).

The validation of the simulation methods will be performed on the basis of available test data. These are fuselage section drop tests and full aircraft crash tests performed in the past, most significant the Fokker F28 crash tests recently performed within a joint NASA / FAA effort or the Controlled Impact Demonstration (CID) performed in the 1980's using Boeing B707/B720 aircraft.

The presentation will focus on the selected strategy for numerical method development and on the process chain tool as a core element for the full aircraft model generation. Finally, the presentation will discuss first simulation results of two fuselage section drop tests (typical fuselage section, center fuselage section) as well as results of a full aircraft crash simulation. Since the development of the process chain tool is in its early phase, the presented simulation results will focus on a coarse modeling level of details relevant for preliminary design studies.



Keywords: Transport aircraft, crashworthiness, explicit finite element method, full aircraft crash simulation, parameterized modeling process chain tool, validation

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