Vision Competencies

Simac Masic & TSS,is for more then 20 years a successful integrator of machine vision systems and supplier of 'turn-key' projects in Electronics, Semiconductors, Food, Packaging, Automotive and Medical industries.

An excepted definition of Machine Vision is: “The analysis of the digital pictures to extract information for quality- and process control and/or steering an activity.”

Simac Masic & TSS supplies complete stand alone inspection cells and/or integrates into existing production lines or machines, for the following vision disciplines.

1D bar-code and the 2D matrix bar-code

1D Linear bar-code

1D Stacked bar-code

The linear and the stacked bar-codes are usually read with a laser-scanner, in which the reflected laser-line is being read with a senor, however this is also possible with camera image processing software.

2D matrix code

The 2D matrix code is a code in two directions and can only be read with an “imager” ,a camera-product. The whole 2D area is used as information carrier.

Because of the two directions the 2d matrix code has a data capacity that is much bigger then a linear code and because of the technique of “image-processing” the 2d matrix can be read easier and is more reliable then a 1D code.

It is this reliability of the 2d matrix that more and more use is in 'track and trace' for production-sites and on the final end-product. Simac masic & TSS supplies, implements and services all these different scan and data processing systems.

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Vision Competencies

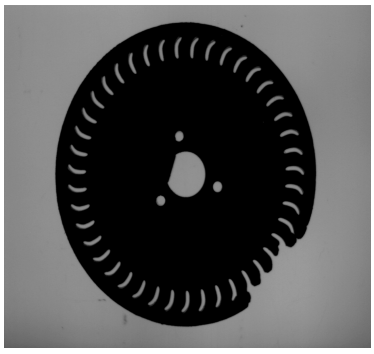
2D Machine Vision – for 100% quality assurance

These systems can be recognized by the following:

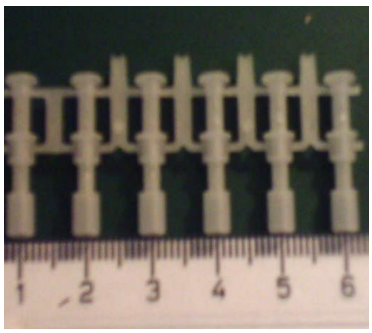
- Digital sensors and/or digital area- or line-scan camera's. CMOS or CCD camera-products
- The correct exposure of the object; static or with strobe.
- A digital image processing-unit.
- Redundant information is ignored and the remainder contains the "Region of Interest" the so called ROI.
- The result image is presented by display, Ethernet, serial, digital storage, PLC control.

Within the 2D technique, the object can be measured in

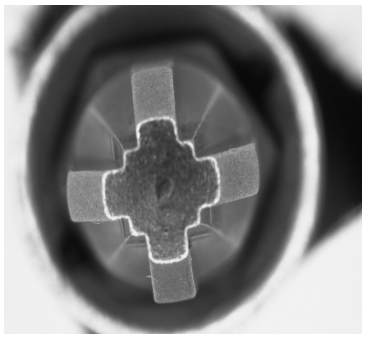
- Quality of surface
- Measurement of characteristic edges, points, surfaces
- Presence and location of special features
- Shape, size, color, presence or absence / defects
- Measuring the dimensions



Form-deviation

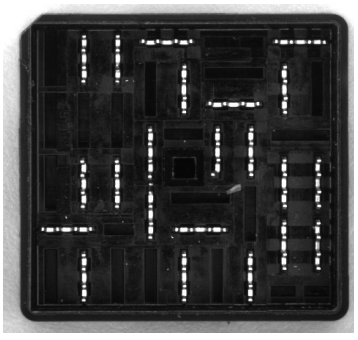


Missing lip



Tool head inspection

Seal inspection



Connector pins control

OCR Optical character reading

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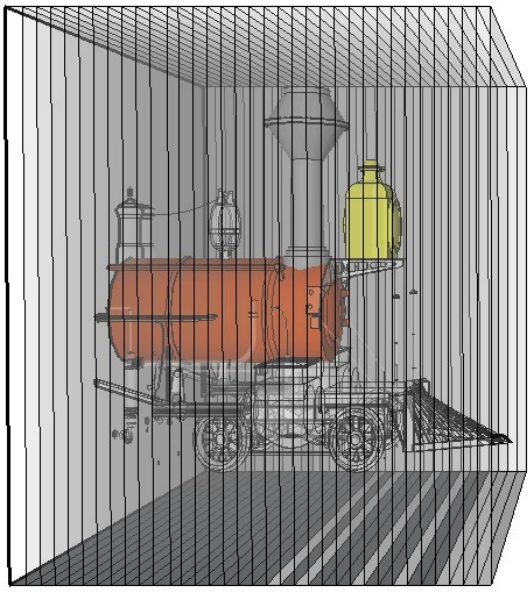
Vision Competencies

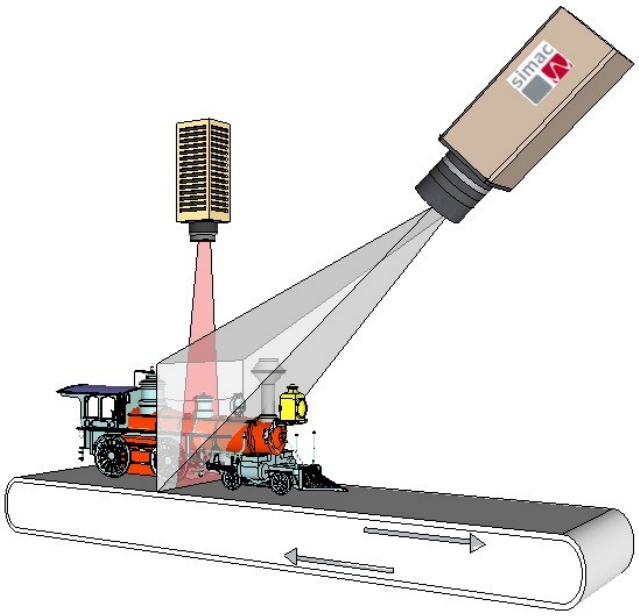
3D Machine Vision – height information and volume calculation

By using a laser, this arrangement is not without danger. Lasers are especially dangerous when the beam directly or by reflection can hit the eye. The eye-lens centers the laser at a very small area so that even at low power local heating can damage the eye. Designing, drafting and amending a camera-system with laser is therefore work for specialists.

Warning laser light

By projecting a laser line on a object that moves with a uniform motion, the processing software can create a 3D image of the object. This is possible because the camera is at an angle to the laser whereby the height information can be read from the offset of the projected line.
See diagram below.





This allows the measurement of physical abnormality on a surface like:

- Height
- Volume
- Flatness of shape
- Surface scratches
- Density

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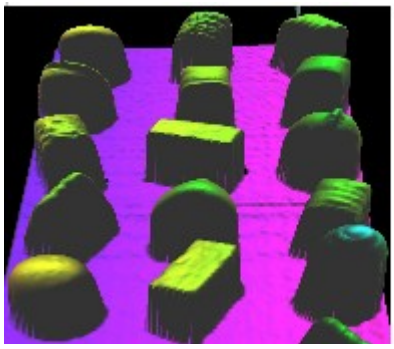
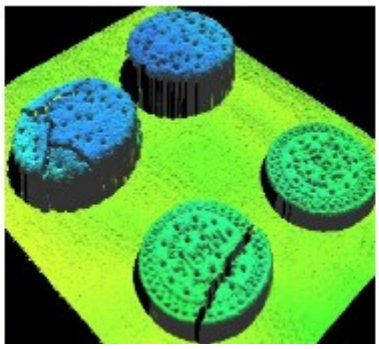
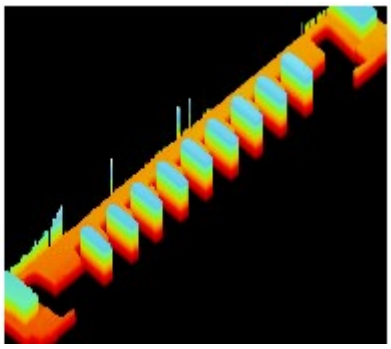
Vision Competencies



3d Image of Pralines



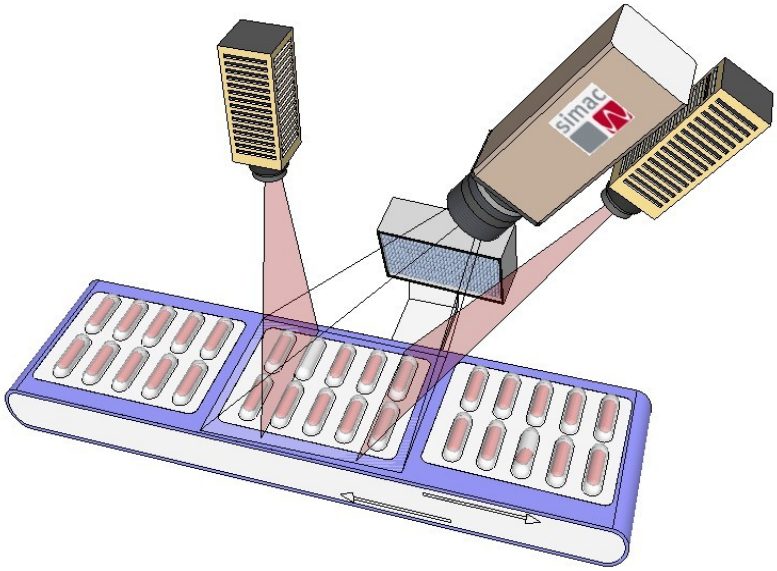
3D image of biscuits



3D image of connector pins

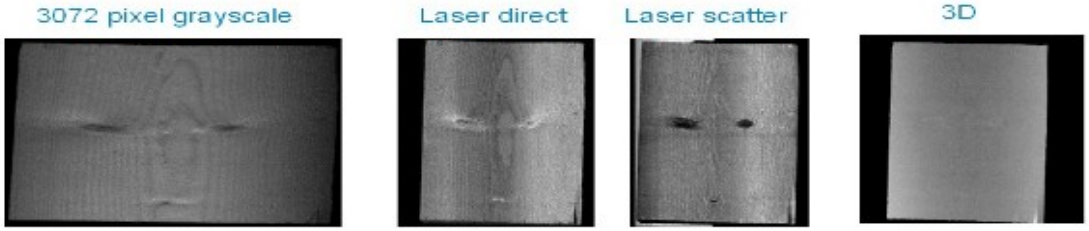
Multi-scan 3d camera's

These camera's have a special CCD chip that allow multiple image-types to be taken in one shot. Gray scale, spread-pattern and 3D image.



Application examples are

- Control of blister packaging
- Control of wood quality, defects, knot, bark and location.



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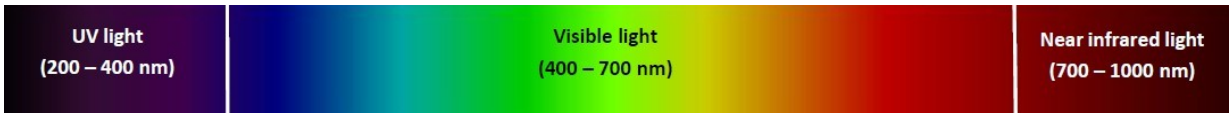
Vision Competencies

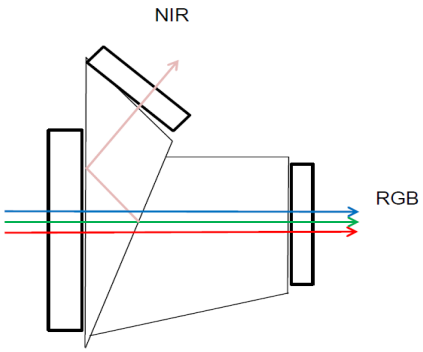
Multi-spectral camera's (2-CCD, 3-CCD and 4-CCD camera's)

Besides the visible light spectrum, in the ultraviolet (UV) and in the near infra-red (NIR), images can be made. Together with special lenses, it is possible to examine product characteristics which in the visible spectrum would not be recognizable.



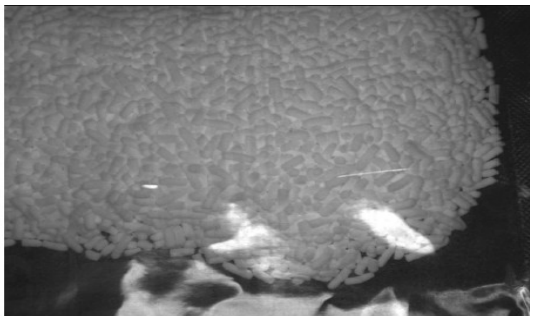
NIR recordings: 2 CCD camera's

These camera's have a NIR light separating prism and two different CCD-chips . One CCD is specially designed to absorb NIR light and the other CCD is to capture the visible spectrum. See diagram

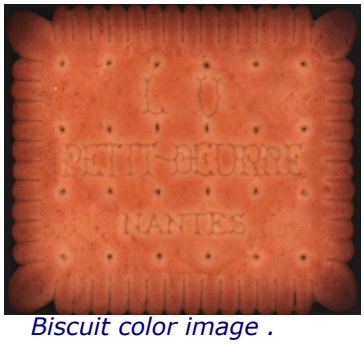


Examples: making the invisible visible

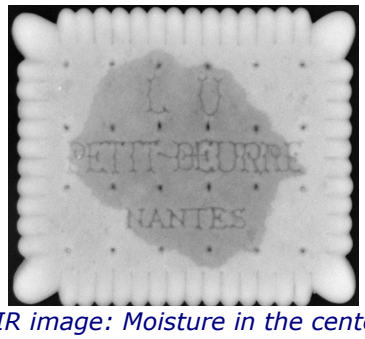
Color image with print visible.



NIR image looking through the print.



Biscuit color image .



NIR image: Moisture in the center.

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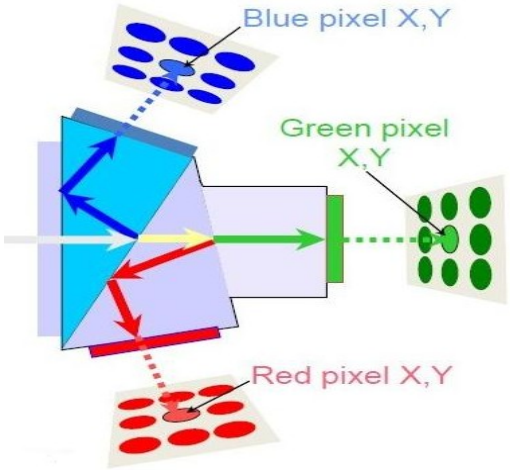
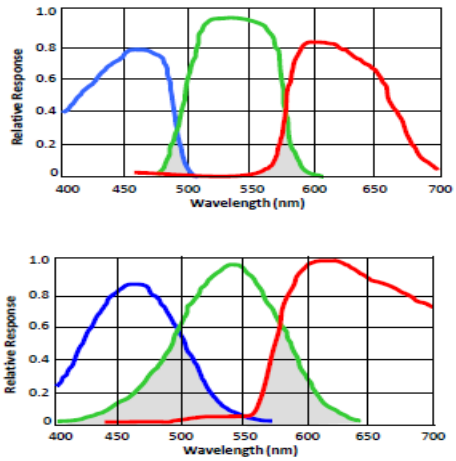
Vision Competencies

Color pictures: 3 CCD camera's

These camera's use hard dichroic prism coatings allowing a strict separation of wavelength to create steep spectral wavelength charts with little overlap. What results in a higher reliability and sensitivity of the color per pixel.



3 CCD Camera with wavelength separating prism



3 CCD(top) vs 1 CCD camera (below)

The advantage of this construction is

- One optical lens whereby one focus adjustment for all 3 CCD channels of the camera.
- Same magnification for all colors
- All CCD's have exactly the same image at the same time
- True colors – no interpolations needed (unlike the 1 CCD)
- Bright colors, lower noise, better dynamic range.
- Sharper edges and transitions more detail with less overlap

Image from 3 CCD Camera

Image from 1CCD camera (more overlap)

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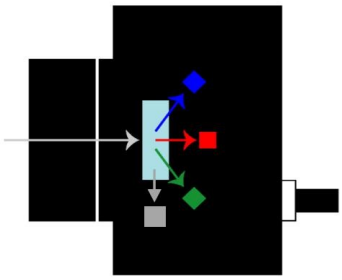
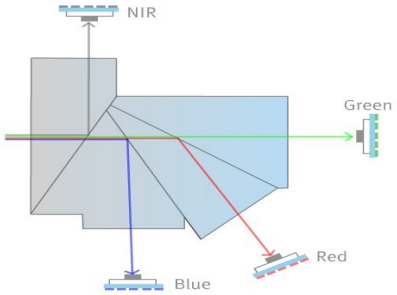
Vision Competencies

4 CCD Camera , simultaneous red, green, blue and NIR light.

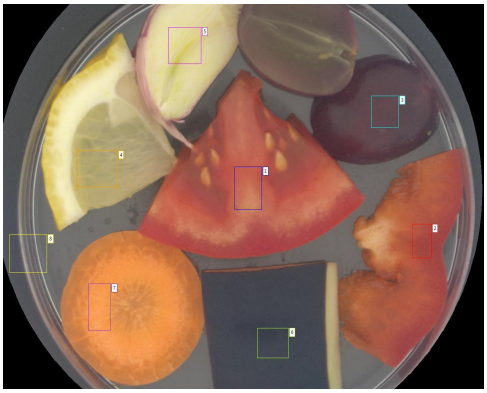
Detection of color errors combined with near infrared analysis found many applications in the food such as detection of rotten and bruise spots in fruit and vegetables.



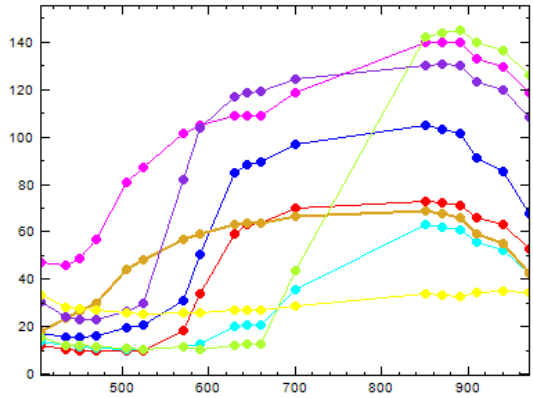
Camera: 4 channel R,G,B and NIR



hard dichroïc prism coatings provide strict wavelength separation



Different fruits and vegetables



Separation image of fruit and vegetables

Below the many other application areas.

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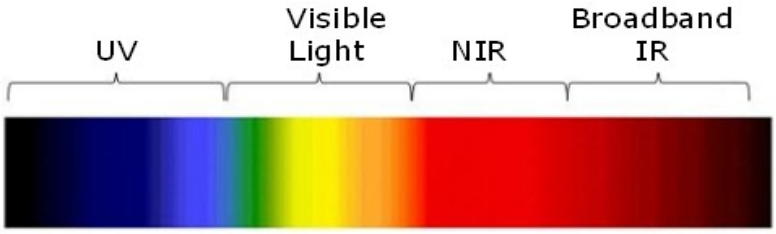
Vision Competencies

Infrared inspection

The heat we feel from sunlight, a fire or radiator is all infrared radiation. Although our eyes can not see it, our nerves in the skin can feel it.

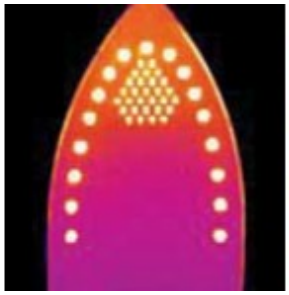
Any object that has a temperature above absolute zero (-273,15° C) emits infrared light off. Even cold objects like an ice cube radiates infrared light. The warmer the object the more infrared radiation it gives off.



IR spectrum
The wavelength for broadband infrared is from 1000nm to 1 mm.

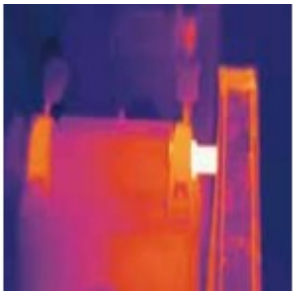
The choice of a thermal image camera has the advantage that a large area or multiple parts simultaneously by non-contact method can be measured. This allows the detection of critical components that are close to rupture or need a repair to be monitored easily. The camera can oversee complete engines, components or panels to check for overheating no matter how small the part. Measurable temperature difference is ±0,03º Celsius.

IR camera



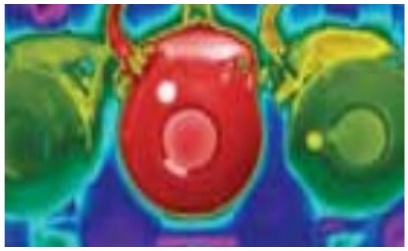
Quality inspection

Printed circuit heat buildup



Overheating bearing

Normal image



IR image

Superimposed image for operator

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Vision Competencies

UV camera's

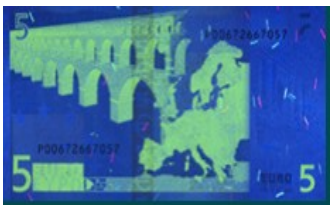
The ultraviolet light contains much more energy than infrared, i.e. the shorter the wavelength the more energy per time unit. High intensities and/or prolonged exposure to UV is harmful to humans. The human eye develops 'stare' at high doses. The skin turns red and/or burns and eventually can cause skin cancer.

The small wavelength of UV (200-400nm) makes it possible to make small unevenness in a greater clarity more visible. In addition there are many substances that emit visible light when irradiated with UV light. This phenomenon is called fluorescence and is used for quality, authenticity tests and restorations.

Authenticity tests

UV Passport image

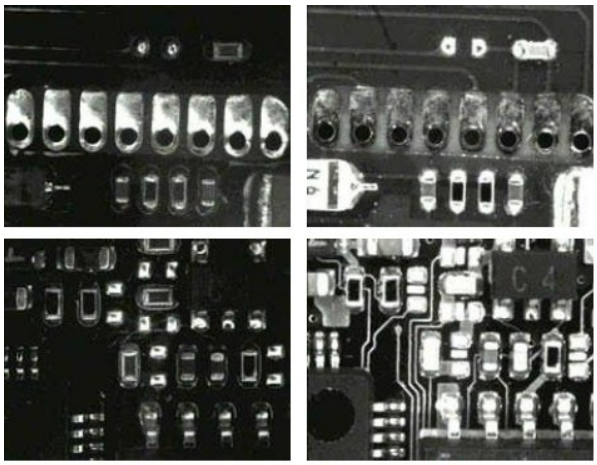
Passport standard



Banknote UV image

banknote standard

Checking solder connections



UV Camera Standard Camera

Restoration of paintings

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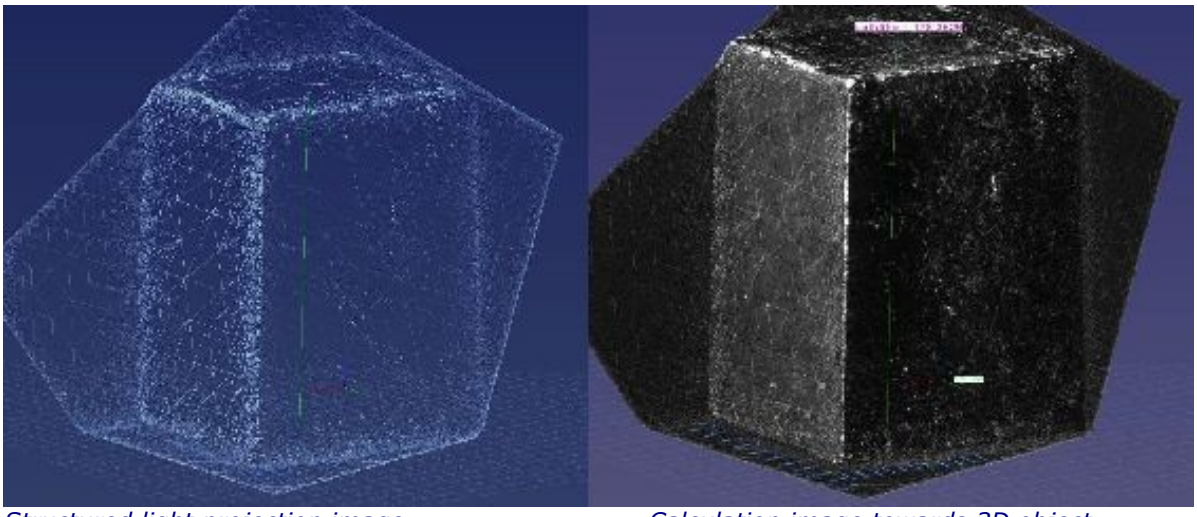
Vision Competencies

Structured light 3D Vision

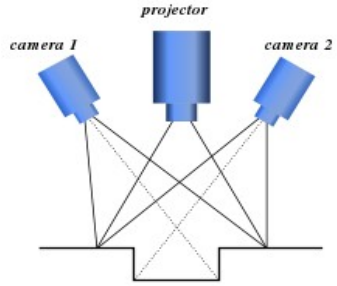
This method uses a video projector to project multiple line patterns on a surface whereby lines distort when the surface is changing. This unevenness in the lines is then used to reconstruct the exact geometry of that spot. This method works only where the surfaces can be exposed to the projected images.

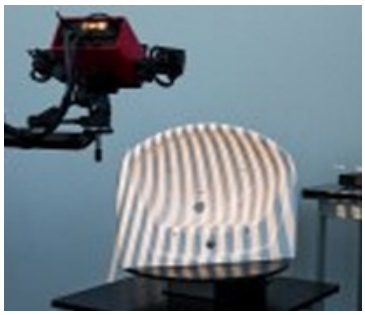
Because the method only measures one surface from 1 perspective (angle); a whole 3D object is composed from different measurements under different angles. A common arrangement for this is a video projector combined with two camera's.(2 angle's in one projection).

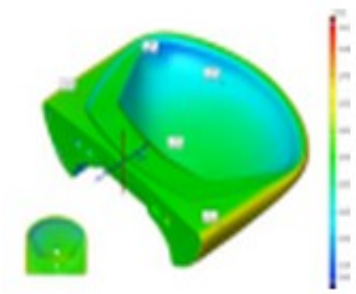


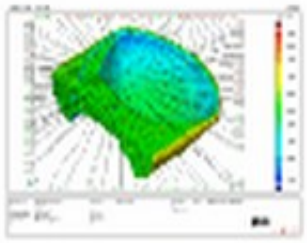
Structured light projection image *Calculation image towards 3D object*

To accurately measure there first must be a calibrated object to determine the optical en geometric distortion of the arrangement and per camera location, these adjustment are then adapted in the software before the actual values of the real object can be measured.









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Vision Competencies

X-ray : Rontgen vision

Warning
Ionizing Radiation

X-ray has a wavelength between 10nm and 0,01nm and is therefore much shorter than UV-light. The small wavelength of X-rays easily pass through solid objects and is only slightly more restrained in substances with a dense mass. The difference in transmitted light is then reflected in the difference in contrast on the digital image. It is this discriminatory effect that can be used for the detection of different materials in closed containers. Equal densities equal the amount of transmitted X-rays but it still can be different material that therefore cannot be distinguished.

This property makes it an ideal tool for nondestructive inspection of closed containers. Because the amount of X-ray is now well controlled and work with minimal levels there is no permanent and/or measurable effect on the irradiated product. It is this progress which makes X-ray is increasingly used in the production of packaged food. Such as canned meat or for products in glass.

Simac masic & TSS has a number of standard X-ray solutions which can be built in 1 or 2 days. These standard configurations are complete with detection software and online support.
For non-standard solutions we can create a problem-oriented solution.

Average size detection depends on the package and the contents. Generally,
Metal 0,3mm, Glass 1,0mm, Stone 1,0mm

Example X-ray module

Inspection examples

Seeds in Glass *Canned density difference* *Bone/ cartilage in meat*

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