Topology Optimization at the Design Studies of Lightweight Vehicle Structure for L7e Vehicle Class

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Project Overview:
- Application of topology optimization at conceptual development of new lightweight vehicle structure
- Taking into account of electric powertrain components placement e.g. lithium-ion battery packs
- Consideration of static and dynamic (crash) loads

Business Profile:
- Competence center offering the partnership with TU Graz and over 100 partners from industry & science
- Focus on the R&D of affordable, safe and environmentally friendly road and rail vehicles
- Staff – near 200 researchers and engineers hired

HW Tools applied at the project:
- HyperMesh – preparation of: design & non-design space, Finite Element meshing, load case applications & optimization parameters setting
- OptiStruct – topology optimization solver & HyperView – results post-processing
- OSSmooth – optimization results interpretation for reanalysis and CAD design

Challenge:
- Definition of important and indispensable loads only
- Lightweight structural design taking into account the crashworthiness
- Reduction of new design iterations number

Solution:
- Definition of main vehicle components positions and acting force values
- Application Inertia Relieff for constraints setting
- Equivalent static forces approach for crash load cases
- Single & combined load cases run method to distinguish the influence of each part of material density plot

Results:
- Illustration of force flow paths and their intensity
- Effect of compliance use – high material independency in topology optimization results interpretation
- 15% for Steel and ca 40% for Al mass reduction for extended structural requirements including crash