Title: **Modelling of thick UD composites for Type IV pressure vessels**

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Abstract:

The project MATISSE funded by European Commission's 7th Framework Programme aims to make a significant step forward in the capability to model, predict and optimise the crash behaviour of mass produced fibre reinforced polymers (FRP). One of the project's main research goals a general virtual testing methodology (VTM) for the development of storage systems for compressed natural gas (CNG) made of wound carbon FRP as well as glass FRP with polymeric liners and metallic bosses.

For this purpose a modelling approach for the impact behaviour of thick unidirectional (UD) reinforced materials is developed. It bases on a combined stacked/layered laminate set-up that uses thick shell (t-shell) and cohesive elements. Furthermore the approach uses the material model *MAT_LAMINATED_FRACTURE_ DAIMLER_CAMANHO. This orthotropic continuum damage model for laminated FRP is based on a physical model for each in-plane laminate failure mode. Furthermore, the inter-laminar failure mode (delamination) is addressed by using cohesive layer modeling. For complexity reason only failure between certain stacks of layers is captured.

The validation of the approach bases on a "reverse finite element method" which is necessary since no fully reliable test procedures for the characterisation of the relevant materials were identified. Therefore, material values determined by calculation or retrieved from literature are applied. The validation is carried out on the basis of three point bending tests on FRP tubes.

The validated UD materials models are applied in a complex full tank model that also comprises the bosses, which are assumed to be rigid, and the liner that is elastically modelled. The tank model is subsequently verified on pressurisation and impact tests conducted on physical tanks.

In a last step several measures of model simplifications are carried out on the tank model in order to achieve reasonable simulation costs with the perspective of application in full vehicle simulations.