



The application of the SMARTTECH 3D scanning technology during the customization of a lorry for the needs of a firefighting vehicle at the company BOCAR.

The company BOCAR is engaged in the production of vehicles adapted to the needs of the fire service. Specialised solutions that meet the requirements of firefighters must fit seamlessly into the existing geometry of the vehicle. The solution allowing you to obtain the information about the shape is the 3D scanning technology from SMARTTECH and – as a perfect complement – software for reverse engineering: Geomagic Design X.

By using a 3D scanner based on the technology of structured light we can be sure of not only a very high accuracy but also of the fact that the time required to obtain all the necessary information about the geometry will be much shorter compared to traditional measurement techniques.

In this particular case we will present the 3D scanning technology used at the company BOCAR using the example of 3D scanning the roof and back wall of the cabin of a lorry in order to design an emergency vehicle lighting.

As a base for building the fire engine the company BOCAR used a Volvo FMX characterised by extraordinary durability and power as well as many conveniences such as active steering and I-SHIFT gearbox, which make the vehicle much easier to operate by the fire brigade.



3D scanner DUAL VOLUME

The 3D scanner used by BOCAR is a scan3D DUAL VOLUME characterised by two independent measurement volumes: the larger – with 800 x 600 mm of measurement volume and 0.1 mm accuracy – used for the broad and fast measurements of bigger objects such as the body of a vehicle; and the smaller – 300 x 200 mm and 0.04 mm accuracy – used for the 3D scanning of smaller details such as mirrors, door handles or air vents. The user can switch between the two measurement volumes by selecting one of them using the software for operating the measuring head – SMARTTECH3Dmeasure.

This solution does not require a complicated calibration process that is often encountered among other 3D scanner manufacturers. No need for calibration means that the end user doesn't have to be burdened with the setting of the 3D scanner's accuracy. This process is conducted by the SMARTTECH specialists during the manufacturing process. A 3D scanner with a permanent calibration tested in accordance with the VDI/VDE 2634 part 2 standard is a metrological device that can be additionally certified in an external metrological measurement laboratory. In the case of the 3D scanner from the DUAL VOLUME line it would mean the testing of both of the measurement volumes for the accuracy of their measurements.



Scanning process – 3D scanner placed on a lift



Surface of the vehicle covered with a matting solution with attached reference markers

The SMARTTECH 3D scanner uses the structured-light technology which is based on the projection of a pattern of light (fringes) on the scanned surface and then looking at the deformation of that pattern on the object using a detector. The obtained data is then send to the software which converts it to a point cloud describing the shape of the measured object using the X, Y, Z coordinates.

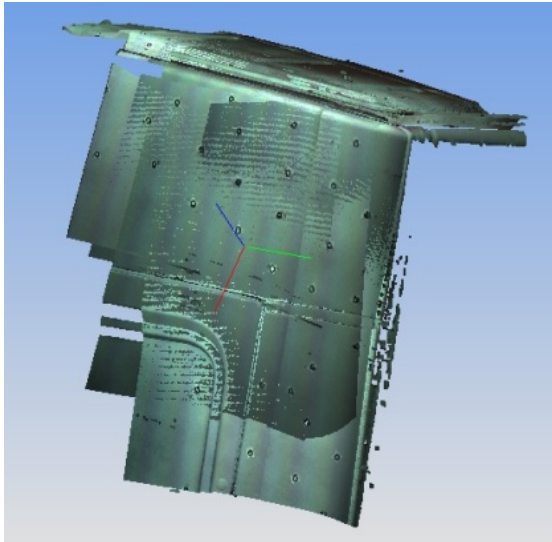
A 3D scanner collects massive amounts of measurement data. The number of points collected is dependent on the resolution of the detector – in the case of the device used by BOCAR during a single scan the 5 megapixel camera collects 5 million points.

In order to efficiently perform the scanning process, the scanned surface was covered with a antiglare matting agent. This non-invasive solution allows the fringes displayed by the projector to be clearly visible to the detector which in turn means that the measurements are very accurate and free from noise. After the scanning process is complete the solution can be easily washed off with a pressure washer leaving no trace on the body of the vehicle. The second stage in our preparation of the object for scanning is to attach reference markers. These characteristic stickers make the 3D scanner able to automatically connect individual scans giving an overview of the obtained data. This

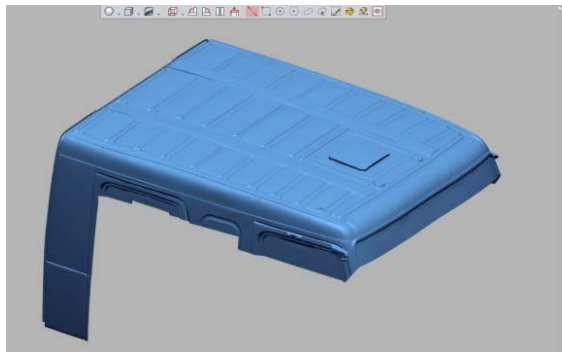
provides the user with the information about which surfaces have been scanned and which still await to be measured.

The 3D scanner was placed on a mechanical lift. Because of the large measurement volume the required surface was scanned within an hour. The point cloud that is displayed on the monitor shows the scanned surfaces in a clear way while the scans merged using the reference markers give a full view on the obtained data.

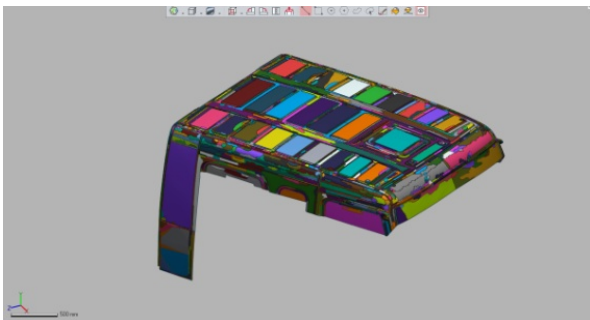
The filters applied by the software SMARTTECH3Dmeasure remove the noise from the data in real-time while the 3D scanning process is taking place. Apart from scanning and the removal of noise from the results the SMARTTECH3Dmeasure allows for accurate alignment of scans using the 3-point method or the option “global” alignment in which the software practically eliminates the error occurring during the alignment of scans.



The final result from the software SMARTTECH3Dmeasure – triangle mesh in the STL format



Result of the 3D scanning in the form of automatically aligned point clouds



Triangle mesh divided into regions making the modelling easier

The last step in the SMARTTECH3Dmeasure is the creation of a triangle mesh in an STL format - we do that by converting the point cloud. The resulting triangle mesh will serve us during the CAD modelling in the software Geomagic Design X.

To improve the quality of the triangle mesh we will perform an optimisation for future modelling. This option reduces the number of triangles in places where the geometry of the object doesn't change allowing us to retain a large number of triangles in the particularly important places where the curvature changes. The next step is the creation of regions – the

areas in the triangle mesh which are fragments of the surface such as: planes, cylinders, cones, balls, rotating surfaces, torus, free-form surfaces. They make the modelling easier and are also used for the orientation in the coordinate system of our CAD model. Next, we begin the surface modelling. Most of the model is created so that by using regions and the surface wizard we create surface patches which after mutual crossing and joining will create a surface model.

During the alignment of surfaces the software allows to perform an analysis of the accuracy of the modelling, that is, the inspection of the discrepancy between the surface model and the triangle mesh displayed in the form of a deviation colour map.

An important advantage of this software is the ability to copy the tree of operations to other CAD software such as SOLIDWORKS, CATIA or NX. The finished model can be saved in many formats, e.g. IGES, parasolid, STEP.

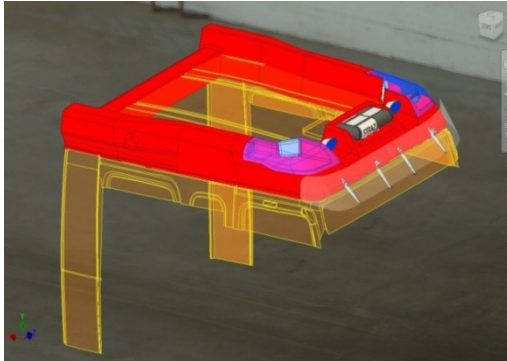
The performed measurements show how the 3D scanning can make the modelling process easier. The

scanner used for the measurements was scan3D DUAL VOLUME and the result of the scanning was a point cloud which served as the basis for the creation of the CAD model of the fire engine cabin.

By using a SMARTTECH 3D scanner and specialised software such as SMARTTECH3Dmeasure and Geomagic Design X it is possible to create geometric documentation (of the CAD model).

The generated CAD model was used for:

- the redesign of the element,
- the designing of additional elements,
- the development of the elements' manufacturing process,
- the development of the method of installation of the elements.



New project of the cabin modelled based on the 3D scan

There are many applications of 3D scanning in the industry allowing for many new previously unreachable possibilities. We are, for example, able to create a surface model (CAD) on the basis of the scanned object as shown in this article and which allows us to design additional elements that will perfectly fit to the existing objects. This allows us to save time and money that would be required for the construction of prototypes and frees us from the risk of causing damage to the object that we work to redesign.

Through the use of the SMARTTECH 3D scanner and the software Geomagic Design X the company BOCAR was able to easily and quickly reconstruct the CAD model of the lorry. This made the designing process of additional components for the fire engine much simpler and cheaper. The virtual model could be easily used in other software such as CATIA, Autodesk Inventor or SOLIDWORKS. The contactless measurement method provides total safety of the scanned surface while the certified accuracy of the 3D scanner is a guarantee of metrologically valid results.



Manufactured fire engine

About the companies:

SMARTTECH – has been manufacturing and selling specialised 3D scanners for 16 years. SMARTTECH is continuously developing its products adjusting them to various sectors of the industry, such as heavy manufacturing, medicine or archaeology. With numerous distributors around the world the company has established a foothold on all continents from both Americas, through Europe all the way to Asia.

More at www.smarttech3d.com

BOCAR – The „Bocar” Sp. z o.o. was founded in 1992 and is a privately-owned company. In the beginning it was a manufacturer of rescue-firefighting car bodies based on used regular vehicle chassis. Currently, it mainly manufacturers new firefighting vehicles constructed on various types of chassis from the renowned brands, providing around 100 specialised vehicles a year. The acquired experience enables the company to accept orders for the most unusual of car bodies according to individual needs. The fire-fighting vehicles manufactured by the company are characterised by its state-of-the-art equipment, beautiful aesthetics and functionality. We use the latest advancements in the fields of welding, gluing and laser treatment as well as lightweight and durable materials such as aluminium, plastic and stainless steel.

Read more at: www.bocar.com.pl