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OPTIMIZATION STRATEGIES FOR CRASH RELEVANT VEHICLE STRUCTURES

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ABSTRACT

New optimization strategies are developed at the German Aerospace Center (DLR) as part of the Next Generation Car META-project. Within this project novel vehicle concepts are being investigated as the Urban Modular Vehicle (UMV). A high grade of modularity is the main design specification of the UMV concept. This significantly influences the design of the main structural components. In the presented contribution, the focus lies on the development of new optimisation strategies for this highly modular vehicle concept. Therefore, new strategies were developed which allows the identification of the right material and the required geometry for the main crash related components.

Keywords: crashworthiness, safety, optimization, car crash.

INTRODUCTION

Today's vehicles and their body structures are characterised in particular by their drive technology and the given crash certification requirements. Currently, many concepts have a traditional combustion engine at the front of the vehicle and a gearbox in the transmission tunnel. Due to the electrification of vehicles, vehicle concepts and their body-in-white structures must be rethought.

The UMV concept is a highly modular and intelligent battery-electric vehicle. The modularity of the UMV, Figure 1, mainly affects the development of the structural design [1]. By dividing the structure into a central stretchable floor region (with an integrated battery box) and exchangeable crash elements in the front and at the sides of the vehicle, a modular platform can be obtained, on which different vehicle concepts (from a basic sub-compact up to a cargo version) can be built without significantly changing the global structural architecture of the vehicle.

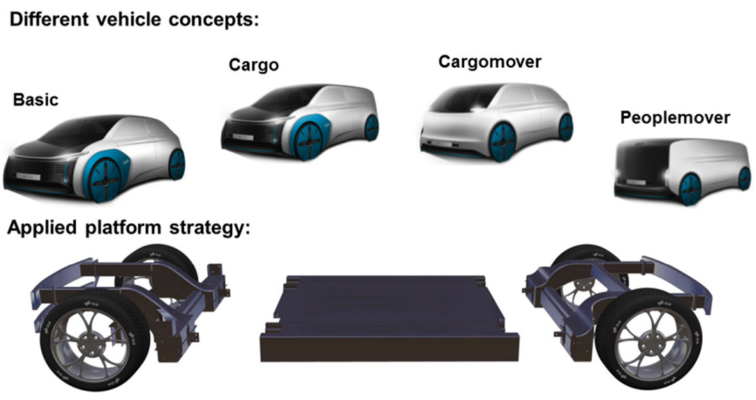

Fig. 1 - Modularisation concept of the UMV

RESULTS AND CONCLUSIONS

A methodological approach for the design process of this modular battery-electric vehicle was developed. The investigation showed that the integration of the new components (e.g. the volume- and mass-intensive battery) allows new modularisation strategies of the global vehicle architecture. Therefore, a modular floor concept was developed through the intensive use of optimisation studies and virtual testing, Figure 2. In the floor concept the variable mass of the different vehicle concepts can be directly addressed by adapting the trapezoidal crash element, which is positioned at the location of the door sills [2]. The functionality and the required energy absorption characteristics of the floor concept could be proven in an experimental campaign.

Another important structural region for passive safety is that of the longitudinal beams in the front and the rear of the car. Within the UMV these beams are implemented as extruded profiles for longitudinal beam and crash box with defined deformation characteristics. The design of the exchangeable extruded profiles and subsequently their deformation characteristics is mainly defined by the masses of the different vehicle concepts. Therefore, optimisation strategies are presented which allow the identification of the right material and the required geometry for these important crash-related components.

Process chain for optimization ***Verification of the crash behaviour***

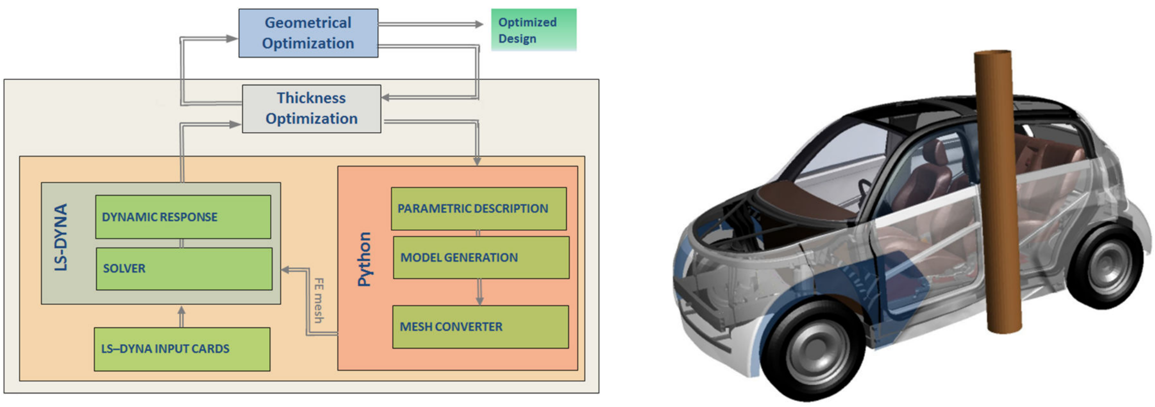

Fig. 2 - Applied process chain for optimization and verification of the crash behaviour

In the talk the methodological approach for the development of this modular electrical car architecture is presented. Herein, the main focus lies on the applied modelling and optimisation strategy for the virtual identification of the essential deformation elements with the required energy absorption characteristics.

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