



1 For quality inspection, 27 cameras record the component as it passes a hollow sphere in free fall. This way, surface defects and geometrical errors are detected.

## INSPECT 360°

### 100-PERCENT COMPONENT INSPECTION IN FREE FALL

Manual visual inspections and tactile gauging checks are still often the best methods available today for inspecting the quality of mass-produced parts. For automated optical inspection procedures, components must be oriented and positioned in a specific way. In the case of mass-produced parts, which are processed as bulk goods of different shapes and sizes in a matter of seconds, such handling proves disproportionately expensive.

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#### Optical inspection without handling

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The Inspect 360° system analyzes the geometry and surface properties of components comprehensively in free fall and, for the first time, enables optical inspection of mass-produced parts at reasonable costs. One by one, the components are carried to a hollow sphere by means of a simple feeding system. Several cameras inspect the component simultaneously from all perspectives in free fall. The components pass

the inspection sphere in any orientation – with no need for special handling. Inspect 360° inspects cast, blanked, drawn or forged metal parts, plastic parts as well as hybrid components made of composite materials. The system can handle components with diameters and edge lengths ranging from just a few millimeters up to diameters of 20 cm and can be scaled to larger or smaller parts. Geometric deviations measuring just a few 100 µm are detected. Depending on the aspect ratio and texture, the system also detects typical surface defects, such as cracks, pin-holes or dimples and bumps with extensions of just a few 100 µm.

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#### Inspection from many different perspectives

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Inspect 360° is equipped with 27 high-resolution inspection cameras that fully map the falling object in a single shot from different angles. Each surface area is recorded

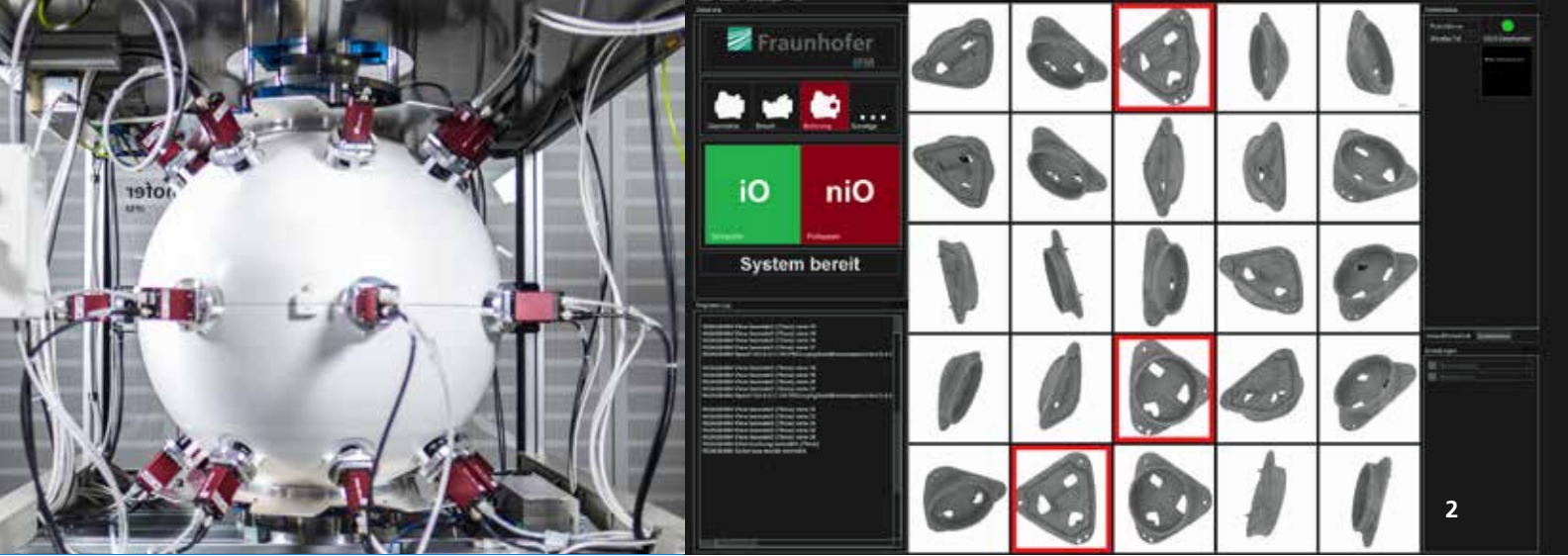
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several times from different perspectives. This way, the technique achieves a robustness which otherwise can only be reached by comprehensive manual inspection. During inspection the component surface is illuminated by high-power LEDs. In order to avoid unwanted reflections, scattering and drop shadows on the component surfaces as far as possible, the inside of the hollow sphere is covered with a diffuse reflective coating (Ulbricht Sphere). Apart from the two small openings for entry and exit of the components, the inspection system is almost entirely encapsulated to ensure that any background or ambient light is completely blocked out.

### Analyzing geometry and surface properties in real time

The 2D images taken from different angles are mapped onto the given CAD-compliant 3D model of the component immediately after recording and processed in real time. Defined areas of the object can be masked out or investigated in more detail. Specially developed flexible algorithms for geometry

and texture analysis are part of the system software. They enable different surface properties, e.g. of hybrid components, to be reliably inspected. For 100-percent component inspection at one-second intervals, data processing is carried out in real time. Quality-compliant parts are classified as such as they exit the test sphere, while faulty specimens are rejected. It is even possible to differentiate test objects by quality class using previously defined deviations from normal.

### Large component variety requires flexibility

Inspect 360° can cope with a large bandwidth of different components with no need for hardware modification. The position and orientation of the inspection cameras remain unchanged. The flash lighting is adapted for similar sized components with different degrees of reflection. If completely new components with new defect classes are to be investigated, only the algorithms for defect detection have to be adapted. A software library consisting of a large number of detector algorithms is available for this purpose. With

2 *The Inspect 360° user interface reveals flaws by marking those perspectives where defects were detected. By comparing the results from visual inspection and from the inspection system, inspection criteria can be adjusted.*

the exception of optically inaccessible cavities and transparent components, the geometric complexity of components is of no consequence to Inspect 360°.

Inspect 360° includes user-specific operating software that displays all shots of all camera perspectives in a tabular overview (Fig. 2) with errors marked in color. This facilitates the adjustment of threshold values for individual defect classes during operation, so that the inspection process can be adapted on site. The classified data can also be used to improve production processes.

### Inspection of surface cleanliness and coatings

For the inspection of surface cleanliness and coatings, Inspect 360° can be combined with the free fall inspection system F-360° from Fraunhofer IPM. The imaging inspection system uses fluorescence measurement for spatially resolved detection of impurities and measures the thickness of coatings. By combining the two systems, the components are inspected in a single measurement run.

#### Typical system properties

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|----------------------------|---|
| Inspection volume          | min. 1 cm x 1 cm x 1 cm<br>max. 20 cm x 20 cm x 20 cm |
| Size of surface defect     | min. 50–100 µm deviation from reference               |
| Size of geometrical defect | min. 100 µm deviation from reference                  |
| Cycle time                 | 1 Hz  |
| System dimensions          | 1 m x 1 m x 1 m (h/w/d)                               |

All specifications and features are subject to modification without notice.