

Technical specification – Portable 3D measuring machine *kolibri Flex 400*

Brief description of measuring system

kolibri Flex 400 is a robust fully-automatic 3D digitizer 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.

The *kolibri Flex 400* contains an electronically controlled object stage as well as an electronically controlled lifting and tilting column. Pre-customized measuring schedules enable a fully-automated and complete measurement by different height positions and attack angles of the *kolibri SENSOR*. The maximum measuring volume is $\varnothing 440 \times 250 \text{ mm}^3$.

The highly accurate 3D data of the measuring objects can be used for the following applications:

- Global 3D deviation to CAD data
- Section based analysis and 2D/3D dimensioning
- Geometrical dimensioning and tolerancing (GD&T)
- Wall thickness inspection
- Reverse engineering

The 3D digitizers are used for first-article inspection, for low-batch and serial inspection as well for reverse engineering in rapid prototyping and digital mock-up.



Figure 1: Measuring system

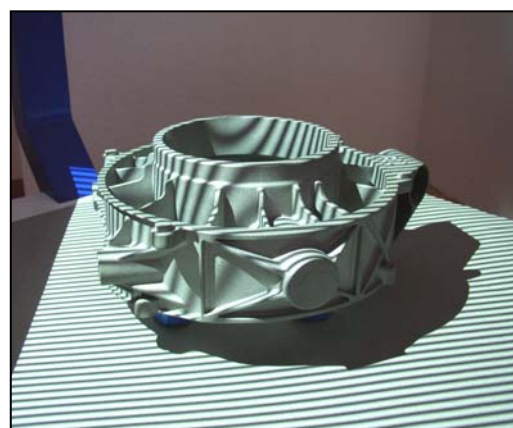
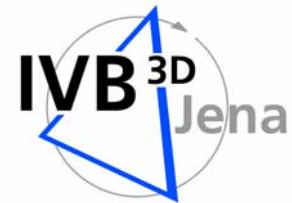


Figure 2: Projected fringe pattern on molded part

The final measuring result is highly-defined 3D-point cloud of the object's surface. 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 well with software solutions from the company GEOMAGIC Inc.



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

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

* requires e.g. 3D-evaluation software Geomagic Qualify

** requires e.g. 3D-evaluation software Geomagic Studio

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.

System components

The system equipment consists of the following components:

kolibri SENSOR	The sensor unit consists of the following components: <ul style="list-style-type: none"> • Digital DMD projector • 2 cameras and adequate objectives
Lifting/tilting column	Lifting/tilting column and wheel unit for automatic computer controlled positioning of the kolibri SENSOR in different lines of sight (on roles)
Rotating stage	Computer controlled rotating stage with calibration camera and adequate objective (on roles)
Soft- und Hardware	<ul style="list-style-type: none"> • PC for system control (3 engines, control of the projector and 3 cameras) • Scanner-Software under Windows XP • 19 " monitor, keyboard, mouse
Rack	19 "-Rack for PC and equipment
Artefacts	<ul style="list-style-type: none"> • Certified dumbbell with sphere distance of L = 200mm • Certified plane 400mm x 400mm

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

Installing conditions

Required space	2 x 2 x 1.7 m ³ (L x W x H)
System weight	142 kg
Electricity	115-230V, 16A, 50Hz
Positioning place	Oscillations/ vibrations of 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
Temperature	15.... 25°C

Measuring field size

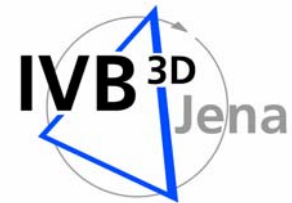
Maximum measuring volume	Ø440 mm, height 250 mm
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Requirements for the measuring object

Surface structure of the measuring object	Non-transparent or non-diffusely reflecting surface
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Measurement time

Data record	3 min
Post processing up to 3D point cloud	3 -9 min (depends on object's size)



Measuring accuracy

Regarding to fringe-projection measuring systems one has to distinguish between the terms resolution and measuring accuracy. The fringe-projection of *kolibri Flex 400* 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	0.3 – 0.4 mm
Accuracy (sphere-spacing-error)	$\Delta L \pm 25 \mu\text{m}$
Noise	$\sigma = 20 \mu\text{m}$

System computer

Processor	\geq Pentium 4 dual core 3,0 GHz
RAM	4 GB
Hard disc	\geq 100 GB
Operating system	Windows XP
Graphics card	Dual-head
Screen	19" flatscreen

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 (cameras of the sensor unit)	SXGA – 1,392 x 1,040
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