PHOTODEX
High-resolution 3D Scanning of Defects
Photometric Stereo - Localization & Annotation

Annotation

Defect annotation is traditionally performed through manual visual inspection, which often results in critical information—such as defect type and location—remaining undocumented in digital form. The PHOTODEX scanner developed at the AIT Austrian Institute of Technology (AIT) addresses this problem and provides

- a **high-resolution grayscale image** of the defect,
- the **surface normals** for each pixel, making even the most subtle 3D changes in the surface detectable,
- **the 3D position** of the captured defect,
- in the future: an automated AI-based **classification** of the defect (porosity, crack, etc.).

All defect data are stored in a centralized database, empowering experts to analyse defects in **high resolution** — including **3D surface details** and precise positional data.
This information is invaluable across industries, from **toolmaking to quality management**, as it pinpoints exactly where specific defect classes occur.

Photometric Stereo during Movement

Photometric stereo is an advanced imaging technique that reveals even the **finest 3D surface changes** with exceptional clarity. By capturing multiple images from a **single camera position**—each under different lighting angles—the method generates a detailed, high-resolution 3D representation of the surface providing

- **a surface normal for each pixel**,
- **albedo image** (a synthetic grayscale image computed from the images acquired under the different illumination directions),
- **gradient images** derived from the surface normals.

With **photometric stereo**, even **subtle defects**—such as micro-cracks or flow irregularities—become clearly visible, **outperforming traditional 3D reconstruction methods** that often miss these critical details.
Previously, the main challenge was **motion interference**: since the technique relies on a **fixed camera position**

across all lighting angles, any movement during capture could compromise accuracy.

The **PHOTODEX scanner**, developed by **AIT**, breaks through this limitation by integrating **color-coded illumination** with advanced camera technology. This innovation enables **photometric stereo imaging even with a moving camera**—whether in a **handheld device** or under **robotic motion**, as demonstrated by the PHOTODEX prototype.
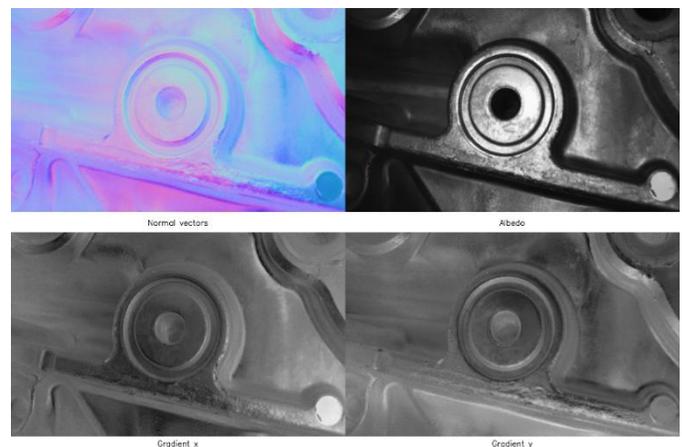

Figure: RGB color-coded surface normals (x, y, z) (top left), synthetic grayscale image (albedo, top right), and gradient x (bottom left) and gradient y (bottom right).

Contact

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Areas of Application

- Semi-automated **annotation** of defects with **3D position**
- Building a **data basis** for AI-based **defect detection and classification**
- High-resolution robotic **3D surface scanning**