

First Croatian Computer Vision Workshop (CCVW 2012)

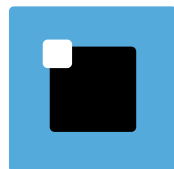
September 20-21, 2012, Zagreb, Croatia

Center for Computer Vision Activities:
**Computer vision for
visual quality inspection**

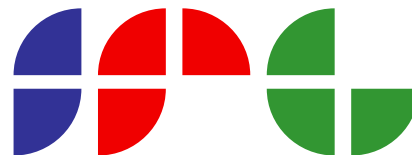
Tomislav Petković and Sven Lončarić

Image Processing Group

University of Zagreb



CRV



Outline

1. About machine vision in general
2. Case study:
Machine vision for fault prevention
3. Case study:
Simple machine vision toolbox

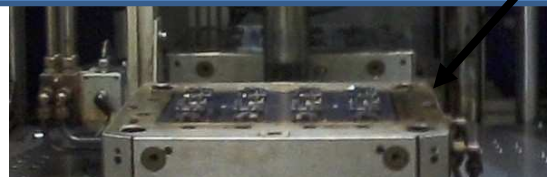
Basic structure of an industrial machine vision solution



camera and illumination

products

product/material/process flow



handling

image acquisition

process control and
image processing unit

user interface



Designing a Machine Vision System

- Camera:
 - type (line or area), field of view, resolution, frame rate, sensor type, sensor spectral range
- Lens
 - focal length, aperture, flange distance, sensor size, lens quality
- Illumination
 - direction, spectrum, polarization, light source, mechanical adjustment elements
- Software
 - libraries to use, API ease of use, software structure, algorithm selection
- Putting everything together
 - accuracy, time performance, cost, development and installation

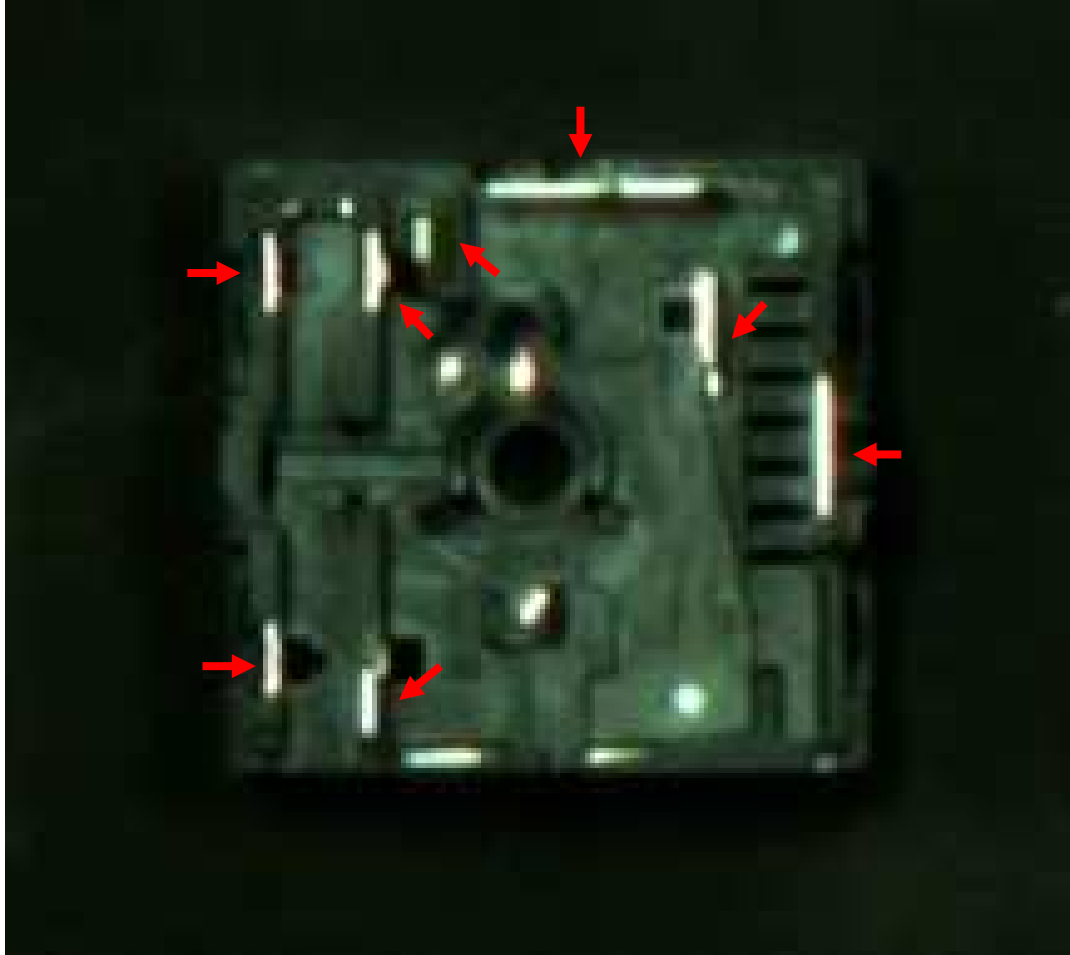
Desing guidelines

- Camera, lens and illumination are **the most important part** of a machine vision system
 - acquisition errors are difficult or impossible to remove or correct during processing
- Also keep in mind:
 - mechanical reproducibility (often overlooked by software people)
 - tolerances
 - distances

Case 1: Fault Prevention

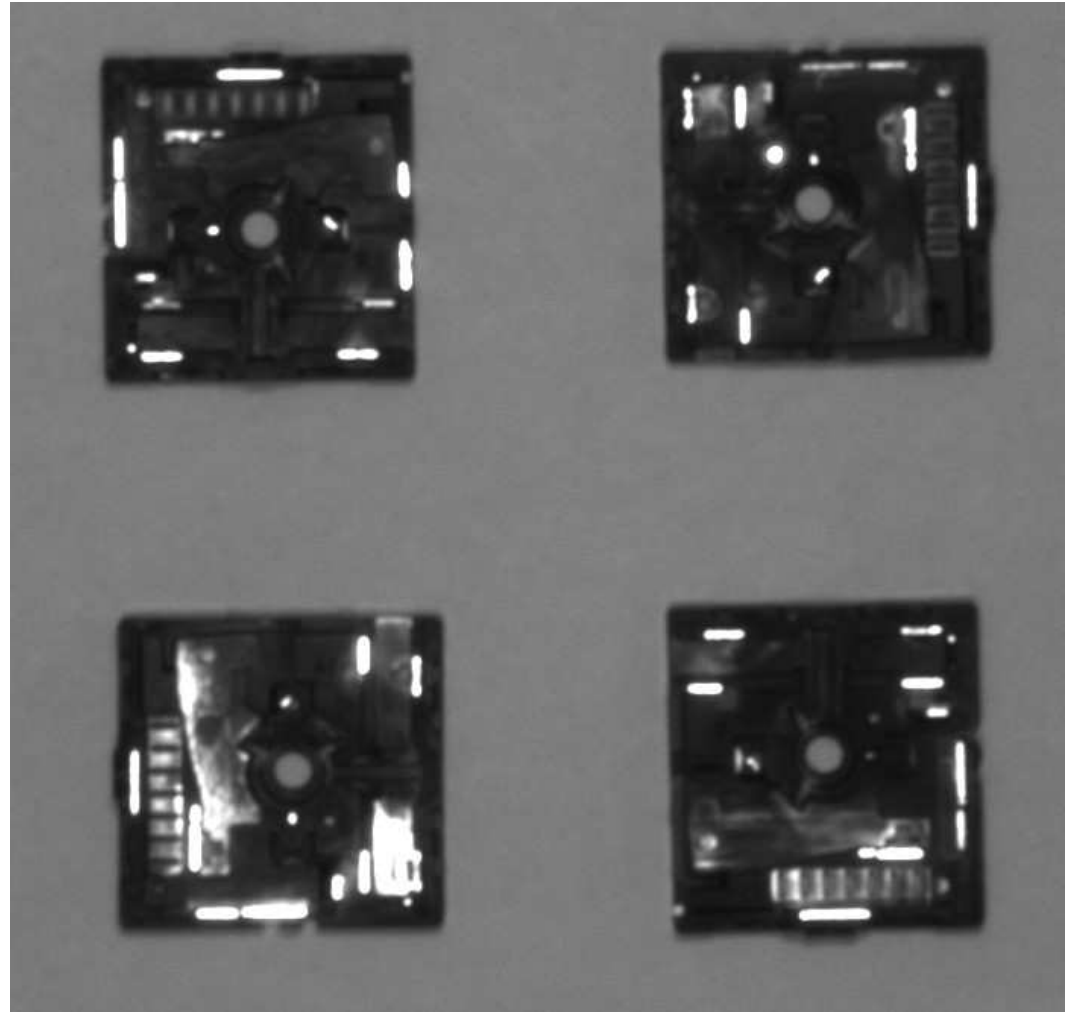
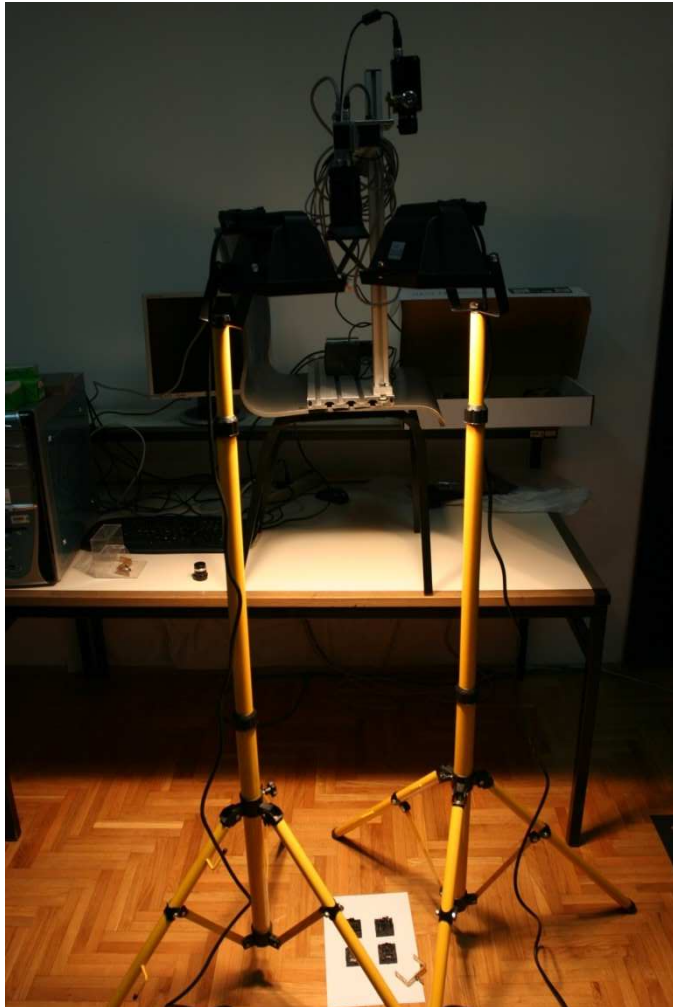
- Molding the base of an energy regulator for electrical stoves at Elektro-kontakt d.d. Zagreb plant
- Motivation
 - if molded part is not ejected properly serious fault can occur
 - repairs are 5000 to 10000€
 - downtime up to 1 week
- Requirements:
 - at least 1 meter clearance for robotic manipulators
 - maximal inspection time is 1 second
 - must be self-calibrating

What is inspected?



- Dimensions
 - 41 mm wide
 - 43 mm tall
- 8 contacts must be inspected
- There are 8 products per mold
- Total of 64 inspections

Laboratory setup



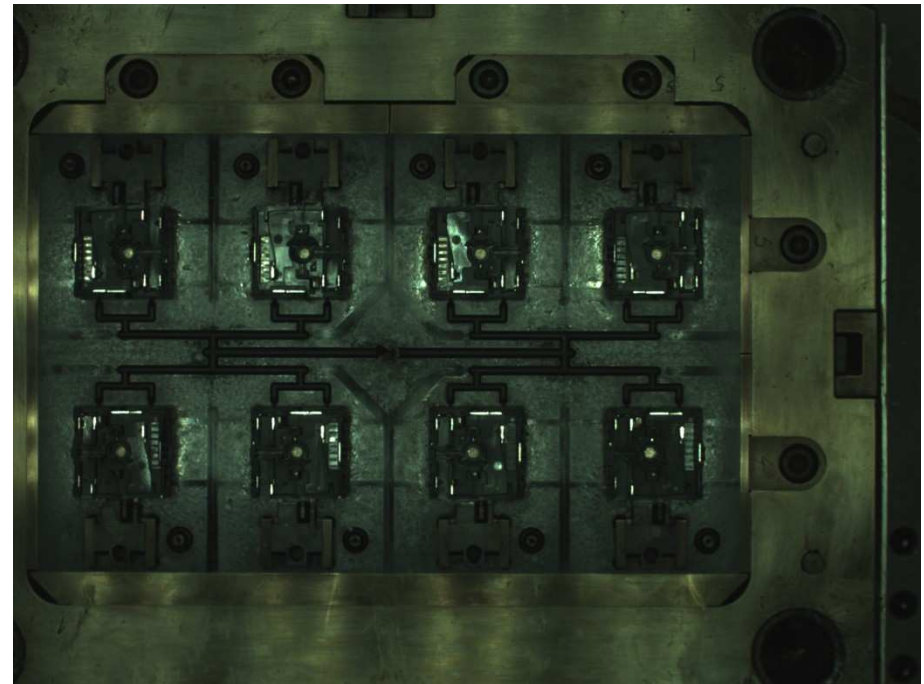
System desing

- Camera:
 - Smartek Giganetix GC2591C, 2592x1994, 1/2.5"
 - area type, CMOS, rolling shutter, up to 15 fps
- Lens
 - Fujinon 2/3" HF12.5SA-1
 - high resolution C-mount lens
- Illumination
 - custom made white LED field using 32 Hebei I.T. S12PW6C high efficiency white LEDs
- Software
 - Smartek GigEVision SDK, Advantech BioDAQ SDK, OpenCV
 - three layers to the application:
 1. processing part C++ (speed)
 2. C++/CLI middle layer (link to GUI)
 3. WPF for graphical user interface

Workflow

1. Image acquisition
2. Registration
 - additional filtering of registration parameters (Kalman Filter) required
3. Part inspection
 - preformed concurrently
 - adopted line detection algorithm [Steger1998, PAMI]
 - length is measured
 - adjustment for individual contacts required
4. Result output
 - stop signal
 - result storage for offline analysis

Factory setup

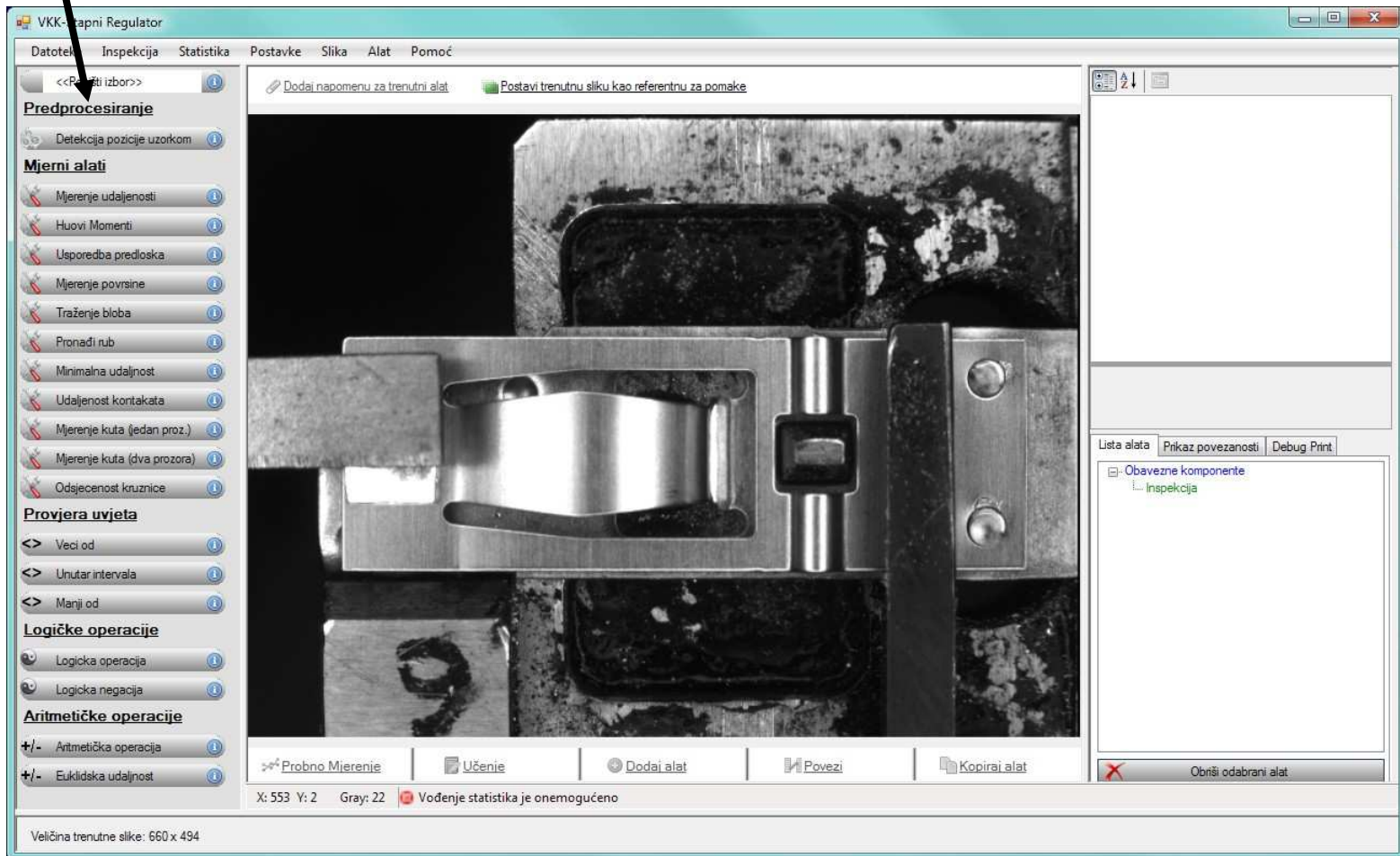


Case study 2: Vision Toolset

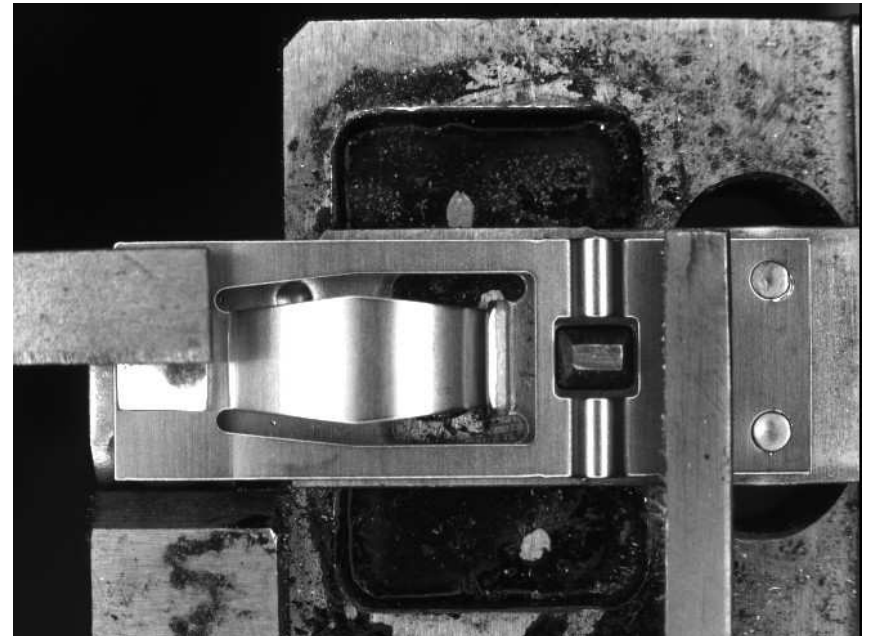
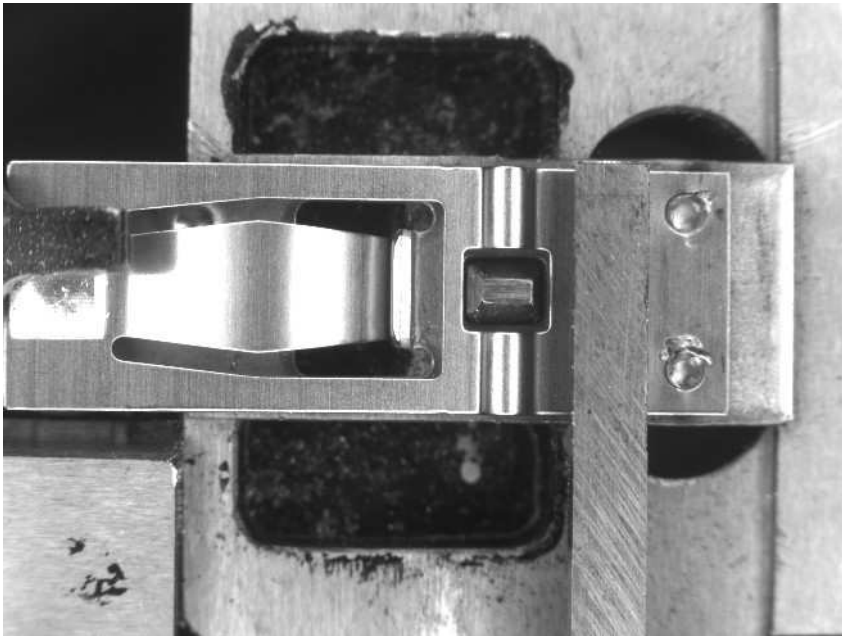
- Quality inspection requires similar measurements at different locations along the assembly/production line
 - length, area, angle and intensity measurements
- Ideal task for under-graduate or master students
- Each inspection tool designed as a simple plug-in
 - image acquisition, display and process control parts are already solved

Interface

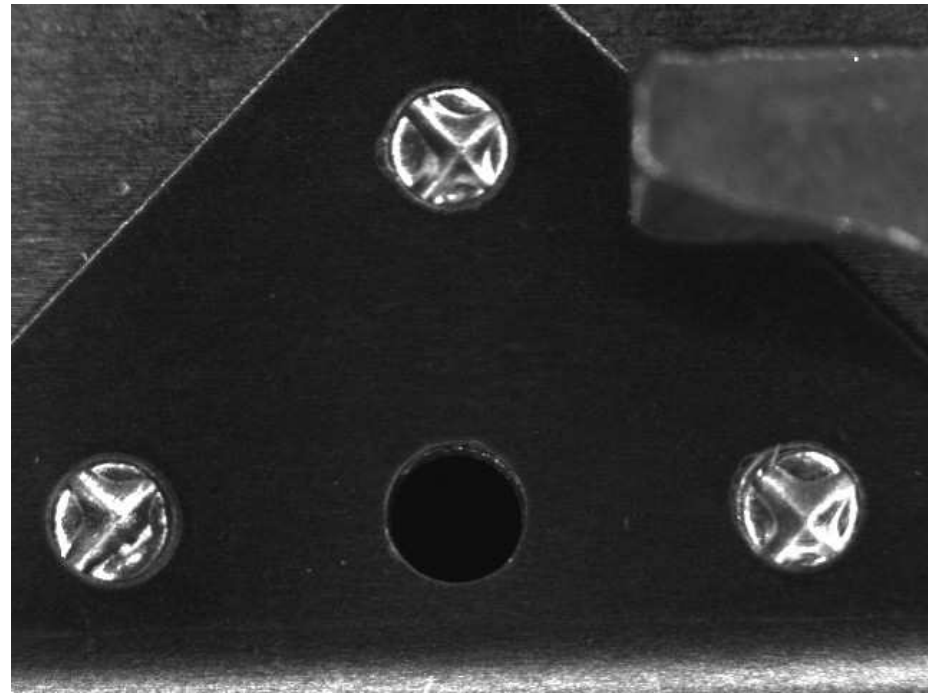
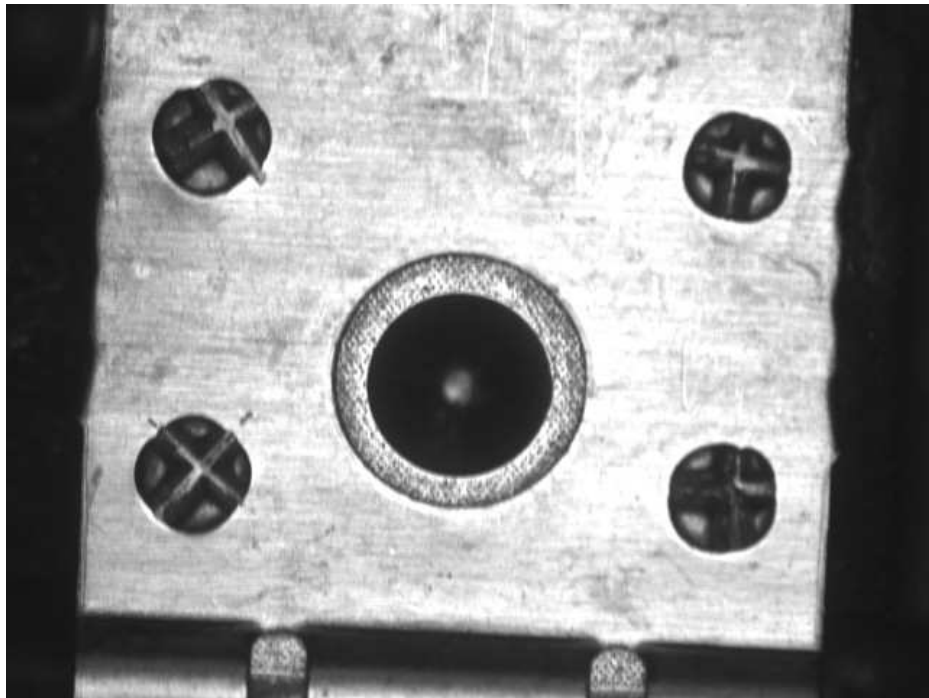
Inspection tools



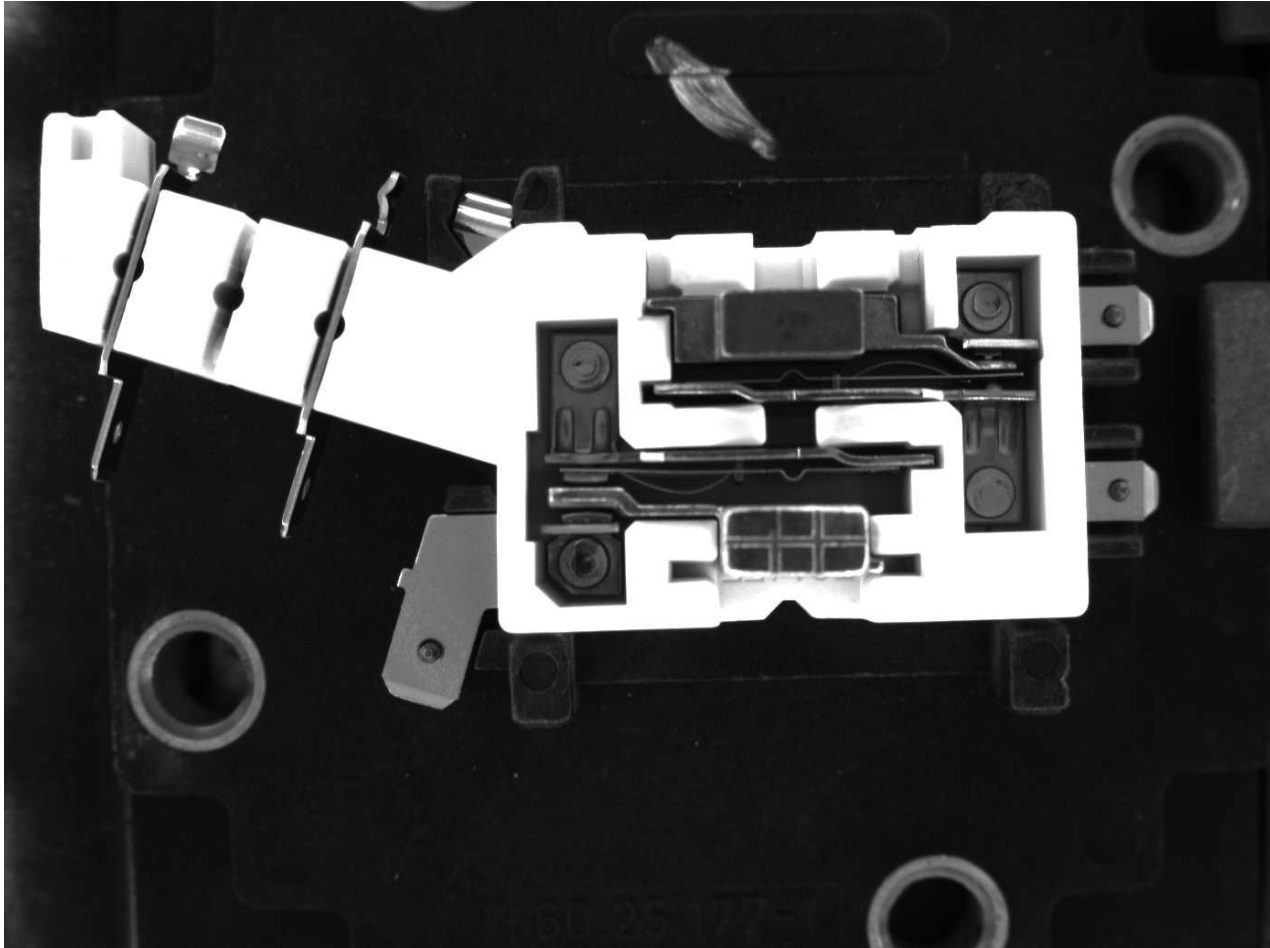
Contact alignment inspection



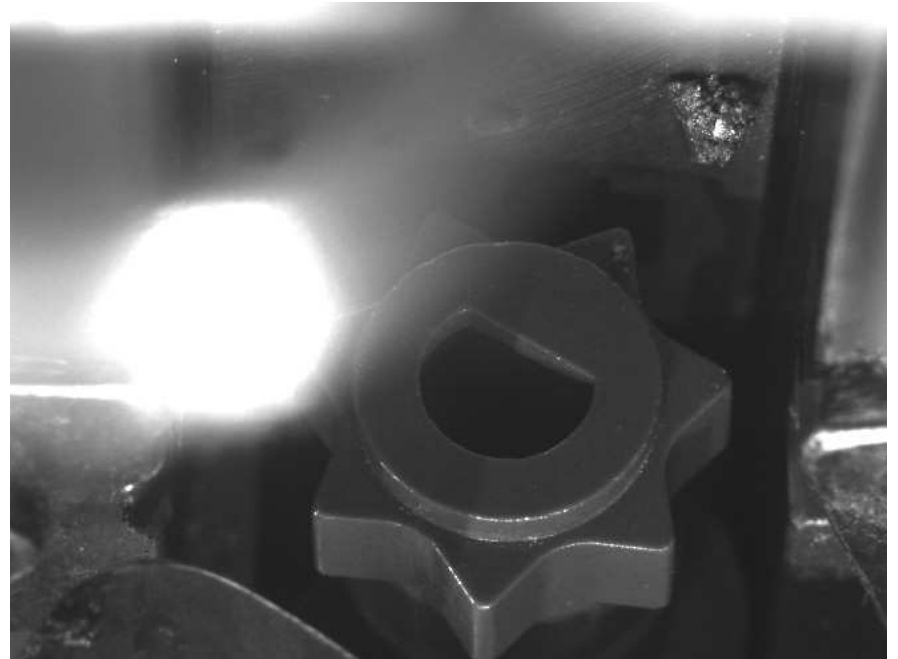
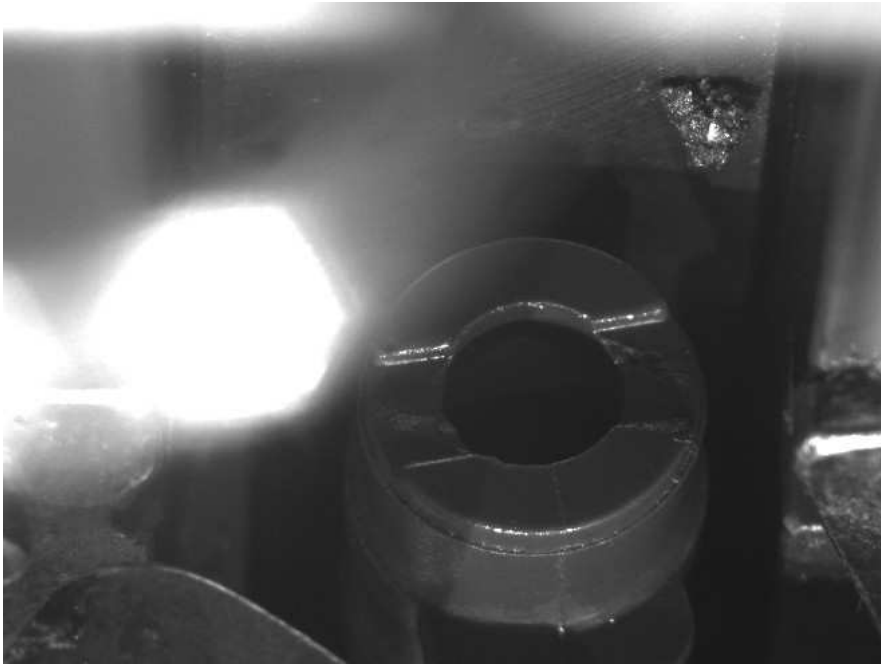
Rivet inspection



Contact type inspection



Shaft classification



Acknowledgment

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- Undergraduate students
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