Every year, the Elbflorace team from Dresden University participates in the Formula Student events, which are held globally. A prerequisite for participating is that the students – who specialise in different fields of study – have to design, construct and produce their own electric vehicle. Up to 500 teams from virtually all industrial nations, including the USA, Germany, Austria, Switzerland, Brazil and China, meet at the venues, which change from year to year. For five consecutive days, the teams have to prove that their vehicle designs and the vehicles they have constructed based on these designs can meet the most stringent demands. Amongst other things, these demands include sound engineering which is suitable for everyday use, appealing design, cost-effective production, efficient operation, and most particularly the energy efficiency and sustainability of the mobility design.

At the TU Dresden, up to 70 students join the Elbflorace team each year to participate in Formula Student. And the team is once again good to go in the 2016/2017 season. The tasks within the team are structured as in a business enterprise. Specific students are appointed to head the engineering and business areas, as well as construction and component development, manufacture, quality control and more.

In the Formula Student event, students of engineering, business studies and economics design mobility concepts for the future. Participants then have to pass various tests using real vehicles. Important aspects here include energy consumption, suitability for everyday use, durability and the economic viability of the vehicle designs. In order to guarantee the high quality of the electric vehicles they develop, students from Dresden University use Nikon measuring technology to measure and test their automobile components.

Paving the way towards e-mobility

Elbflorace verifies the quality of new vehicle technology using Nikon's CT technology
assurance, marketing and controlling. Students from all faculties are involved in the project, including students of psychology and sociology. Matthias Bayer, who headed the engineering division in the Elbflorace team last year, explains: “Organising the team in this manner prepares students systematically for structures and processes in real companies. The Formula Student program not only focusses on engineering and business concepts, but also prepares students for their future fields of work in the real world of business.”

Powerful supporters for committed research

Naturally, the team – in which the members fluctuate almost yearly, depending on their academic progress – requires suitable equipment and facilities in order to turn their mobility visions into reality. To achieve this, the team has inspired a number of industrial sponsors over the years to support its visions. In Dresden, sponsors who support the vehicle project include the automobile manufacturer BMW, the electric and component developer Bosch, the tyre manufacturer Continental, the chemical and plastics experts BASF, the fibre producer Saertex, the bearings manufacturer SKF and the gearbox specialist ZF. “Modern electric vehicles which meet the demands of Formula Student consist largely of light metals and fibre-reinforced plastics. The students are glad to use the expertise and latest products of their sponsors. Naturally, they continue to develop and optimise these, particularly in the interplay of all components in the design and construction phases. Both partners benefit from the results – the students and also the sponsors.”

Flexible, universal measuring technology required

An additional challenge for the students consists in creating a completely new electronic vehicle within just one year. Naturally, they are able to fall back on the insights gained and ideas developed by the previous team. Nonetheless, they redesign and develop lots of new components each year. The quality of these components needs to be monitored and ensured continuously. Only by doing so can the finished vehicle meet all engineering requirements. However, as Bayer explains, the teams did not until just a few months ago have the measuring technology they needed in order to flexibly measure and test various components in their electric vehicle. In particular, they needed equipment to measure fibre composite, glass and carbon fibre structures. For example, layers of fibre repeatedly became detached on the inside, and structural cracks appeared in some transverse links which were made of carbon fibre. Identifying these and determining the causes proved to be particularly problematic. For example, the cracks were often not noticed until the transverse link failed completely. Also, the components had to be taken apart laboriously in order to see where the cracks were running.

After initial talks with experts from Nikon Metrology, it became clear that computed tomography (CT) could prove to be the answer for inspecting the internal structure, without destroying the sample. Ashley Bray, product manager for metrology CT at Nikon Metrology, reports: “Nikon’s X-ray measuring technology has numerous essential advantages for capturing data and assessing complex
components. Thanks to the large measuring volumes, the equipment can gather data quickly and effortlessly from 3D objects, regardless of its shape. But most importantly, CT technology enables you to look inside the component without destroying it."

Last but not least, the CT measuring process where 2D X-ray images are captured while the part rotates is completed in a matter of hours. The hundreds of 2D X-ray images are often reconstructed in a 3D volume providing micron-level detail. This means that the quality of the transverse link can be tested not only immediately after production, but again during operation, in order to assess the level of functionality. The Formula Student team in Dresden is now making use of these advantages for the second year running. They also benefit from the optimised evaluation software. Not only can they pinpoint cracks and areas where layers of fibre have separated internally, but they can also measure the extent and scope of the damage inside the component directly using the generated 3D images. This means that the measuring data can be assessed immediately, enabling them to swiftly draw valuable conclusions on the behaviour of the components.

As Bayer confirms, the Elbflorace teams in Dresden were able – within a matter of months – to make considerable improvements to the design and construction of their transverse links thanks to Nikon’s CT technology. Short cycle times play a major role in this respect. CT technology considerably reduces the amount of effort required in comparison to mechanical or destructive measurement methods. Above all, CT technology is particularly valuable and profitable for lightweight engineering with fibre composites, which will become increasingly important in the future. Product expert Bray summarises:

In Formula Student, research into future mobility concepts joins forces with ground-breaking CT measuring solutions. The students report that this ground-breaking technology will soon be used for other components – structural components and bodywork parts – in their vehicles. They’re totally convinced by the advantages. These include the simple measuring procedure, reliable readings even from complex components and secure, fast evaluation. Here at Nikon, the Industrial CT Team is delighted that the high-quality, sophisticated micro-focus CT technology has been able to contribute to the success of the Elbflorace team.”