DRIVING SPREE

Fiber reinforced composite structures in the Next-Generation-Car – Interurban Vehicle (NGC-IUV)

The German Aerospace Center (DLR) is developing innovative, functional-integrated, safe and light automotive vehicle structures within the DLR Next-Generation-Car (NGC) project. Various lightweight strategies are being studied on three different vehicle concepts in order to reduce the mass-related driving resistance and to improve the driving dynamics and passenger safety.

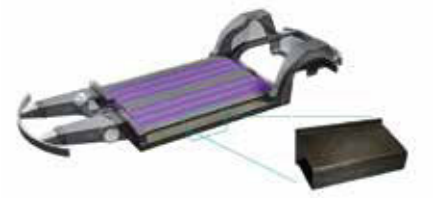
As a comfortable car for long distances, the "Interurban Vehicle" is the representative of the premium class segment within the NGC family.

Body in white of the NGC Interurban-Vehicle

Integrated optical fiber sensors

Sustained yields ...

In order to ensure the long required range of the emission-free fuel cell drive, the vehicle masses need to be reduced as much as possible. The structure of the vehicle, which is more than 5 meters long, therefore relies heavily on high-performance Fiber Reinforced Plastics (CFRP). For passenger protection and to protect the hydrogen storage tank located in the central vehicle floor, a crash concept with an intrusion-resistant passenger compartment and defined deformation and energy absorption zones in the vehicle's lateral areas is essential.



Floor module with hydrogen tanks

Mechanical test and simulation of CFRP structure

... with digital assistance

Due to the complex failure behavior of CFRP structures, precise predictions using explicit FE analyses in crash scenarios are very challenging. In order to improve the understanding of the material behavior, necessary for the design of crash structures, investigations are carried out on a generic component level. Mechanical relations within the inner structure can be studied for example with optical fiber sensor systems based on Fiber Bragg Grating (FBG).

A strong coupling of FE-calculations and test measurements can help to reduce the difference between simulations and tests. During loading it is possible to capture large numbers of strain measurements along the optical fiber. The obtained quantity of strain measurements is higher than with ordinary strain gauges, but, unlike with optical methods like digital image correlation (DIC), very accurate information can be obtained from the inner structure.

Furthermore there is a possible use-case for such structurally integrated sensor systems in components for series applications. The condition of the component could be monitored during driving operation along its lifetime and help the early detection of structural damage.

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