Modelling And Testing for Improved Safety of key composite StructurEs in alternatively powered vehicles

**Motivation and Objectives**

With increasing energy costs and stringent emission targets aiming for 95 g/km CO₂ emissions for the year 2020, material efficient lightweight design and alternative propulsion systems play an important role in today's vehicle research and development activities. Furthermore the security of occupants is a core demand on passenger vehicles. MATISSE addresses both, electric and compressed natural gas (CNG) storage systems and an extensive use of light fibre reinforced structures.

For the reliable application of fibre reinforced polymers (FRP) in a vehicle structure the accurate prediction of the material behaviour using the finite element method (FEM) is crucial. MATISSE focuses on advancing the modelling, simulation and testing capabilities for FRP structures under dynamic loading (crash impact safety). Crash modelling tools used in the automotive industry currently do not adequately address a number of issues specific to FRP structures under these load conditions.

**Project Plan, Milestones and Deliverables**

The figure shows the work packages and their interactions. The main research results are:

- Prognosis of future crash scenarios and hazards for occupants
- Advanced modelling techniques for composite materials
- Novel adaptive composite crash structures
- Enhanced type IV CNG storage tanks
- Proposal for virtual evaluation methods for composite structures.

**Technical Approach**

MATISSE aims to develop an integrated, validated approach to the modelling, simulation and testing of safety-critical pressurised FRP structures subjected to impact loading. The applicability of this approach also extends to FRP structures that are not subject to high internal pressure, however MATISSE will focus on pressurised ones as we have identified two classes of these structures that can be major determinants of alternatively powered vehicle (APV) safety.

**Achievements**

WP1: The most likely future crash scenarios have been identified. Due to the application of active safety systems the amount of accidents involving the vehicle front and rear zone will be continued to reduce in the future. So, the prevention of lateral impacts will remain an issue. WP1 has been completed.

WP2: For both types of material (application in door beams and the CNG tanks) preliminary material models have been established and initial simulations of the components have been run. The simulation results have been compared to testing results executed on coupons or simplified part specimens.

WP3: Based on the results of WP1 a side intrusion door beam has been selected as an application for an adaptive crash structure made of fibre reinforced composites. Moreover, several composite materials have been considered and concepts for the design and the inflating mechanisms of the door beams have been generated. Based on these concepts simple prototype parts have been produced.

WP4: A first semi detailed model of a CNG tank using thick composites with unidirectional fibres has been established which will be used for the set-up of a virtual testing process of CNG tanks. Furthermore, a concept for a practical testing of those tanks has been generated.

WP5: This WP will start in October 2014. Here, a modelling and simulation tool chain will be developed that allows designers to predict and optimise the safety performance of parts and of the whole vehicle prior to hardware prototyping and testing.

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**Coordinator** Roland Wohlecker, fka  
**Contact** info@project-matisse.eu

**Prog. manager** Nikos Papakostas, LMS – Uni. Patras  
**Contact** papakost@lms.mech.upatras.gr

**Partners** 11 partners, among them CRF, Daimler, TU Graz, Autoliv, Chalmers, TU Munich

**Website** www.project-matisse.eu