

## Technical specification - optical 3D digitizer *kolibri Flex 40*

*kolibri Flex 40* is an automated 3D digitizer as table-top-unit that works on the basis of digital self-calibrating fringe projection. Two cameras capture different structured light patterns. With the help of triangulation, similar to the human stereo vision, the exact 3D coordinates can be calculated for each single camera point. The patented use of an additional stationary camera enables a complete highly accurate surface digitizing without reference markers (that have to be fixed on object's surface), matching procedures, or a special object positioning.

A special *MULTIview-technology* enables a self-calibrating measurement process where the absolute position and setting of cameras and projector is not relevant. The system is therefore inured to changes of environmental conditions (thermal fluctuations). Precise engineering mechanics is not necessary.

Special features of *kolibri Flex 40*:

- Automation
- No reference markers
- No matching
- Self-calibration
- MULTIview technique
- High data quality
- Fast inspection process

The measuring system contains three cameras such as one camera on top, two cameras aside from the projector in addition to a digital projector. Via several precision mirrors the projector illuminates the object as well as the sensor unit cameras capture the images from two different height positions. The two different angles enable a high illumination of object details and complete measuring results. Complex 3D geometry can be measured therefore fast and non-contact.

*kolibri Flex 40* works with pre-installed measuring schedules that guarantee a high reproducibility of measuring results. These measuring schedules are customized to the macro-topography of the measuring object and its surface quality. The number of camera positions as well as the capturing direction of the cameras can be flexible varied. A measurement process up to production of the point cloud lasts according to measuring plan between 6 and 12 minutes (by 12 captured views). The user interface is easy to use and requires only a couple of steps to begin the measurement process.

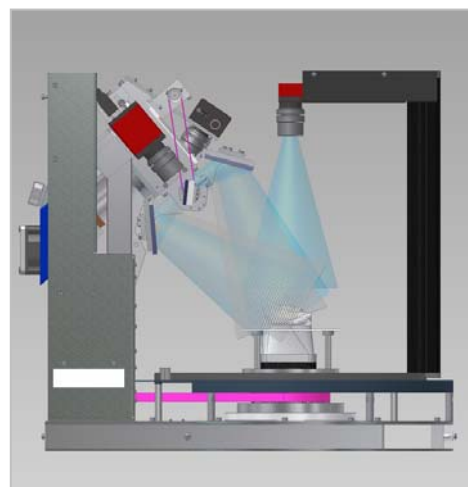
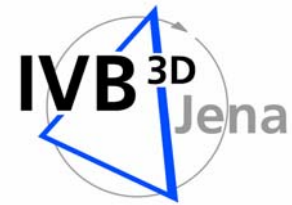


Figure 1: Measuring system *kolibri Flex 40*



The final measuring result is a highly defined 3D point cloud of the surface of the technical component. The point cloud can be triangulated and post-processed with standard 3D-evaluation software for quality inspection, reverse engineering, geometrical dimensioning and tolerancing etc. *kolibri*-systems work excellent with software solutions from the company GEOMAGIC Inc. (Qualify und Studio).

The application fields of the 3D digitizer are mainly in quality inspection, reverse engineering and rapid prototyping:

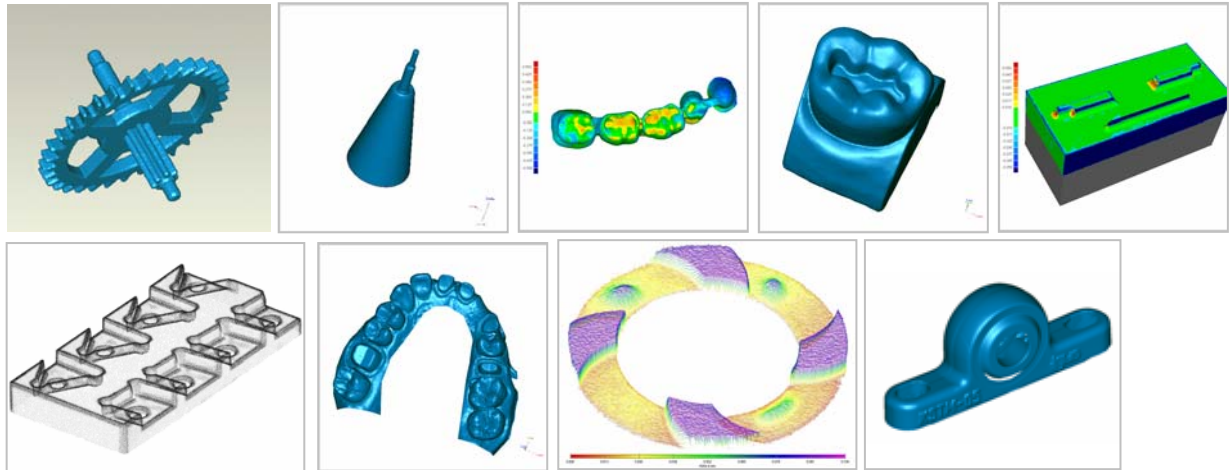
Quality inspection*	Reverse engineering**
<ul style="list-style-type: none"> <li>• Generation of geometric models (STL data ) by triangulation</li> </ul>	
<ul style="list-style-type: none"> <li>• Colour indicated comparison between CAD model and as-built part</li> <li>• Align models using the method of choice – datums, 3-2-1, reference point systems best fit</li> <li>• Geometrical dimensioning and tolerancing</li> <li>• Gap and flush, edge comparison</li> <li>• Wall thickness inspection</li> <li>• Industry specific solutions, e.g. turbines, automotive industry</li> <li>• Automated creation of inspection reports</li> <li>• Easy data transfer per ASCII, Excel, CSV etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Creating of water tight models for rapid prototyping and digital manufacturing</li> <li>• Automated conversion of complex polygon models to precise NURBS-Models for CAD-, CAM- and CAE-systems</li> <li>• Model editing capabilities include creation of tunnels and holes</li> <li>• Smoothing of surfaces and boundary edges, offsets and shell surfaces in preparation for digital manufacturing</li> <li>• Industry specific solutions, e.g. aerospace, automotive industry, dental industry, medicine, art and archaeology</li> </ul>

\* requires an 3D-software like Geomagic Qualify

\*\* requires an 3D-software like Geomagic Studio

*kolibri Flex 40* can be also delivered with a modified measurement field size in the system configuration of a *kolibri Flex 80* or *kolibri Flex 20*.

System variation	Measuring field size	Point distance
<i>kolibri Flex 20</i>	Ø 20 mm, height 7 mm	0.013 – 0.02 mm
<i>kolibri Flex 40</i>	Ø 40 mm, height 13 mm	0.025 - 0.04 mm
<i>kolibri Flex 80</i>	Ø 80 mm, height 25 mm	0.05 - 0.08 mm



**Figure 2:** Samples of measurement results, captured with the measuring system *kolibri Flex 40* and *kolibri Flex 80*

The measuring principles and system are patented by the Fraunhofer Gesellschaft. IVB as development partner of the Fraunhofer Institute for Applied Optics and Precision Engineering in Jena develops, manufactures and distributes the measuring instruments.

**Components**

<b>Rotating table</b>	Large, rotating stage for object rotation
<b>Digital projector</b>	Projector with digital, fast display and LED-light-source
<b>Cameras und lenses</b>	One digital camera on top, two digital cameras aside from the projector (incl. adequate lens system)
<b>Mirror</b>	Several mirrors for projector and cameras to generate a further object view from a second height position
<b>Computer and Software</b>	<ul style="list-style-type: none"> <li>• PC for system control (2 engines and rotary encoder, control of projector and cameras)</li> <li>• Operating software under Windows XP</li> <li>• 19" monitor, keyboard and mouse</li> </ul>
<b>Casing</b>	Robust and service-friendly case
<b>Artefacts</b>	Test (calibration) artefacts with certificate and storage box

The measuring system will be provided according to the following technical dates and performance parameters.

### Installing Conditions

Dimensions	530 x 400 x 480 mm <sup>3</sup> (W x D x H)
Weight	37 kg
Electricity	230V/115V, 50Hz, 300W
Temperature	15..25°C
Positioning place	Oscillations/vibrations of the table, the building or the air can affect the functionality of the system. The customer is responsible to quantify these affects and in case to install an oscillation isolation.
The working table is not part of the offer.	

### Measurement field size

Measurement volume	∅ 40 mm, height 12 mm
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### Requirements for the measuring object

Surface structure of the measuring object	Non-diffusely reflecting surface
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### Measurement time

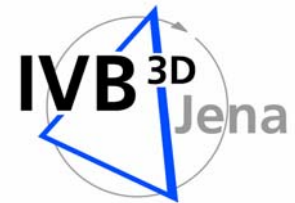
Data record	3 min (by 12 views)
Post-processing and coordinate calculation up to 3D point cloud	3 - 9 min

### Accuracy

Regarding to fringe-projection measuring systems you have to distinguish between the terms resolution and measuring accuracy. The fringe-projection of *kolibri Flex 40* projects a continuous metrics in the space. A single camera pixel is thereby up to 40 times more precise than its size on the measuring object. The resolution – means the distance of two camera pixels on the measuring object – is defined by the number of camera pixels and the observed measuring field. Is the resolution to low small details cannot be fixed.

The measuring accuracy is nearly the same in all 3 space directions.

Point distance	0.025 – 0.04 mm
Accuracy (sphere-spacing-error)	$\Delta L \pm 10 \mu\text{m}$
Noise	$\sigma = 5 \mu\text{m}$



### Computer

Processor	≥ Pentium 4 Dual-Core ~3,2 GHz
RAM	1024 MB
Hard disk	≥ 100 GB
Operating System	Windows XP professional
Graphics card	Dual-head
Screen	19" Flat Screen

The PC is a component of the measuring system. It may not look like an "office computer", foreign software and changes of basic windows settings can lead to functional failures. We recommend using a separate PC for data evaluation, office applications and the integration in a company network.

### Cameras

Resolution	SXGA – 1,392 x 1,040
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