Eng. Mauro Linari, MSC.Software

Structural optimization and its applications in automotive industry

Structural optimization is one of the numeric tools which usage is increasing more and more in the design process of the structure. Its ability to take into account of large number of design variable and constraints is really useful to find solutions not always reachable by intuitive and manual process. Some specific functionality has been introduced to link numerical solutions to the real life. Furthermore new methods allow using structural optimization also in the concept phase of the design process.
Some functionality will be presented using generic examples in order to understand it in a simple but exhaustive manner.
Practical applications from automotive will be presented to better understand how the structural optimization is affecting the complete design process and the benefits that are possible to reach. For completeness experiences from other industries will be presented.
Applications will be relative to the most of the available MSC products (MSC Nastran/ Marc/Adams/…)

Eng. Fabio Rossetti, EnginSoft

New CAE frontier: analysis, optimization and manufacturing simulation for complex shape composite structures

The new CAE technologies and advanced optimization tools merge together and face in detailed and efficient manner the design problem of the composite material structures. Pushing the envelope of simulation technologies in the automotive sector allowed to evaluate the mechanical behavior of the composite structures and their industrial feasibility in the presence of complex parametric geometry. The advanced design and simulation tools for composite Prep/Post interact each other within the multiobjective and multidisciplinary environment modeFRONTIER for the product/process optimization in order to achieve performance maximization , shape optimization and time-to-market reduction.

Dr. Claudio Annichiarico, UNIFI

Formula SAE as a training ground

Formula SAE is an international student competition, which target is to design and build a full-working race car. The University of Florence was the first Italian University believing in the didactical value of such competition, and gave birth to the Firenze Race Team in the year 2000. In eleven years, Formula SAE allowed to improve the technical skills of the students, and inspired many research activities. After a brief discussion on the latest works performed by the Formula SAE workgroup, there will be the opportunity to take a look at the car to find out its technical features.

Eng. Giovanni Monfrino, CRF

Composite design for product development

In the highly competitive car market, new strategies have been now developing taking into consideration multi material approach as an optimal trade-off between structural performances – light saving and industrial sustainability. In this scenario, an effective competence for composite design enables the achievement of the abovementioned targets.
A complete workflow of the product development in a multi-material context will be presented.

Dr. Andrew George, Swerea SICOMP

Composites manufacturing and process optimization strategies for vehicle structures

The use of fiber-reinforced composite materials is increasing in the automotive industry. The increase in their application follows earlier trends in the aerospace industry as has occurred with many other manufacturing technologies. Many processing options and simulation tools for composite materials were developed for the aerospace industry, which can be adapted to automobile manufacturing.
This presentation begins with the general material concepts behind composite materials, along with design differences between more traditional materials and composites. The various processing method options for composite materials will then be presented along with process selection criteria. The status of the field of processing simulation will then be presented, covering the full chain of tools from draping through mould filling and on to residual stress and shape distortion. The results from these simulations can then be used in structural simulation, resulting in a methodology to optimize the performance of a composites part based on early manufacturing process decisions without the need for prototyping.

Dr. Magdalena Szpieg, Swerea SICOMP

Recycling and life cycle assessment of composite materials

Recycling of composite materials has been considered to be difficult due to the complex structure of these materials. Various types and content of fibre reinforcement as well as very different applications are factors that make recycling complicated. Today, the content of composite components in the automotive industry is increasing. Due to that, the methods to recycle composites have to be developed. Until recently, the growing number of composite components from retired aircraft, wind turbine blades and automobiles have been disposed in landfills or incinerated. Since a European Union directive came into force in 2004, many member states are forbidding landfill disposal of composites. Also the new automotive legislation forces increased reuse of materials. The End-of-Life Vehicle (ELV) Directive, issued in year 2000, requires that 95 wt % of a vehicle manufactured after January 2015 has to be reused or recovered. The directive assigns the original equipment manufacturer to design recyclable products.
Traditionally, there are three recycling technologies for polymer composites: mechanical recycling, chemical recycling and energy recovery (incineration). These methods will be discussed in detail. Life cycle assessment will also be introduced and an example of LCA on a composite component from the automotive industry will be presented.

Eng. Simone Ragionieri, SmartCAE

Virtual testing of composite motorsport structures through progressive failure simulation

The structural design of a Formula 1 race car is a very challenging task, due to the combination of conflicting requirements such as safety, stiffness and lowest possible mass. Moreover, the design cycle of the car is dramatically short and several updates are usually needed during the race season to gain competitivity. Any design update requires a new structural validation and eventually an homologation test according to FIA rules. Virtual testing, i.e. an high fidelity computer simulation of the actual homologation test, is advised as highly desirable to optimize the structure and for risk mitigation purposes.
The virtual test of several FIA homologation tests, like front, rear and side crash, which are destructive, must include the simulation of the composite laminates, of which the car monocoque and crash absorbing structures are made out, beyond their elastic limit. State-of-the-art damage modelling criteria

and computer codes are needed to complete this kind of simulation with acceptable accuracy and reliability.
The presentation will show the mathematical modeling assumptions, the composite material non-linear characterization options and the results of a selection of crash test simulations of formula one safety structures, along with a discussion of how the simulation results compared with actual testings.

Prof. Tadeusz Uhl, AGH

Selected problems of application of composite materials in vehicle structures

The lecture presents general information about composite materials, their properties, manufacturing technologies and some economical aspects of their application in automotive industry. Some example of design problems will be discussed.
Application of the composite materials for crash energy absorption will be considered with focus on numerical modeling and simulation and experimental validation of the results. Comparison of crash energy absorption of metallic structures and equivalent composite structures will be shown.
One of the most important factor of composite materials for automotive structure is their disposition to aging. The problem of composite aging, different reasons of composite aging and possibility of aging modeling and prediction will be discussed.
The issue of composite structure integrity testing is crucial for critical composite car elements like suspension and driving system components. Some methods of composite structure quality assessment will be shown.