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Research Area 1: Vehicle Lightweight Design and Safety

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1. Vehicle Lightweight Design and Safety

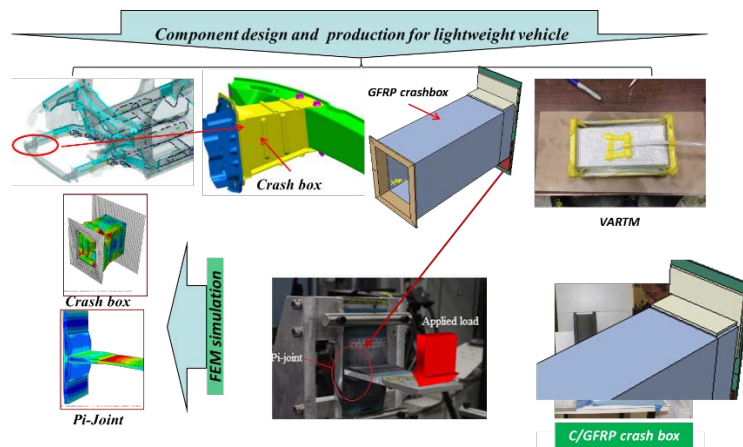
In automotive industries, factors such as vehicle weight reduction and energy absorption through the large deformation but in a controlled manner of the vehicle structures is getting researchers' attention over the last few years, with particular reference to occupants and pedestrians safety.

Generally, lightweighting of existing airplane and automobile models can be carried out in two ways; structural improvement and material change.

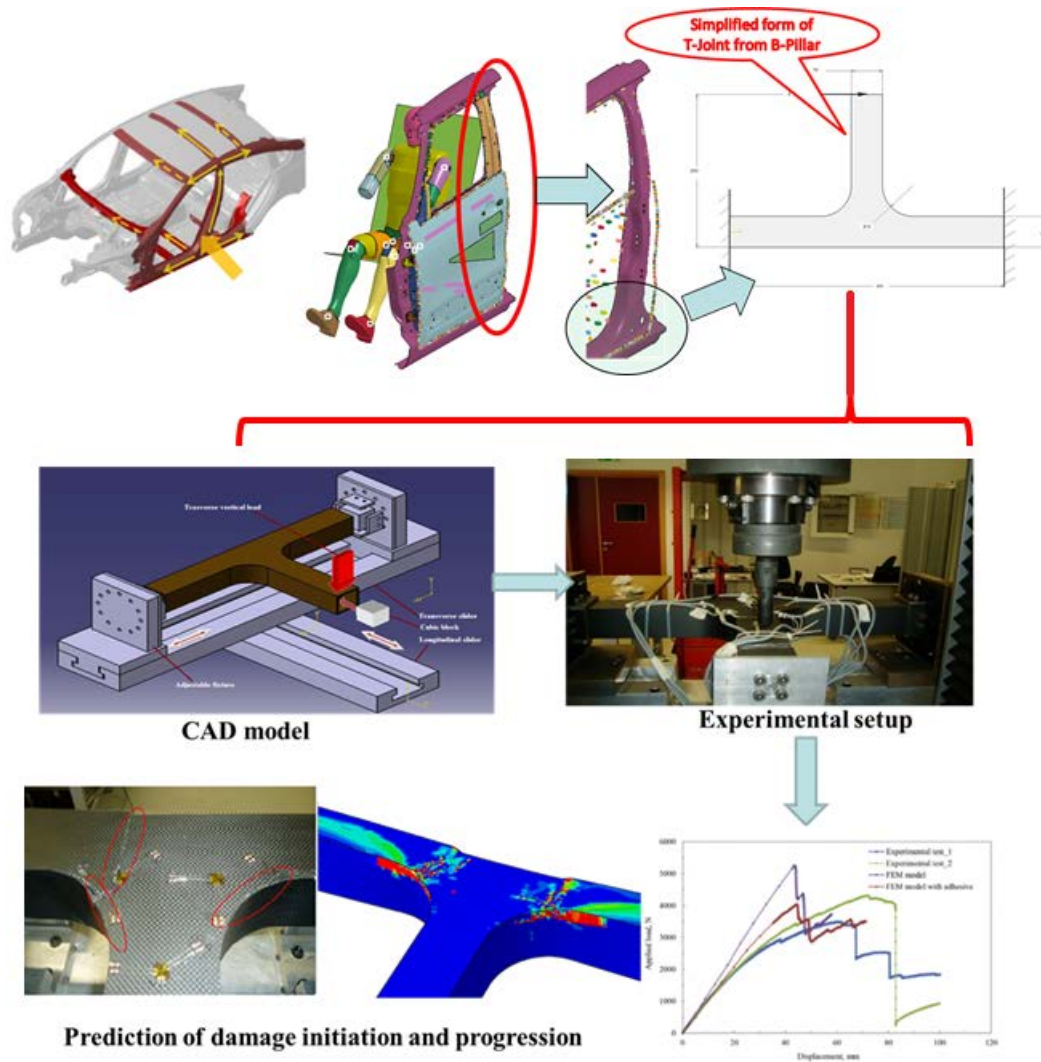
While dealing with material replacement, safety levels of occupants, pedestrians, cyclists and urban infrastructure in crashes mainly depend on the structural behavior of the front and rear structures of the vehicle, in combination with the rest of the frame: front/rear bumpers, hood, sides, floor panels, pillars, etc. The crashworthiness analysis of vehicle structure using advance numerical techniques and innovative lightweight materials will be dealt with robust and innovative approaches.

In this subgroup vehicle structural design, simulation, optimization and testing and safety will be dealt using the following approaches.

- i. *Modular based design*: This implies easier assembly and improved repairability. Each module/component will be subjected to individual optimization in terms of manufacturing processes, weight optimization, crash energy absorption, etc. Selected components will be compliant with some specific characteristics required to fit within the global lightweight vehicle design and safety standards.



- ii. *Basic vehicle concept*: A number of structural optimization, materials replacement, and additions (Additional components) will bring specific self-protection in case of front, rear and side impacts, as well as in cases of rollover.



- iii. *Developing controlled fracture behavior of composites, light metals, and foams:* This category encompasses the study of fracture behavior and the effect of high strain rate on the mechanical behavior of individual materials, part integrity, and stabilization function of chosen components at medium and highspeed crashes. At these rates primarily, the deformation behavior is important from the point of crashworthiness.
- iv. *Optimization:* Different vehicle subsystems are targeted for optimization to improve the performance of vehicle during crashing and driving. Some of topics are frontal bumper subsystem, continuously variable transmission (CVT) system, lightweight materials for vibration isolator.

Integrated beam and crash box solution



QUADRANT proposed solution for rear bumper beam



Integrated composite solution developed by Mercedes for top class vehicle



Our proposed solution for frontal bumper beam [9]



CVT system under optimization