3DInMed

Digital stereoscopy in industrial and medical applications

The significance of digital stereoscopy for industrial applications, such as remote visual inspection has been increasing over the last few years. Stereoscopic systems offer entirely new possibilities to extract and visualize additional information resulting in significantly enhanced conditions for inspection and maintenance tasks. For this purpose Fraunhofer HHI has developed image-based algorithms able to support the analysis and optimization of the complete 3D processing chain from acquisition to reporting of measurement tasks.

Challenges

- Guarantee of highest stereo image quality
- Precise calibration of optical system
  - Geometrical alignment
  - Correction of lens distortion
- Providing enhanced information in real time
  - Distance measurements
  - Area measurements
  - Contour measurements
  - Tracking of measurement spots
- Retain established workflows

Benefits

- Real-time 3D processing
- Contactless measurements
- Inspection of hardly accessible parts
- Feedback by overlay of results
- Distance-dependent control of accuracy
- Strictly image-based performance
- Reliable On/Offline reporting
- No extra sensors required

Technical case study of a flexible 3D Video Borescope for use in industrial environment made by SCHÖLLY

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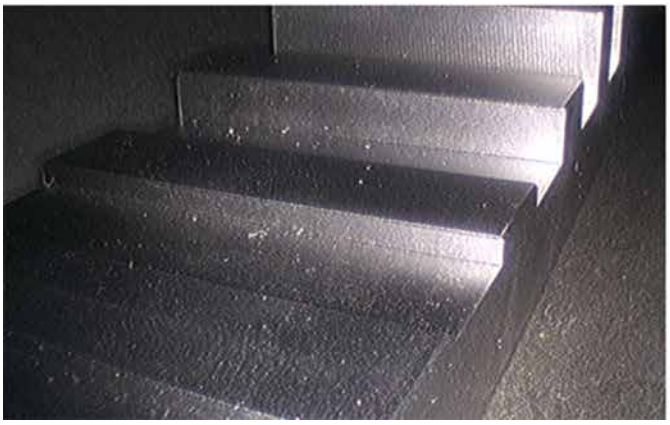

(a) Typical object for visual inspection task: A surface with difficult light reflections, Image acquisition device: Standard 3D Video Endoscope made by SCHÖLLY

(b) Result of real-time depth map estimation:
Far range *Close range*

Technical Background

Full HD digital stereoscopic systems introduce a wide variety of new possibilities in industrial applications. However, such systems also require a properly calibrated system to allow contactless measurements tasks of hardly accessible parts. Geometric misalignments are corrected in real-time by detecting robust feature point correspondences. The algorithm guarantees linewise pixel alignment to allow reliable, subpixel accurate and fast depth estimation using a high-end GPU.

Given such well calibrated stereoscopic imaging systems allow metric measurements of critical measurement spots by triangulation. In this context robust feature point correspondences can be used to survey the distance dependant uncertainty of measurement. Therefore, in uncontrolled environments typical inspection tasks like point-to-point, point-to-layer or area measurements can be performed with valuable online feedback and high metric reliability. The need of extra techniques like structured light to enable touchless inspection and measurement processes of inaccessible tubular parts or cavities is no longer necessary. The targeted technologies are also more and more used in other application areas, such as minimal invasive surgery, using 3D endoscopes and digital microscopy.

Project background

The described procedures are developed by members of the "3IT - Innovation Center for Immersive Imaging Technologies" in the project "3DinMed". The project partners are ARRI Medical, C.R.S. iiMotion GmbH, Fraunhofer HHI, Fraunhofer IIS, SCHÖLLY FIBEROPTIC GmbH, SeeFront GmbH and Solectrix GmbH. The project is funded by the German Federal Ministry for Economic Affairs and Energy on the basis of a decision by the German Bundestag.

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