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# A Comparison of the Outputs of 3D Scanners

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**Abstract**

Various types of 3D scanners are used for digitalization of objects (products, space). These are mostly different types of optic or laser 3D scanners. The presented article deals with the comparison of the Steinbichler Comet L3D optical scanner and the Creaform EXAscan laser scanner. Determination of parameters of both scanners is necessary if we need measure on obtained data and not only use the scanned shape. To make this comparison, a specimen was designed that satisfies scanning criteria using the two types of the 3D scanners; i.e. it does not contain complicated shapes or parts that are not possible to scan using the chosen technologies (deep apertures with a small diameter, corners, etc.). The designed specimen was scanned 3 times using both types of 3D scanners. The obtained images were then cleaned (elimination of unwanted artifacts) and STL files were generated. The obtained scanned data were evaluated using VolumeGraphics VGStudio MAX 2.2 software with the necessary modules. In the comparison selected dimensions, shape and orientational deviations were evaluated and the scanned image obtained was compared to the CAD model.



Keywords: 3D scanner; comparison; optical; laser

## 1. Introduction

A 3D scanner is a device serving for the conversion of a real object into digital form. During the process of sensing, the scanner collects with the help of different technologies information about the shape and dimensions of the scanned object and depending on the technology can also record, for example, information about the color of the object. The scanned data is made up of so-called point clouds; this means each scanned point has a position in space

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in terms of a coordinate system, possibly also a color. The information obtained can then be used for the creation of a digital three-dimensional model of the scanned object.

The resulting data can be subsequently processed for different purposes through specialized software products. 3D scanners can be divided according to several criteria – for example construction and method of scanning.

Dividing of 3D scanners by construction:

- stationary – they are bound to one place, these are scanners of large dimensions,
- mobile – they have the advantage of being small in size and can be brought to an immovable object. [3, 4, 8]

They can be divided according to the method of scanning:

- contact – they need mechanical contact with the scanned object for scanning. These are stationary 3D scanners, to a predominate measure coordinate measuring machines (CMM) and measuring arms.
- non-contact – optical, laser and other technologies are used for scanning. [3, 4, 8]

They can also be divided based on the method of scanning:

- optical – they work on the photographic principle. The object is scanned from several angles, and the scans are subsequently combined, to create a digitized 3D image of the object.
- laser – these work on the triangulation principle. Light reflected off the object is sensed and on the basis of the period of return of the light ray and the angle of impact the position of the scanned area in space is determined.
- ultrasound – ultrasonic waves are used for scanning, and as with lasers the period of reflection and the angle of impact are sensed using ultrasonic waves. Unlike laser scanners, they have a lower precision (0.3-0.5 mm).
- x-ray – RTG radiation is used for scanning. Residual radiation falling on the detector after the passing of the scanned object is detected. With this type in addition to the external shape, complete information about the overall volume of the object is obtained (internal geometry, defects of material).
- mechanical – a type of contact scanner. These can be divided into measuring arms and CMM machines. With these types of scanners information is not obtained from the entire surface but from selected points which characterize the given locality of the object.
- destructive – the scanned object is destroyed during scanning. This serves for obtaining the external and internal geometry of the object. During scanning a thin layer of material is gradually skimmed off the object and the exposed surface is subsequently scanned. In this process a model of the entire object is gradually acquired. [3, 8]

Areas of application of 3D scanning:

- reverse engineering – reconstruction of objects
- quality control – control of products during operation, numerical simulation with the use of scanned objects
- architecture – for modeling buildings and their visualization, for designing buildings, visualization of partial modifications or during complete reconstructions for creating virtual models of historical buildings, digitalization of historical objects
- multimedia – use in games, creation of animation in films, for modeling of virtual cities, etc.
- art -– reconstruction of cultural and historical monuments, such as statues, creation of the foundations for replicas.
- medicine – reconstruction and visualization of the human body (prosthetics and orthotics), bones, etc.

## 2. Scanners

### *2.1. Steinbichler Comet L3D*

The Steinbichler Comet L3D enables non-contact optical scanning. The version used for the comparison has resolutions of 2Mpx and 1600x1200 pixels available (Table 1).