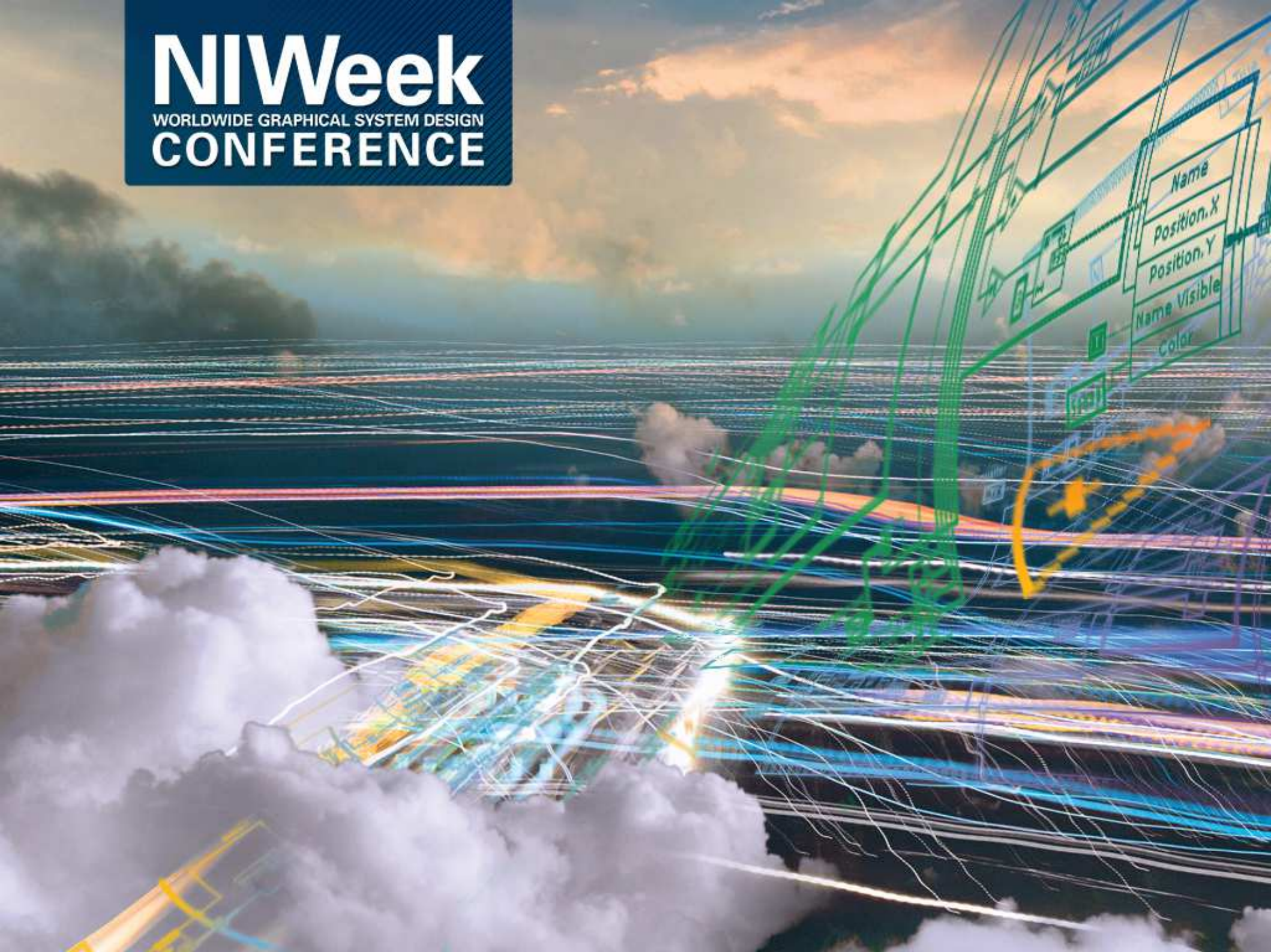


NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN

CONFERENCE





Automatically Detecting Cosmetic Defects Like a Human

Ivan Meissner

QUALIMATEST SA

meissner@qmt.ch | + 41 22 884 00 35

What is cosmetic defects ?

Cosmetics defects are mainly non functional

- Defect are stains, scratches, shocks, dents or foreign particles
- Control mainly made by operators



What are the challenges for an automatic cosmetic defects control?

Cosmetic defects are difficult to see

- Defects may be on a textured surface



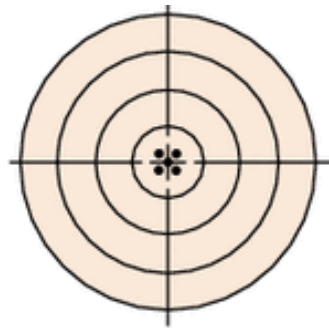
- Defects may be visible only with a specific light angle



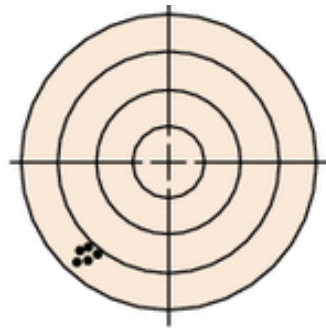
Cosmetic evaluation is subjective

- No quantitative limits
- Results will depend on who is doing the control
- Results will depend on control conditions (light, ...)

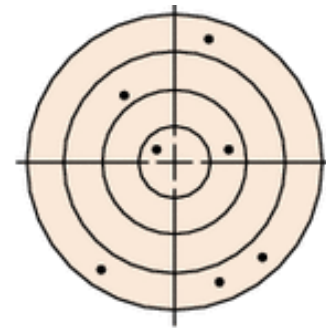
Which leads to low repeatability and accuracy



High Accuracy
High Repeatability

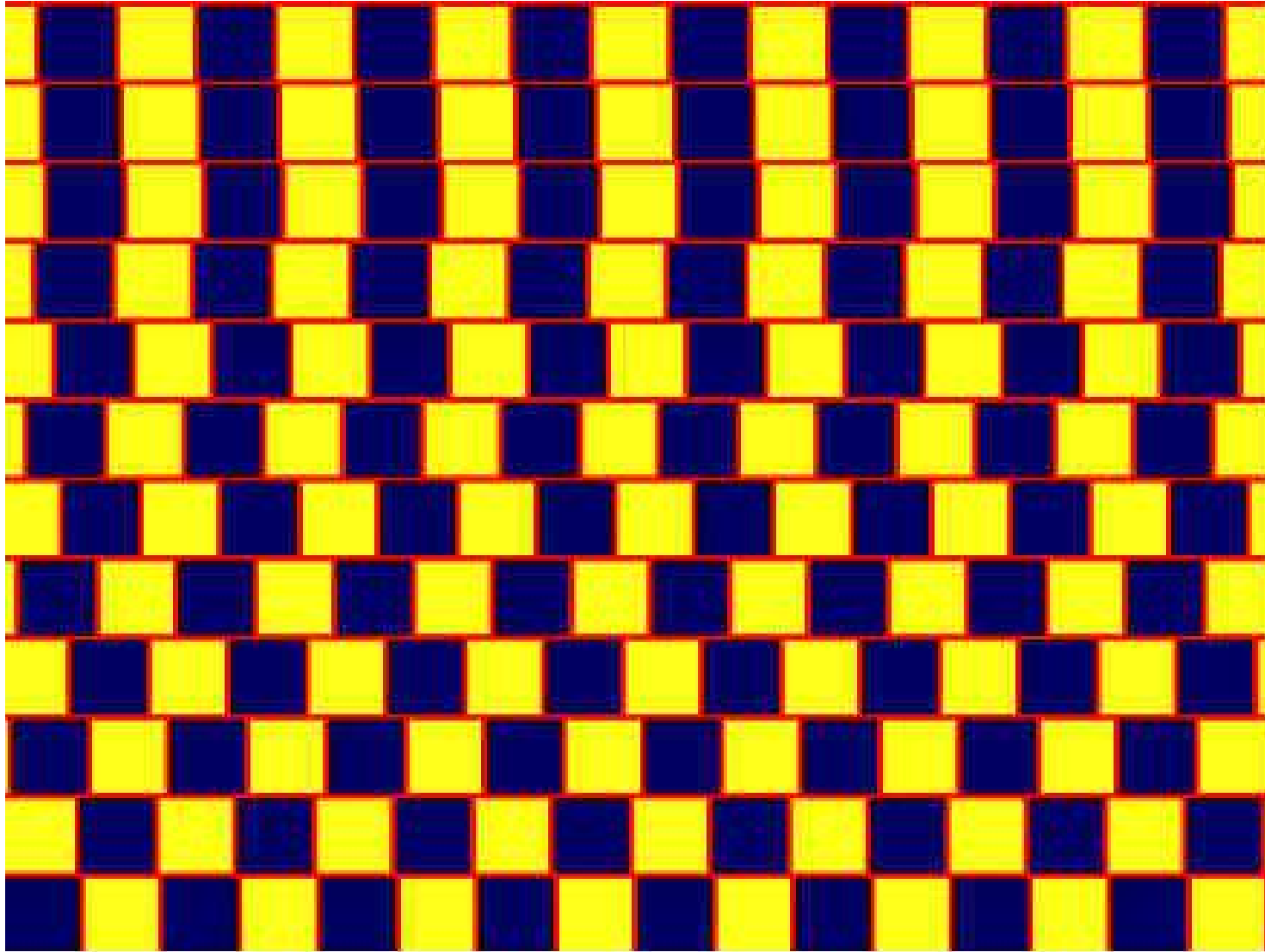


Low Accuracy
High Repeatability

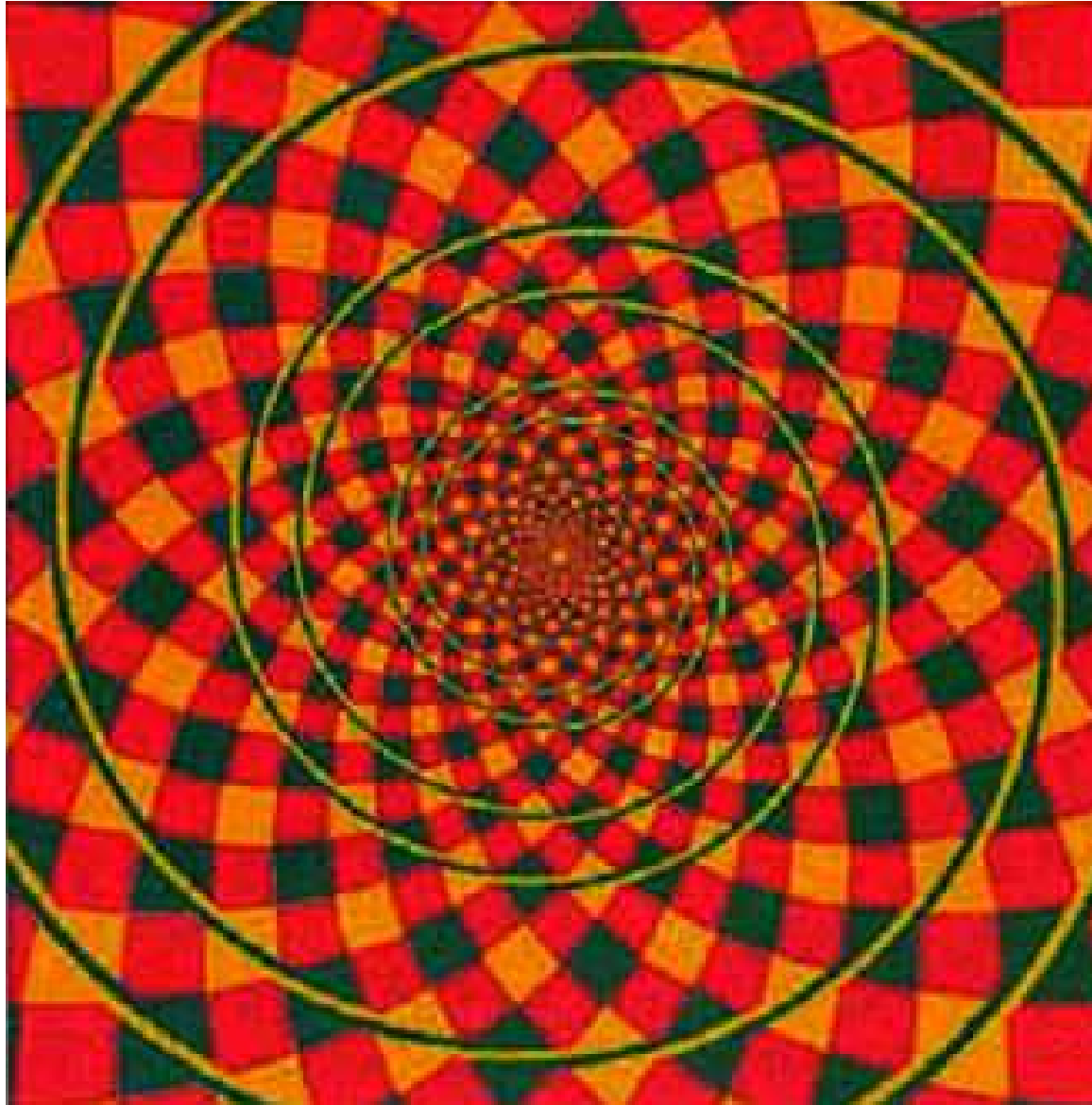


Low Accuracy
Low Repeatability

What is your perception, do you see straight lines ?



What is your perception, do you see concentric circles ?



Case used for the presentation

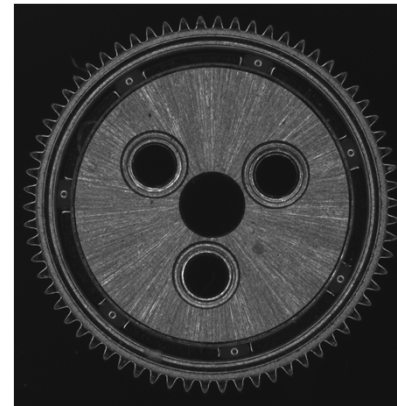
A wheel and a ball bearing for watches



Picture shown as an example from breguet.com



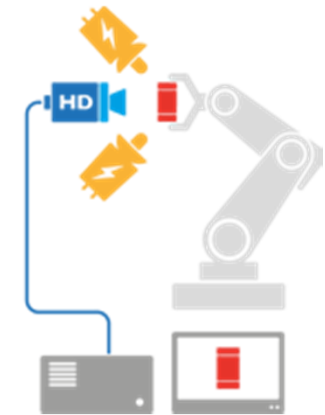
Picture shown as an example from vacheron-constantin.com



QMTSubFace for automatic cosmetic quality control

QMTSubFace is a complete package

- Platform for automatic cosmetic quality control based on human criteria
- NI based Hardware and Software
- Multiple system options depending on part shape and process type



QMTSubFace is a 4 steps process

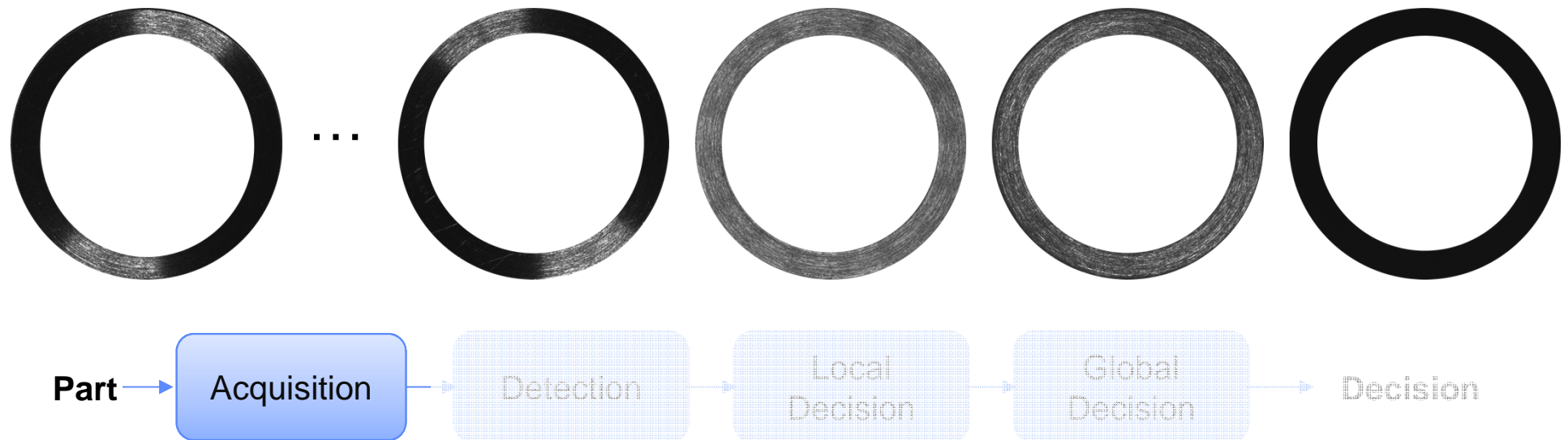


- Image(s) acquisition : Defects have to be contrasted
- Anomalies detection in images(s)
- Local qualification and decision : Is each anomaly a defect ?
- Global qualification and decision : The part may not be good without defects

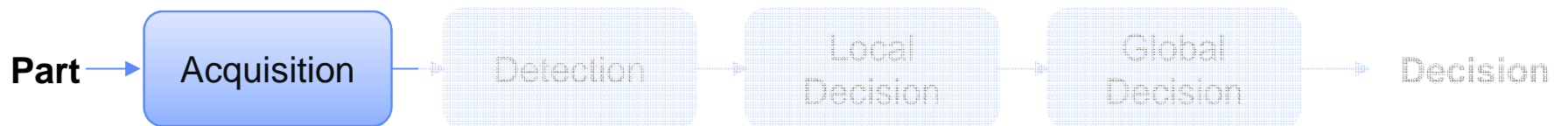
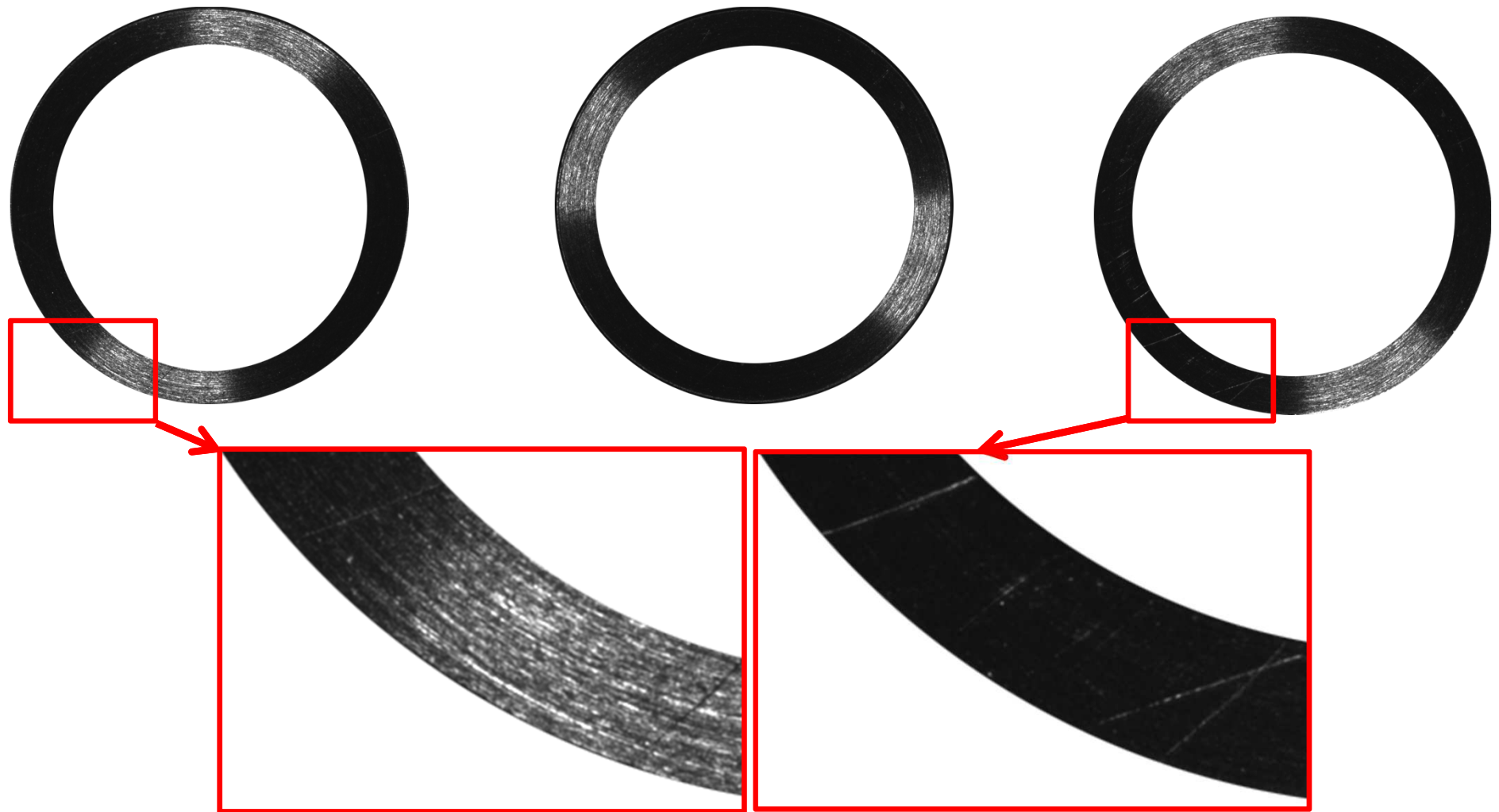
-> Final decision

3 lightings resulting in 15 images

- Qualimatest specific 12 directions lighting combined with a ring
- On axis lighting
- Backlight
- Synchronized image acquisition and lighting control to limit the process cycle cost



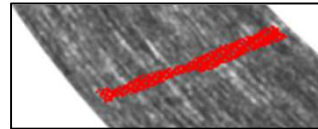
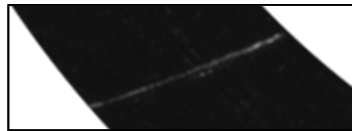
Directional light allows to see scratches



Detection has to quantify each anomaly

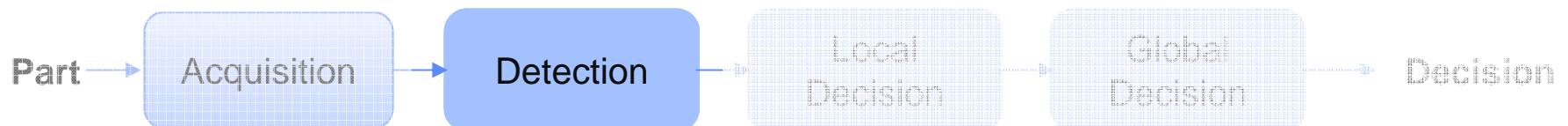
For local decision

- Area, compactness and elongation for geometry
- Standard deviation and mean of intensity for brightness



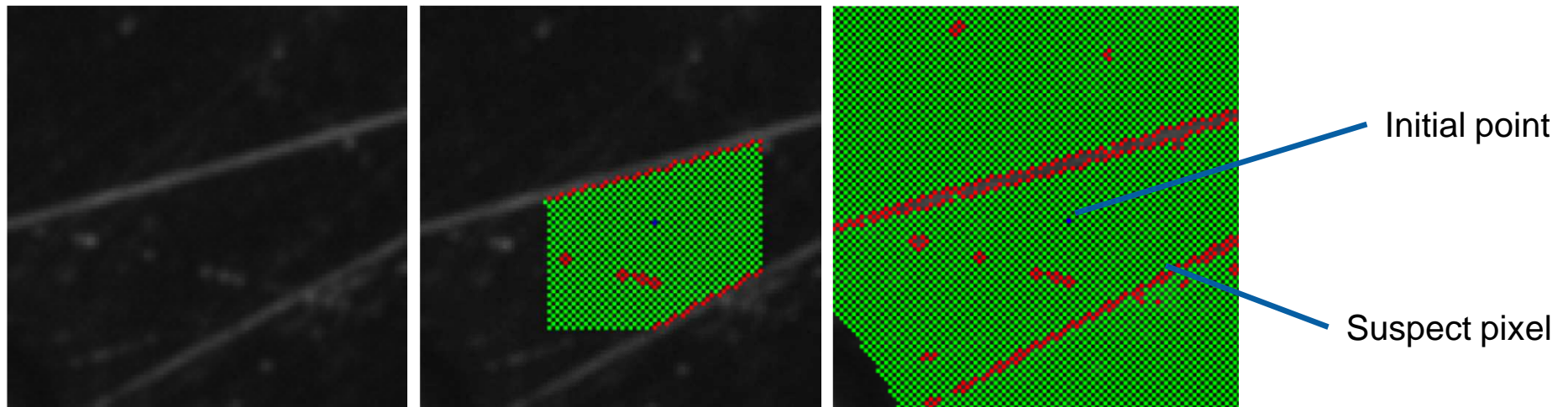
For global decision

- Numbers and overall area of anomalies
- anomalies geographical distribution and density

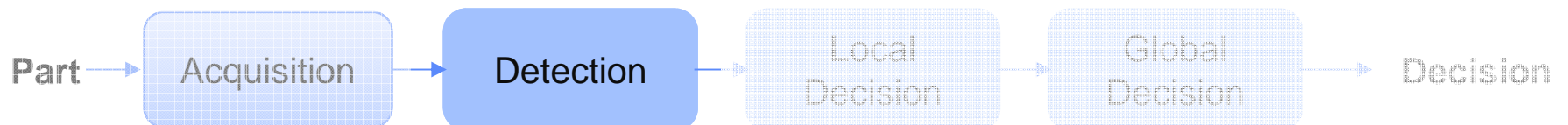


Adaptive Threshold for homogeneous surface

- Region growing from initial seed points (segmentation type)
- Neighbors comparison (intensity) with the region statistic
- Propagation on all surface with definition of suspect pixels

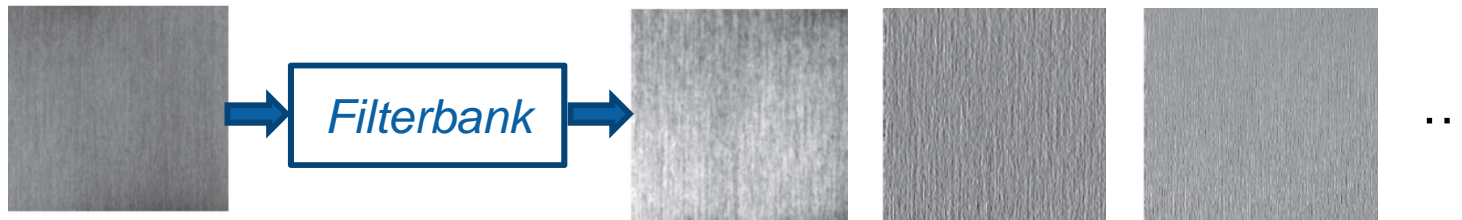


- Same processing for all 14 images (each light condition)
- One suspect pixel out of the 14 images is finally suspect

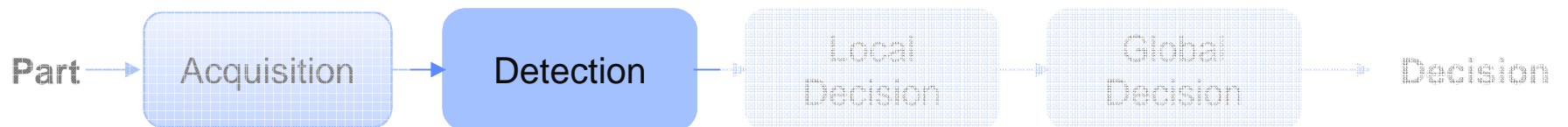
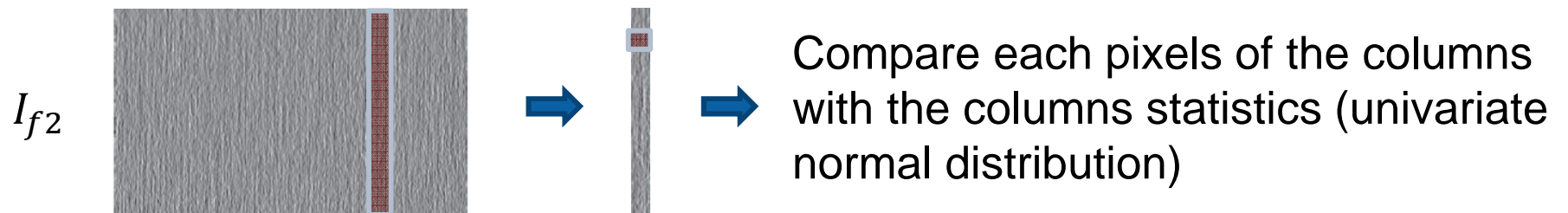


Processing for textured surface (1 / 2)

- Image filtering with 9 different filters

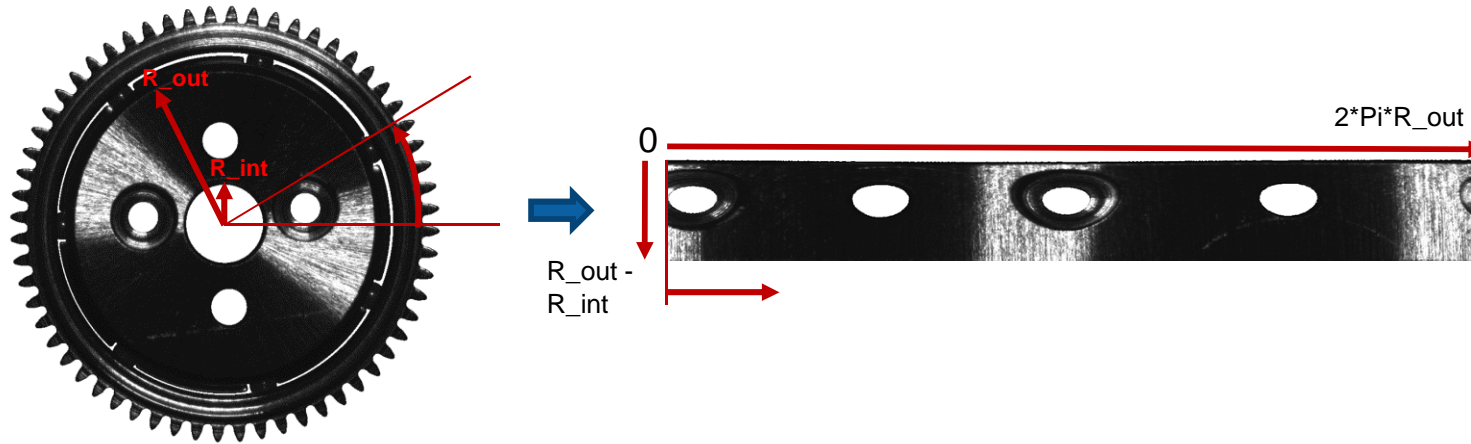


- Process the 9 filtered images by columns to detect the suspect pixels

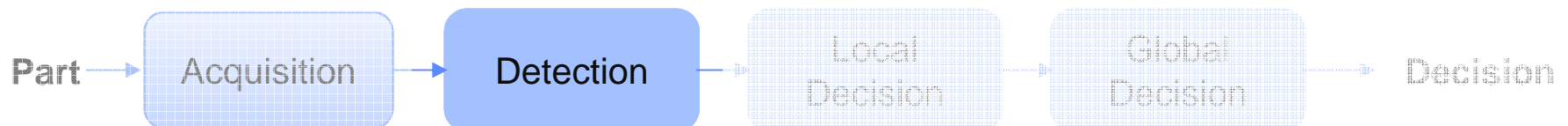


Processing for textured surface (1 / 2)

- Unwrap image option

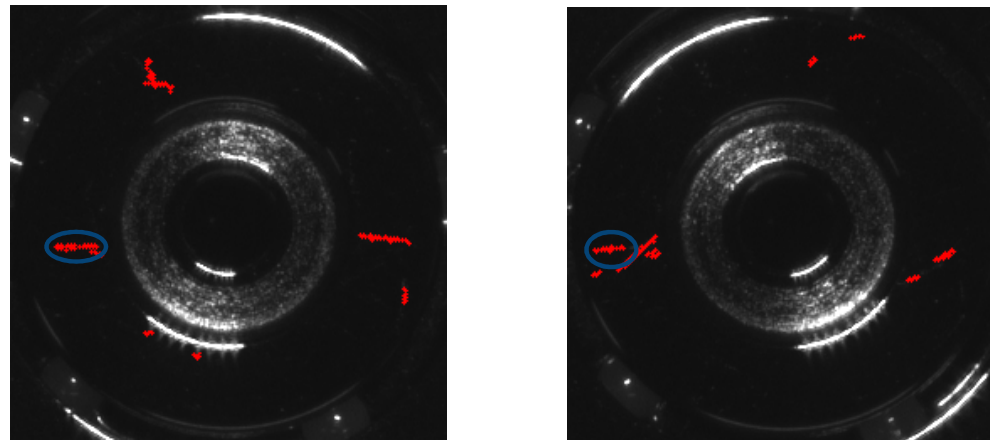


- Same processing for all 12 images (each light direction)
- One suspect pixel out of the 108 images (9 x 12) is finally suspect

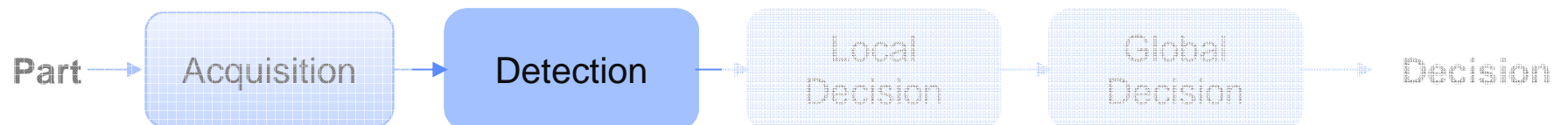


Suspect pixels are combined in anomalies

- Suspects pixels are combined in blob in each image
- Blobs in all images are combined to create anomalies :
 - Short distance between blobs of opposite images
 - Pixels in common
 - Similar orientation

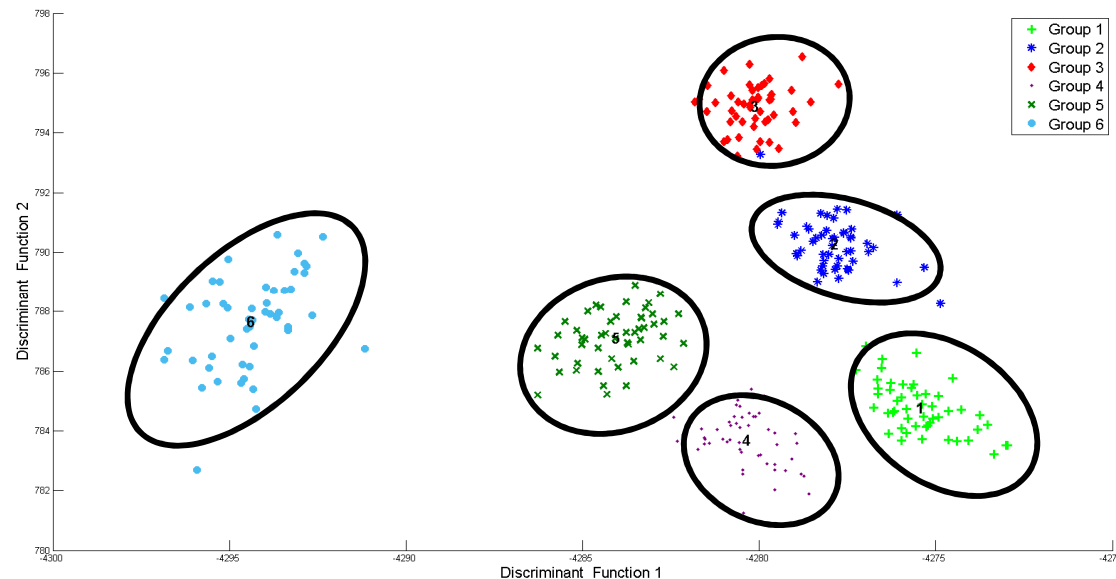


One anomaly seen in two different directional images



Anomalies are classified to sort defects

- Each anomaly is classified : insignificant, modest or critical
- Classification is made by linear discriminant analysis (LDA)



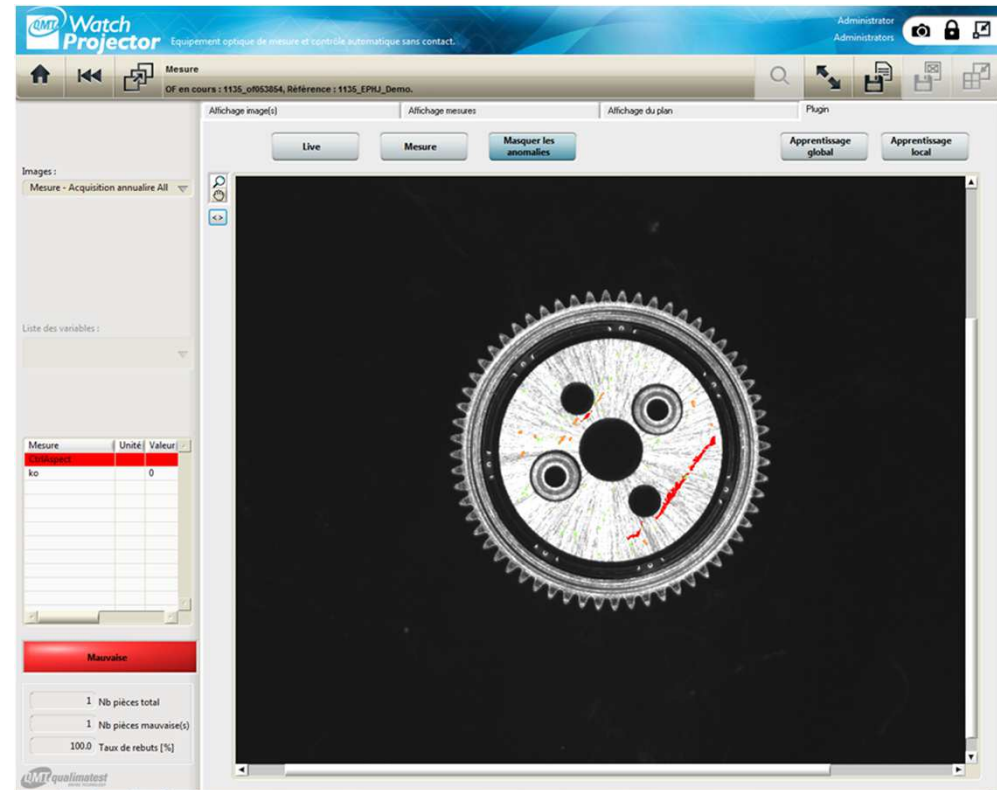
- LDA parameters are defined by training



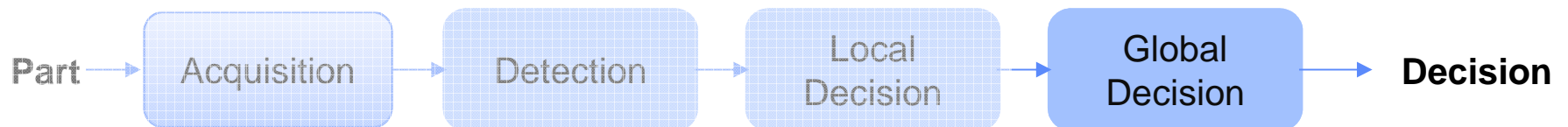
Final decision

The cosmetic evaluation of a part is NOK if

- Number of critical anomalies > 0
- Number of modest anomalies $> NG$ (*)
- Modest anomalies density $> DG$ (*)

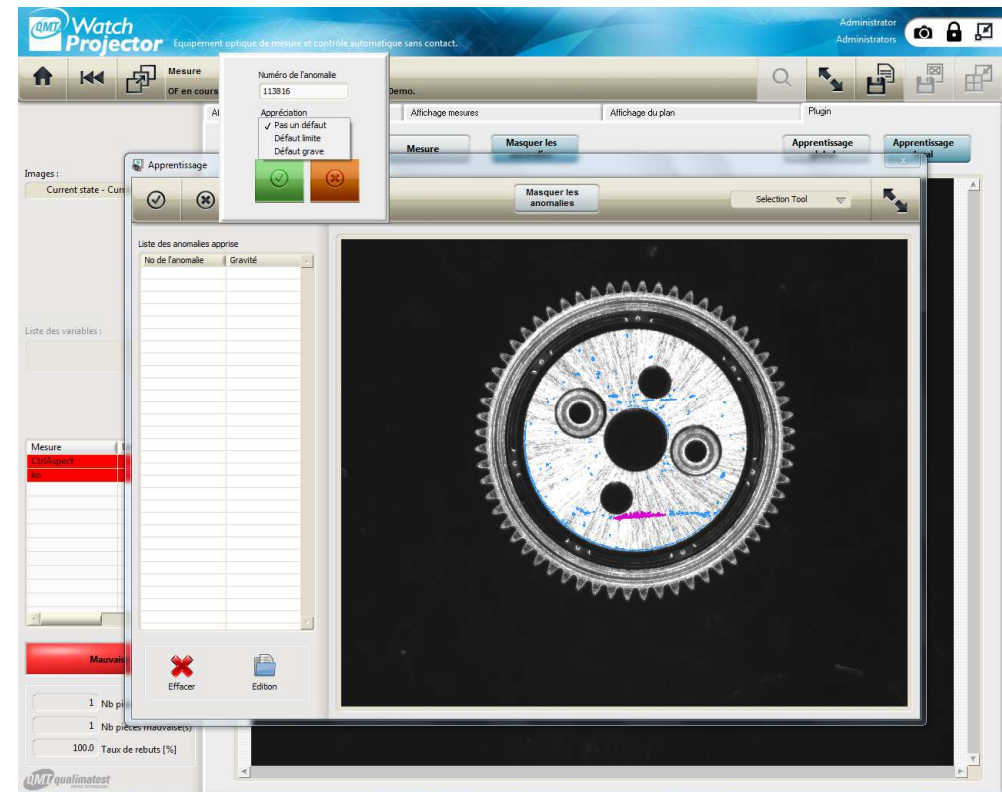


(*) parameters are defined by training



Local and global classifier training

- A customer expert evaluates parts to train the classifier
- Each anomaly has to be evaluated
- Each part has to be globally evaluated
- A classifier can be used in all products with the same surface and quality criteria
- A part may have multiple surface types with multiple classifiers



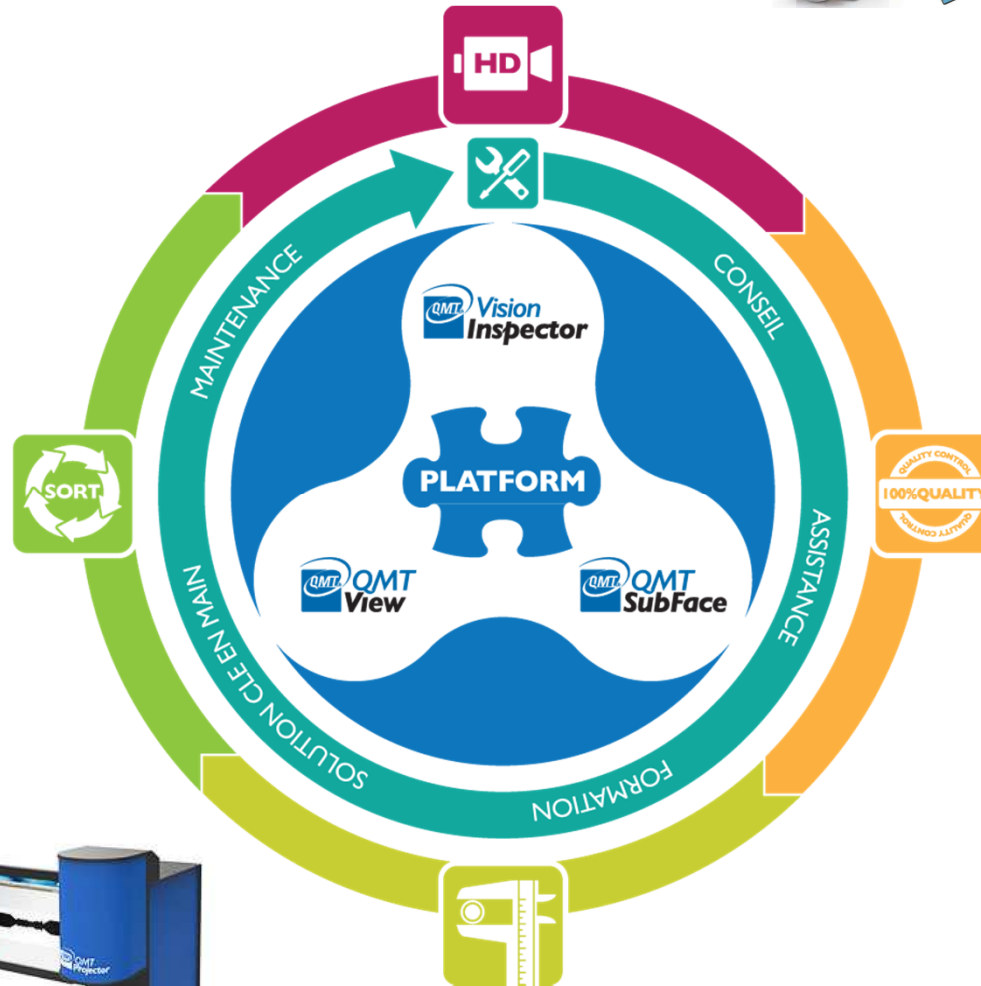
Conclusions

QMTSubFace decreases the quality control cost

- An automatic cosmetic quality control also on textured surface in less than 10 seconds
- A repetitive control for customer satisfaction and the “right quality”
- A training tool for customer autonomy
- A turnkey solution with the Qualimatest product range and services

QMTSubFace on Qualimatest platform

Vision components



Vision station



Measuring equipment



Questions



Contact us

1228 Plan-les-Ouates (Geneva), Switzerland | info@qmt.ch



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www.youtube.com/user/qmtmeissner



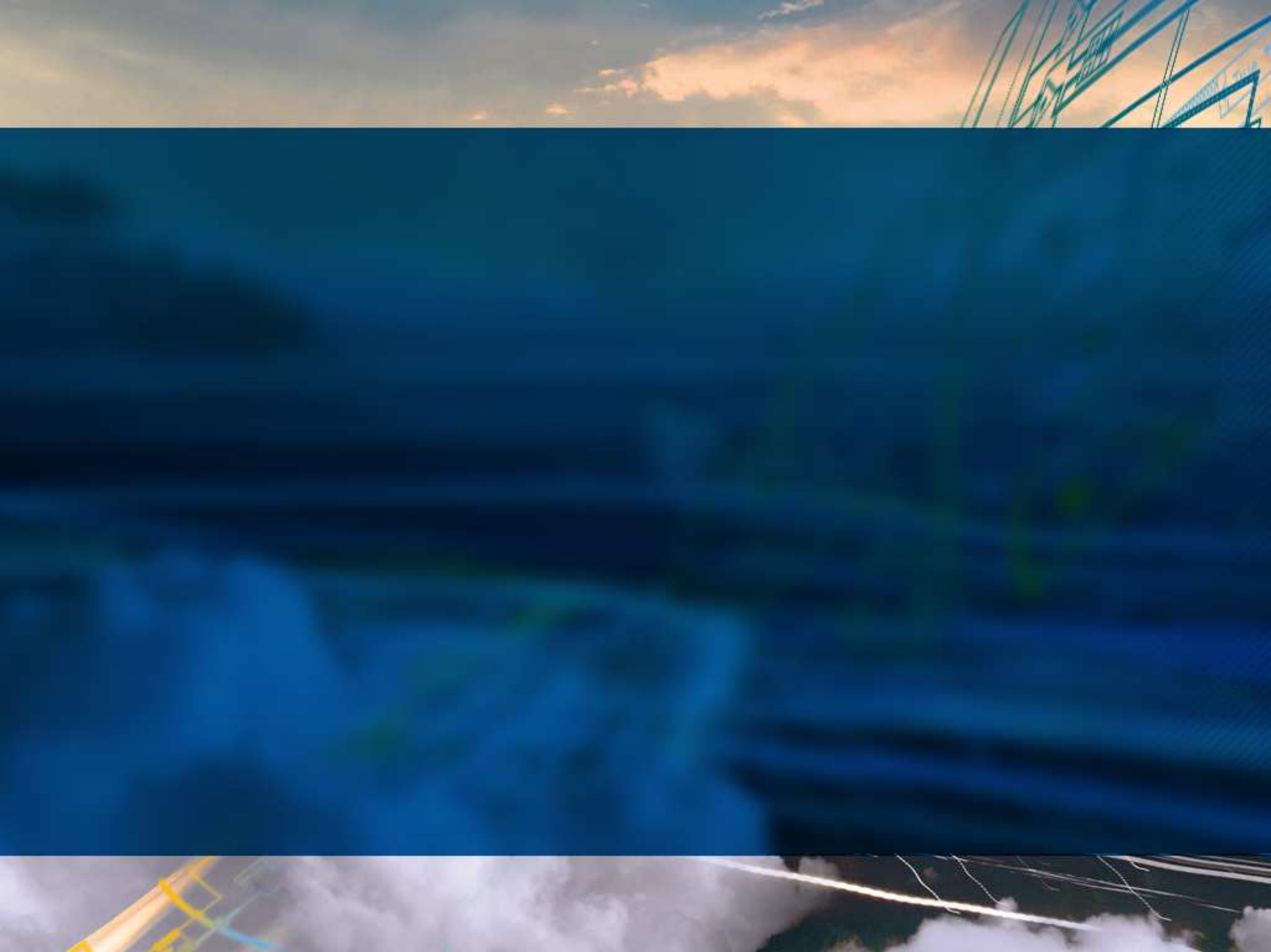
fr.slideshare.net/QMTMeissner

Acknowledgement and Bibliography

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