SHAPE-FROM-FOCUS – AN UNEXPECTED BUT POWERFUL 3D IMAGING TECHNOLOGY

DR. TOBIAS HENZLER,
MACHINE VISION SALES ENGINEER
TECHNOLOGY SPECIALIST 3D

VISION. RIGHT. NOW.
MOTIVATION

Example of application

- 3D inspection of tool
  - 3D shape ok?
  - Depth of central hole ok?

- High resolution needed
MOTIVATION

Challenges

- Resolution
- Depth of focus
- Occlusion
IDEA

low depth of focus ≠ an obstacle = feature that can be used
SHAPE-FROM-FOCUS

Technology

- Acquire a stack of ca. 200 image slices at different focus points
- Determine in which slice a pixel is in focus
- Create a height map (3D) and an intensity image (2D) with extended depth of focus
SHAPE-FROM-FOCUS

Intensity image (2D)  Height map (3D)
SHAPE-FROM-FOCUS

Hardware (s.a. demo in foyer)

- **Camera**: 12 Megapixel, monochron, GigE
- **Lens**: telecentric with liquid lens
- **Illumination**: dome light (blue)
- **Invest**: ca. 5 k€

Specifications

- **Measurement volume**: 7 x 5 x 5 mm³
- **Resolution**: 3 x 3 x 1 µm³
- **Exposure time**: ca. 40 ms/slice, 8 s for 200 slices
SOFTWARE PROCEDURE

Recipe

- Acquire 200 images slices during focus ramp
- Calculate a measure of focus quality of each pixel in each slice by analysing its neighborhood, high contrast when pixel is in focus
- Analyse for each pixel along the stack of slices where focus quality is highest, sub-slice accuracy
- 3D height map = sub-slice # of best focus
- Intensity image = intensity of best focus slice
SHAPE-FROM-FOCUS
SHAPE-FROM-FOCUS
SHAPE-FROM-FOCUS

Summary of technology

- High resolution enables low depth of focus
- Telecentric view avoids occlusions and makes calibration simple
- Static parts, no moving parts needed
- Possibility of highly parallel processing to increase speed
- Efficient 3D technology with interesting price/performance ratio
THANK YOU
VERY MUCH FOR
YOUR ATTENTION

Your contact
Dr. Tobias Henzler

STEMMER IMAGING AG
+49 89 80902-232
t.henzler@stemmer-imaging.de
www.stemmer-imaging.de