

Algorithmic Vision Research for Industrial Surface Inspection

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Application Challenge

Industrial Surface Inspection

Automated detection of any visual appearance abnormality on material surfaces

Minimal Set of Requirements

- (1) Extremely low false alarm rate while retaining “reasonable” detection performance
- (2) Graceful scoring of defects
- (3) Fast

Relevant Factors

(-) Variations due to material properties

- Optical properties: reflective (diffuse or specular), refractive, absorbing, fluorescent?
- Geometric properties: flat, curved, smooth, porous?

(-) Variations due to background types

(-) Diversity of defects

(-) Scarcity of defect image samples

(-) Nuisances: dust & dirt, “let-go” defects, etc.

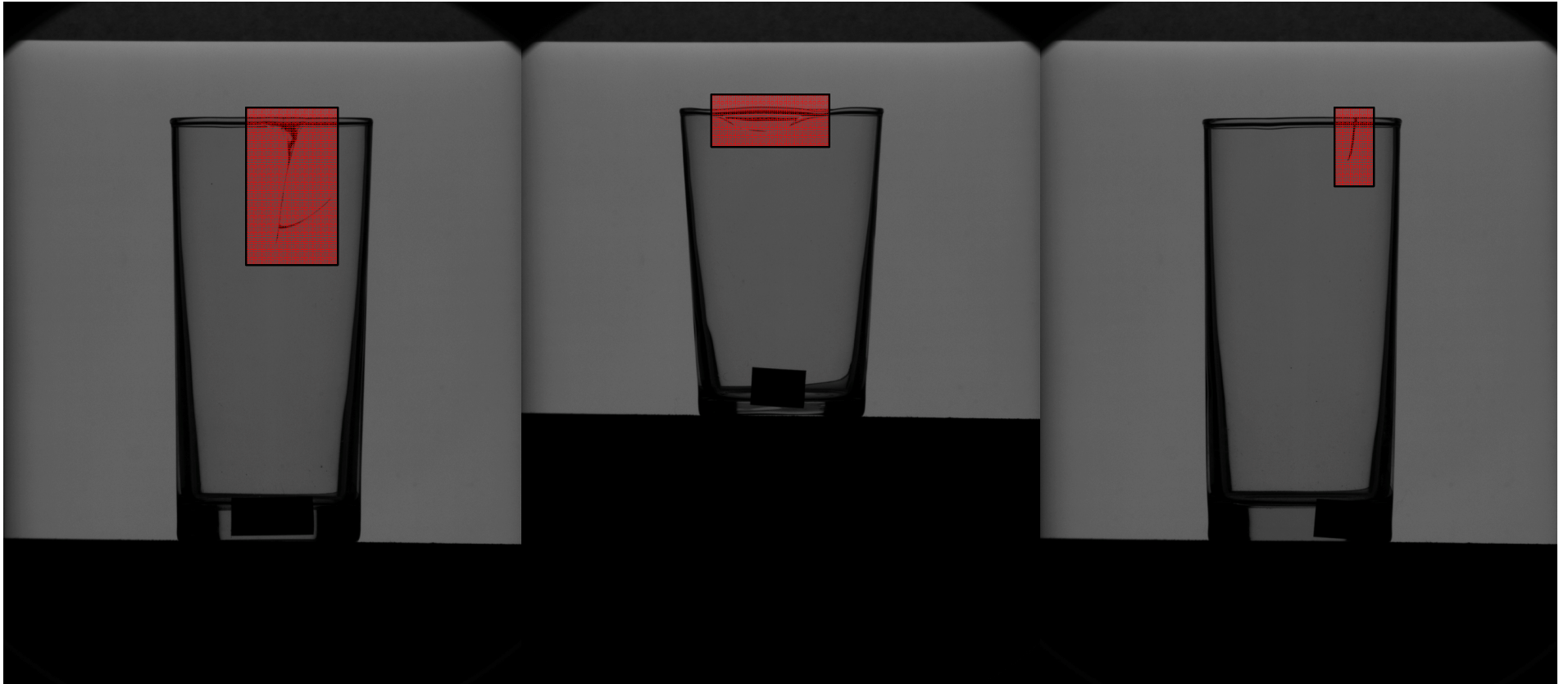
(+) Abundance of background image samples

(+) Controlled/customized illumination

Application Examples

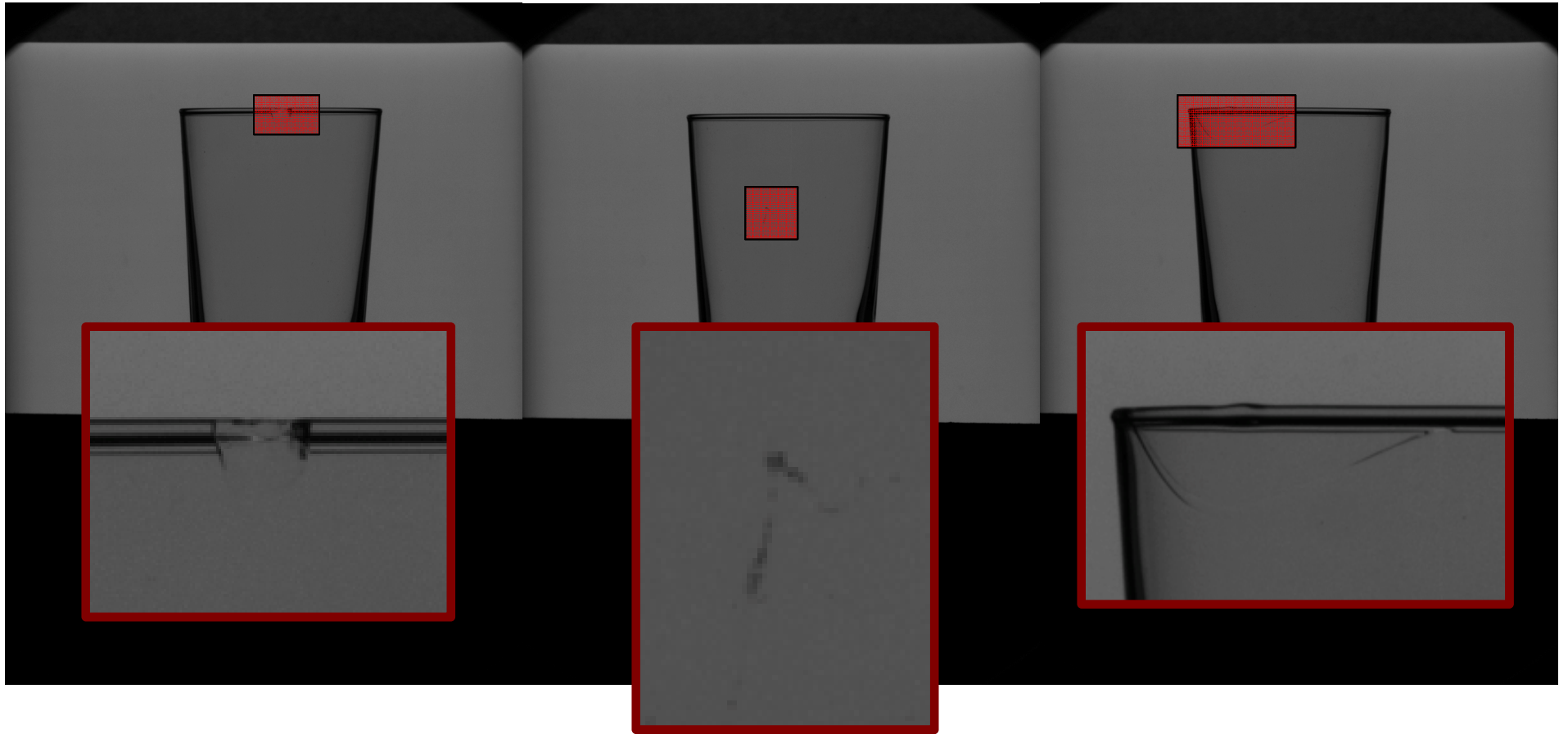
- (1) Glassware Inspection
- (2) Sheet Metal Inspection
- (3) Dried Fig Inspection
- (4) Textile Fabric Inspection

Glassware Inspection – 1/2



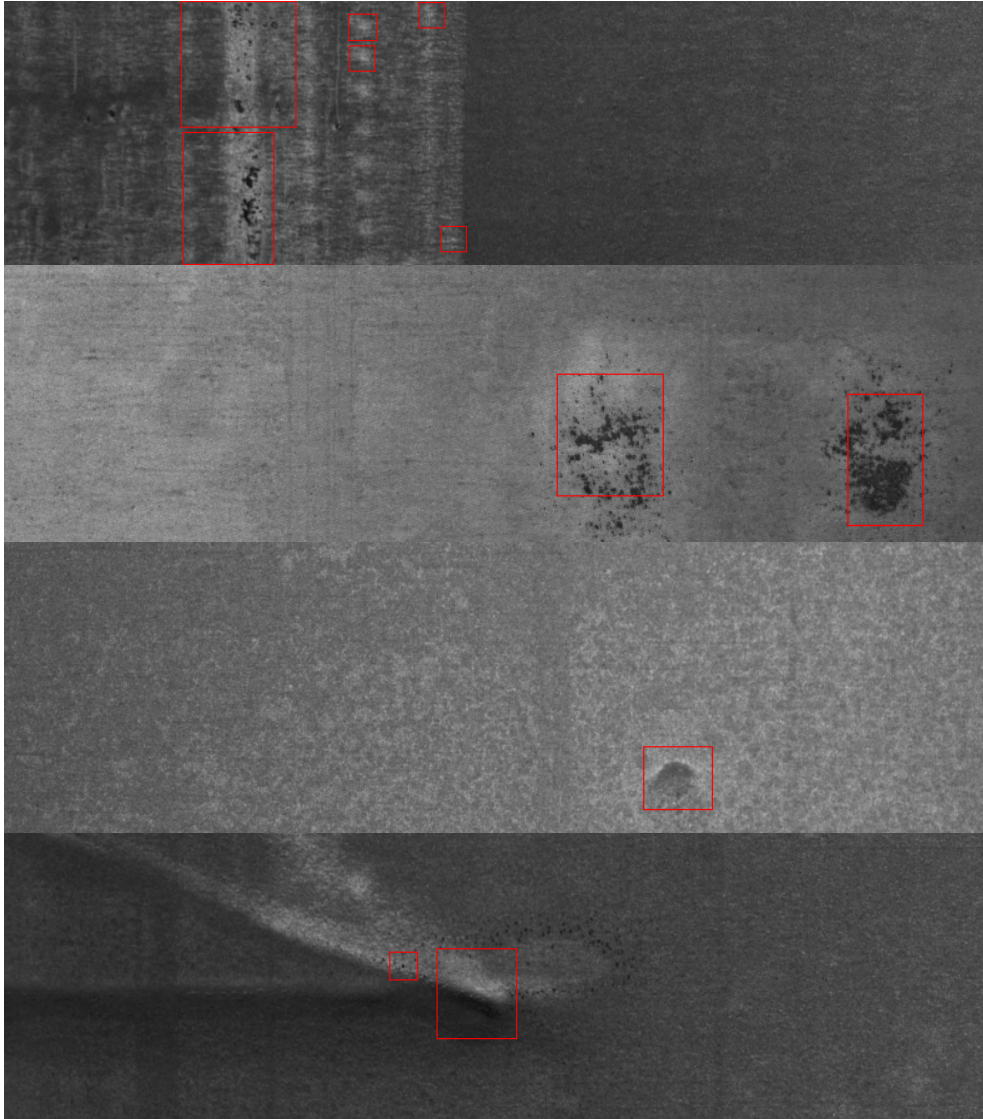
Easy examples

Glassware Inspection – 2/2



Less easy ones

Sheet Metal Inspection – 1/2



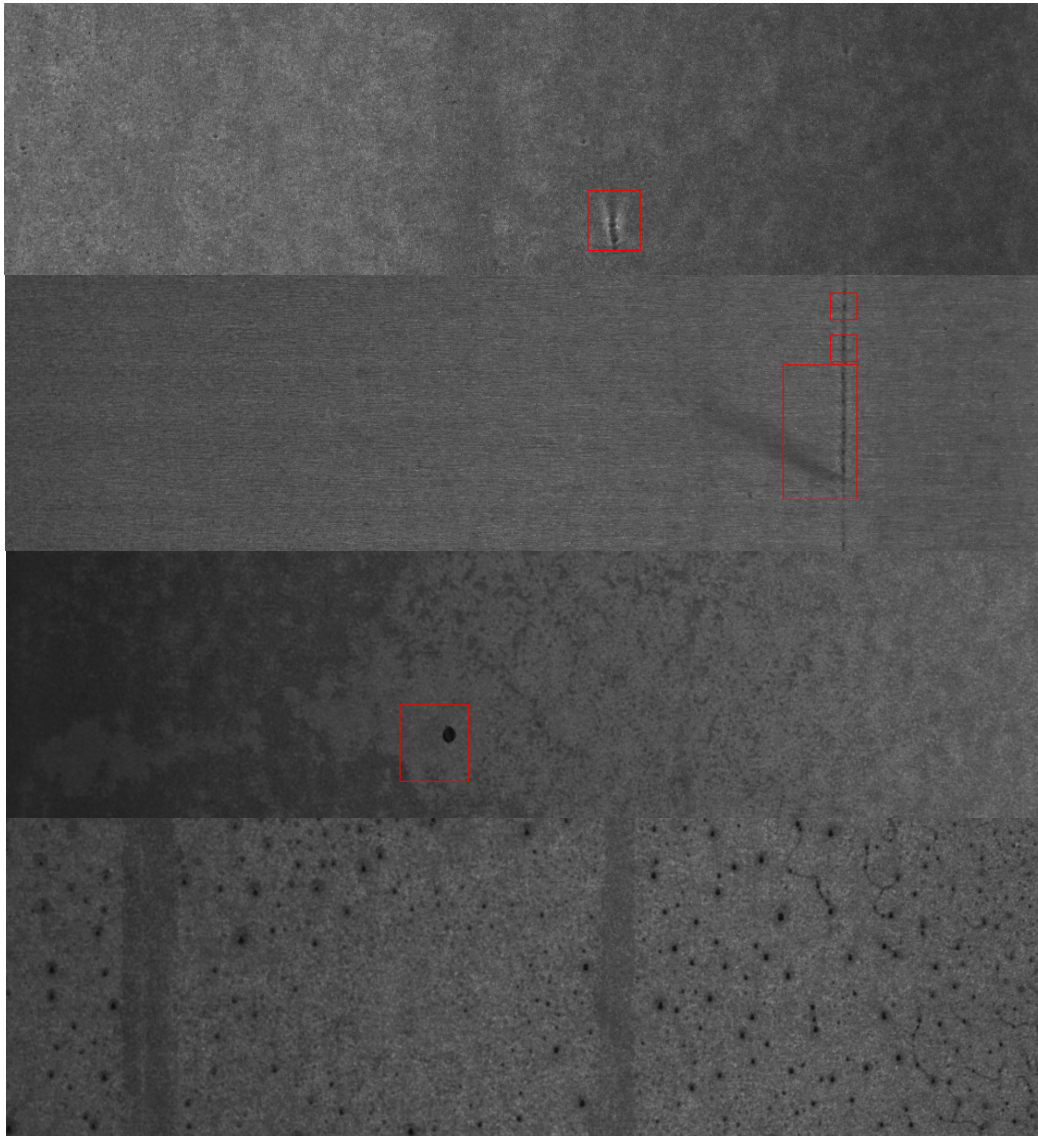
Friction

Friction

“Komet”

Stroke

Sheet Metal Inspection – 2/2



Material

“Roll-over”

Dirt

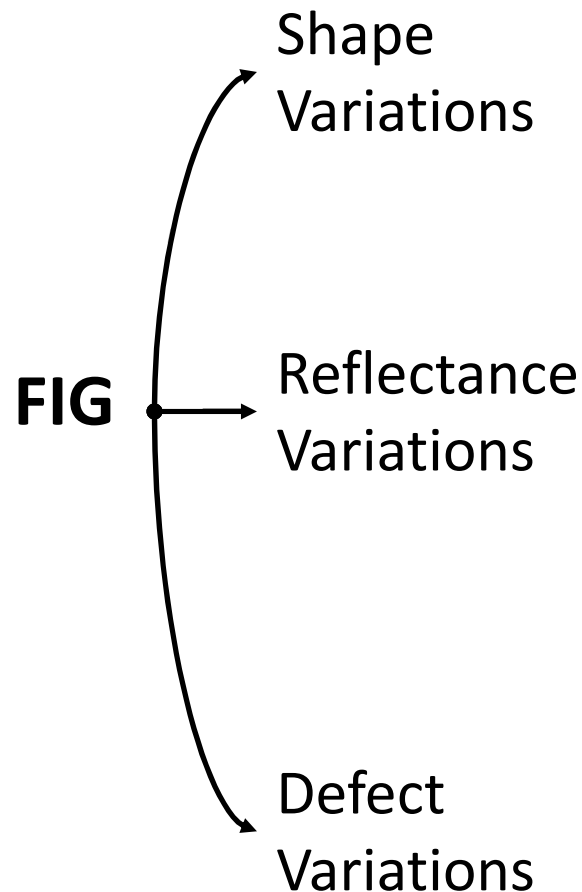
“let go” defect

Oil drops
NOT a defect!

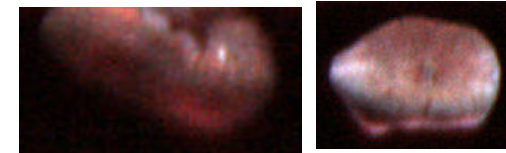
Dried Figs Inspection – 1/2

Bell-shaped with a flat bottom

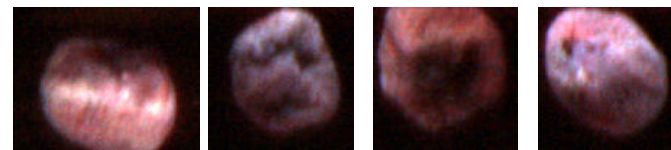
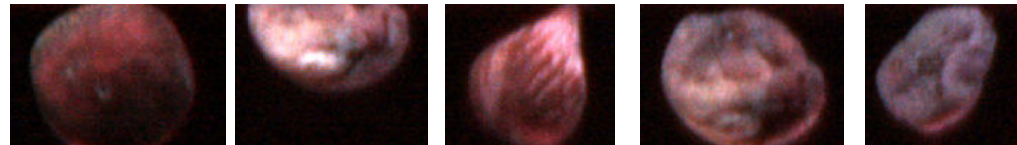
Highly deformed spherical, porous surface



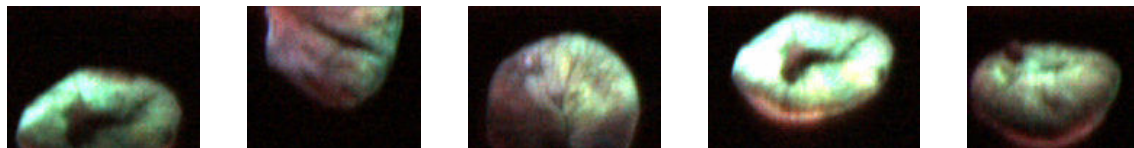
ordinary still image of figs



Images of healthy fig



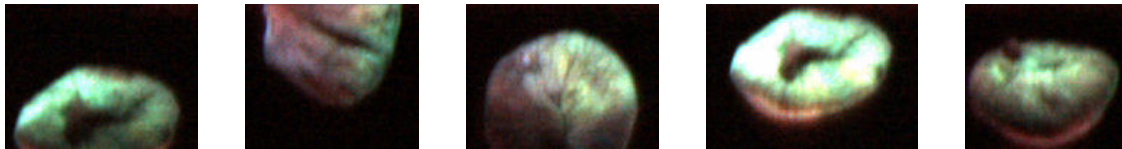
Images of healthy fig



Images of contaminated fig - “good” examples

see next slide

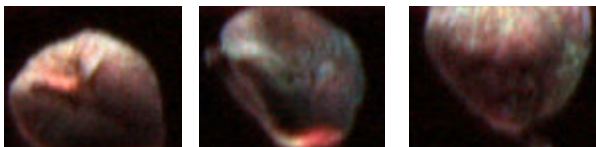
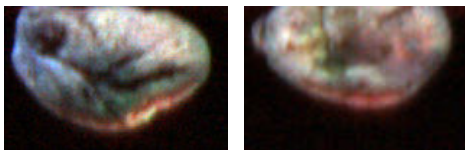
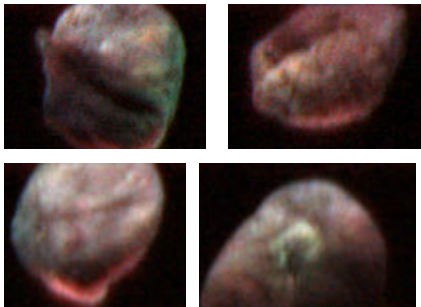
Dried Figs Inspection – 2/2



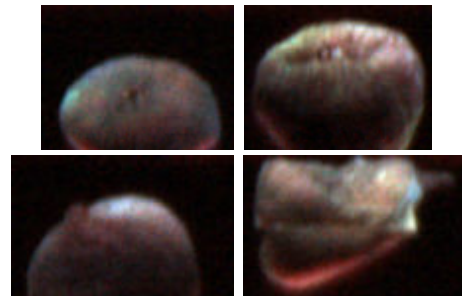
“Good” examples
large and heavy contamination

Defect Variations

dispersed contamination
indiscriminate defect color



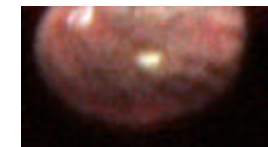
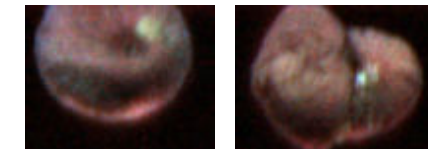
contamination on the contour
indiscriminate defect color



very light contamination
very low color contrast



very localized contamination
spot-like defect
not very discriminate color

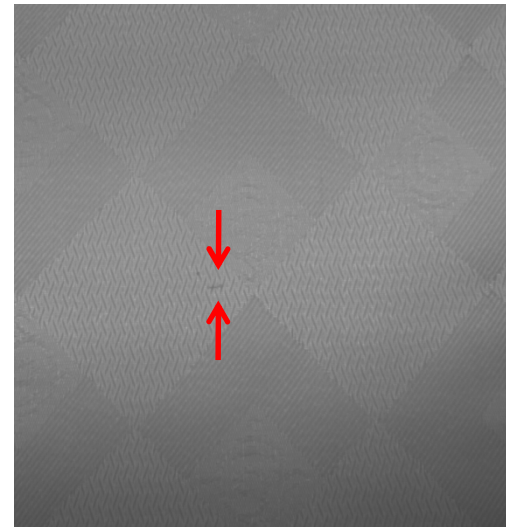
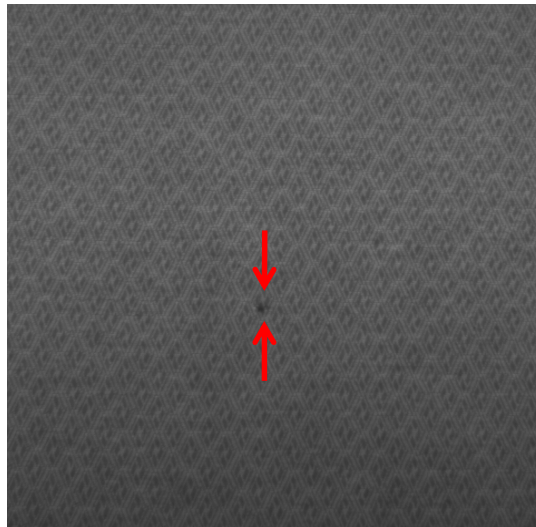
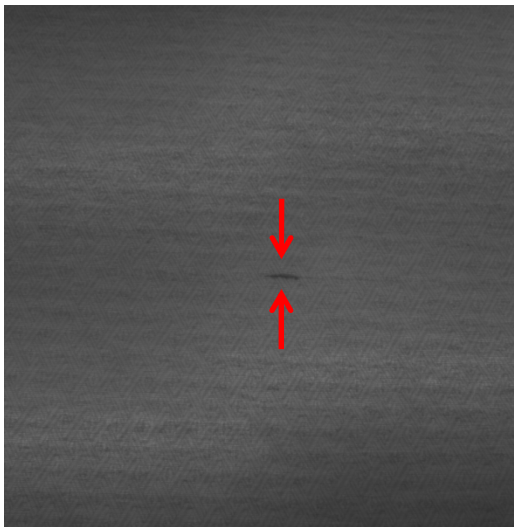
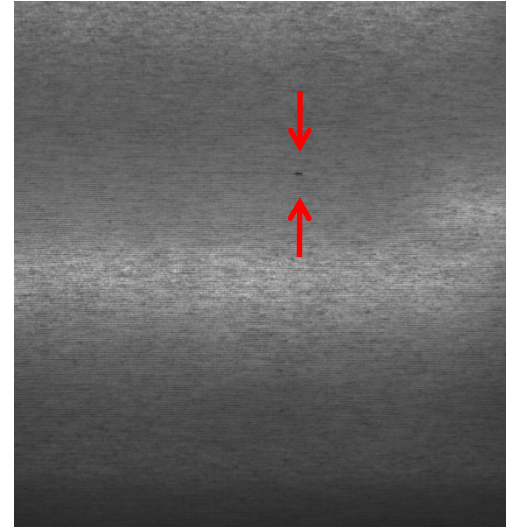
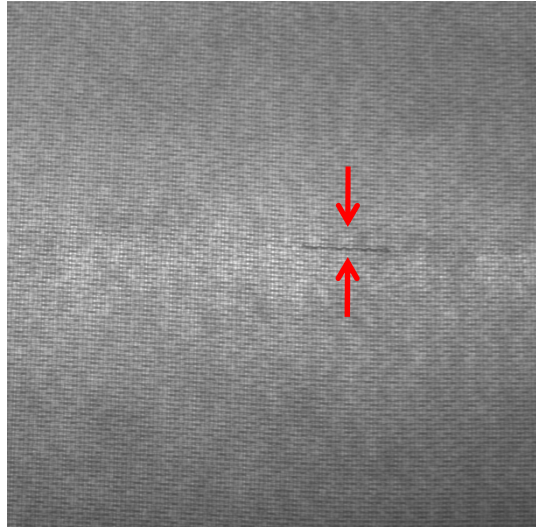
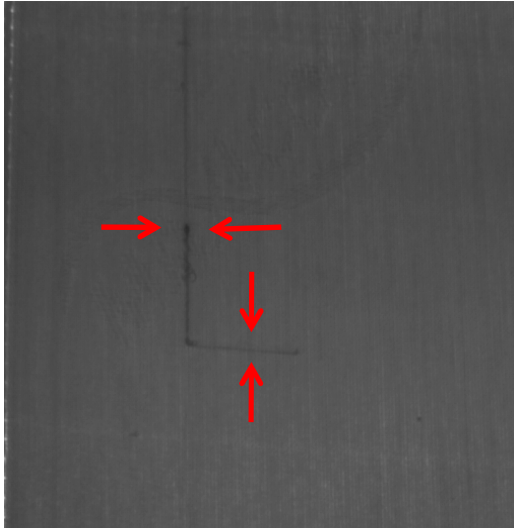


saturated



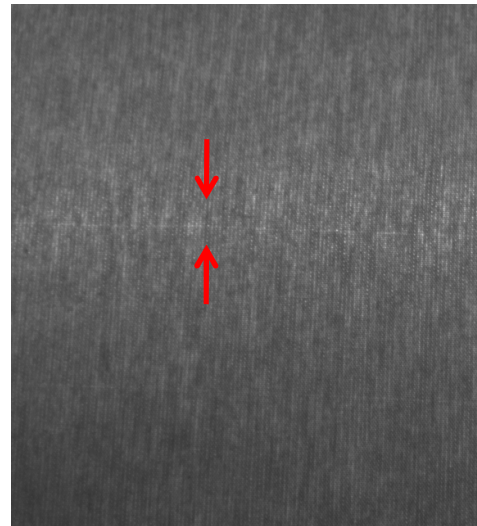
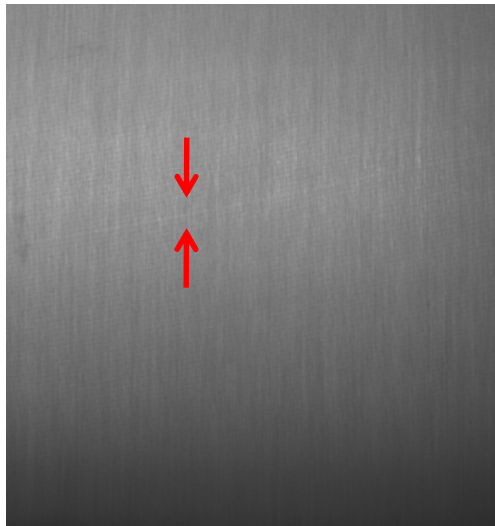
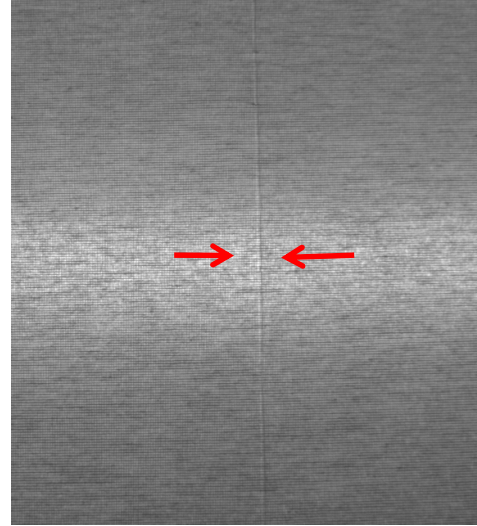
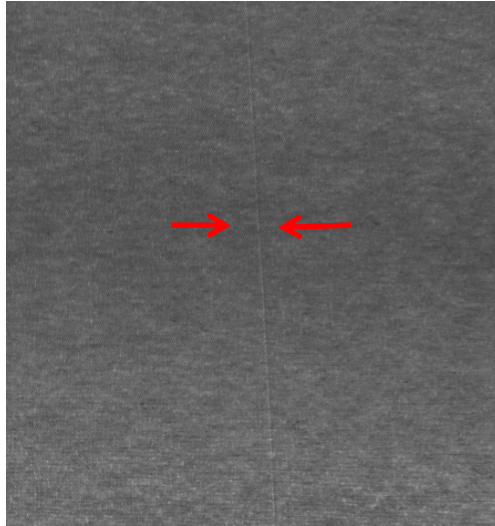
Textile Fabric Inspection – 1/3

Localized Defects



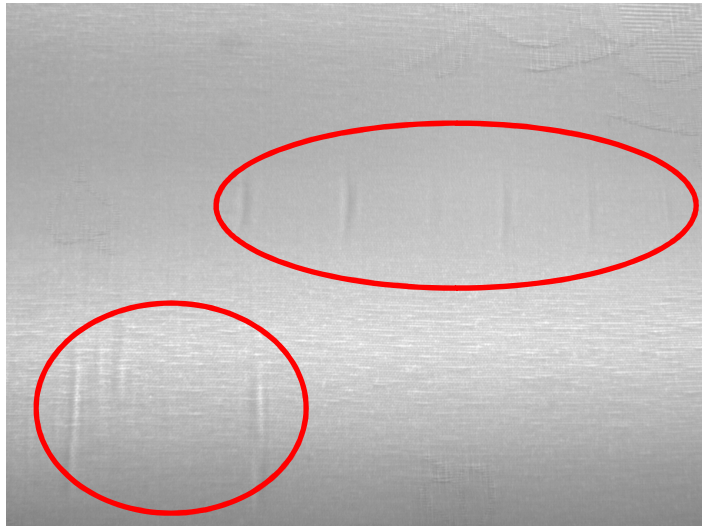
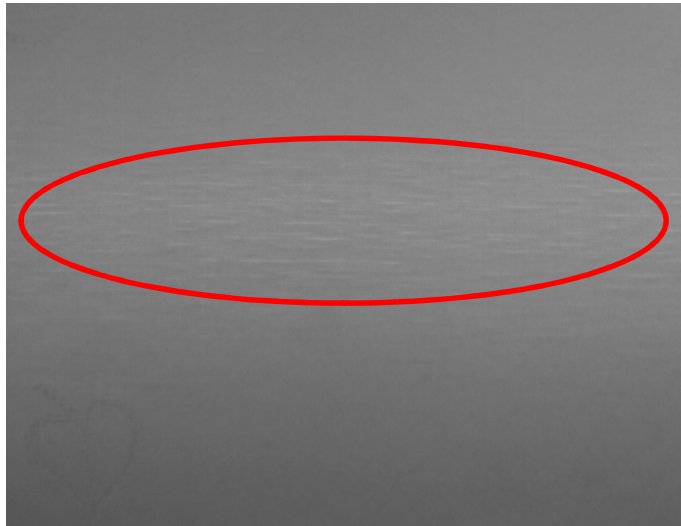
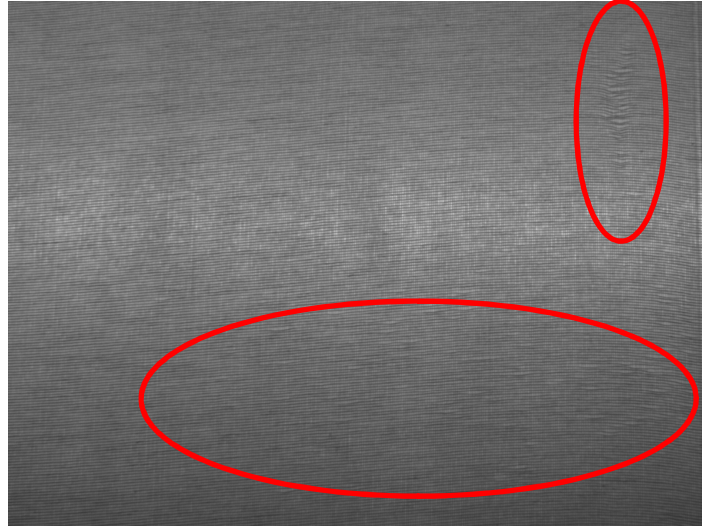
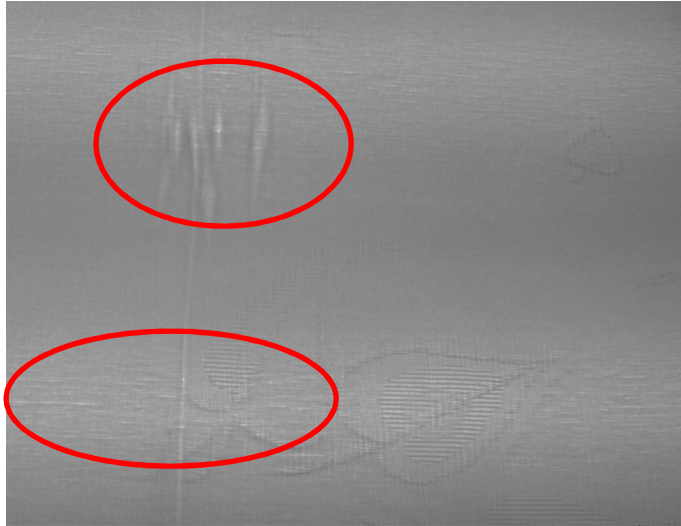
Textile Fabric Inspection – 2/3

Thin line defects



Textile Fabric Inspection – 3/3

Other defects



Relevant Factors **Revisited**

(-) Variations due to material properties

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(-) Diversity of defects

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Vision Research Challenge

A generic framework addressing all materials without emotional involvement!

