

Polybright

Visual monitoring for part tracking and process control.

Torino 16/03/11

José Ángel Gutiérrez Olabarria.
joseangel.gutierrez@tecnalia.com
Tecnalia

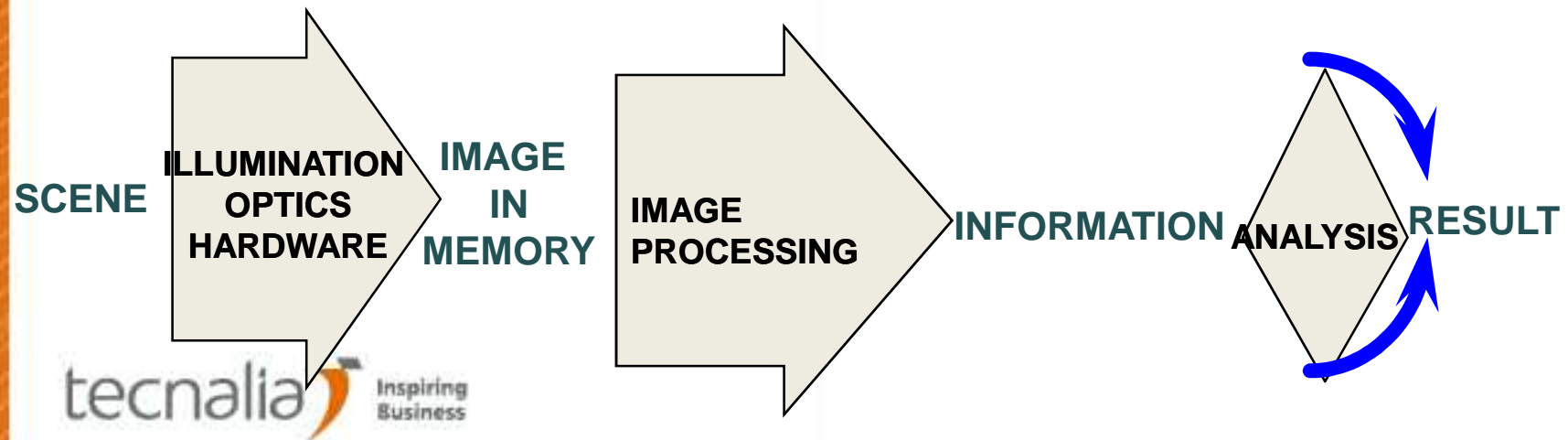


1. Introduction to machine vision
 1. 2D Imaging techniques
 2. 3D Imaging Techniques
2. Issues to take into account in machine vision systems design
3. Machine vision application video samples
4. Application to laser polymer part tracking and process control
5. Conclusions

What is Machine Vision and image processing?

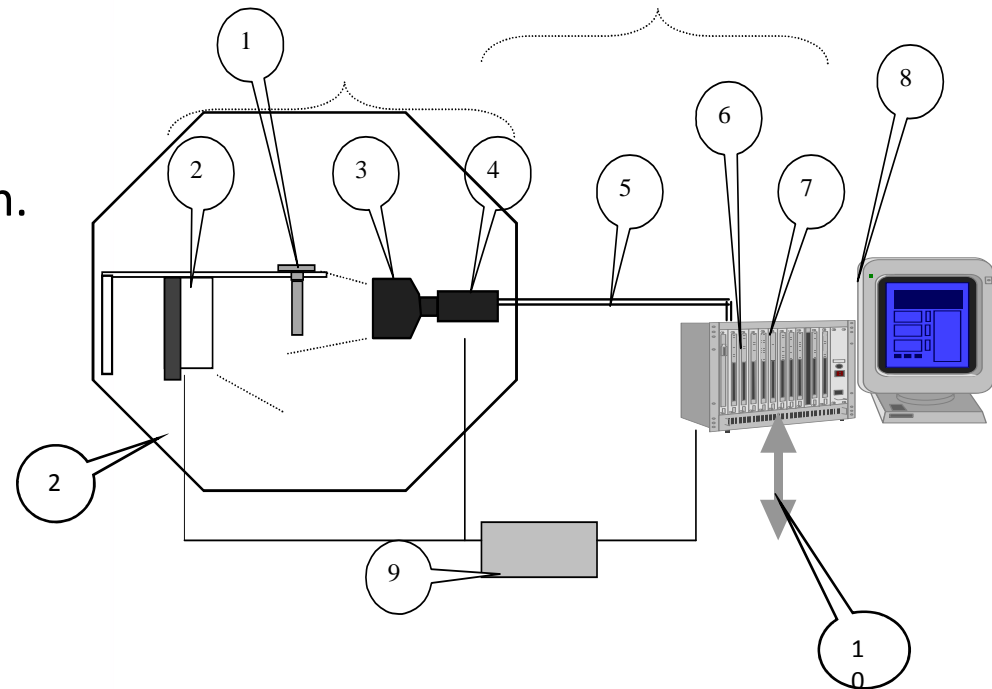
"Automated or assisted data process captured by visual means"

1. Capture using visual means: Hardware tools, image acquisition.
2. Automated/assisted process: Software processing.



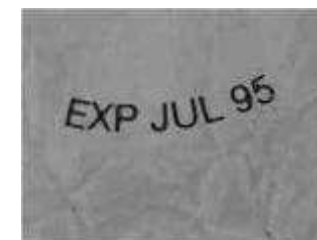
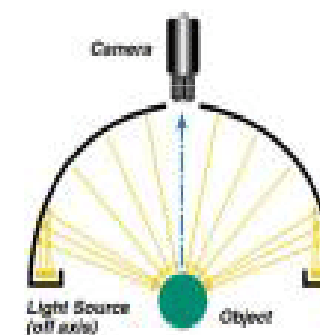
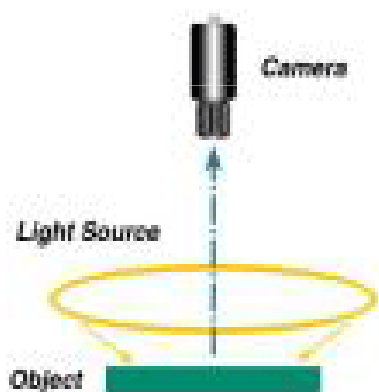
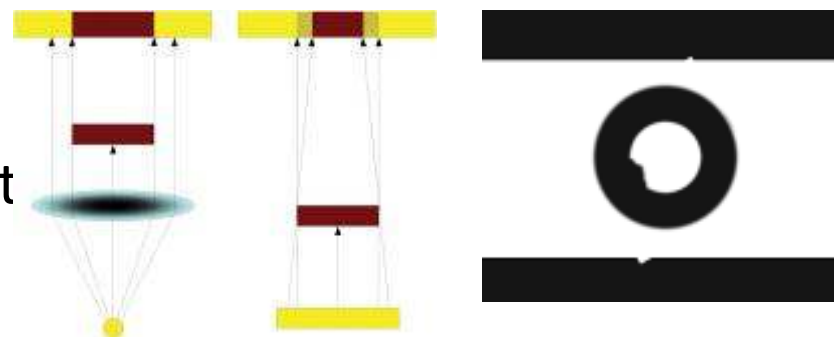
"Cross disciplinary subject"

- Hardware: Initial data filtering.
 - Light, cameras, digitalisation.
- Software:
 - Pre-processing: threshold, histogram, filters...
 - Processing: algorithms, information...
 - (Post-processing)
 - Communication of results



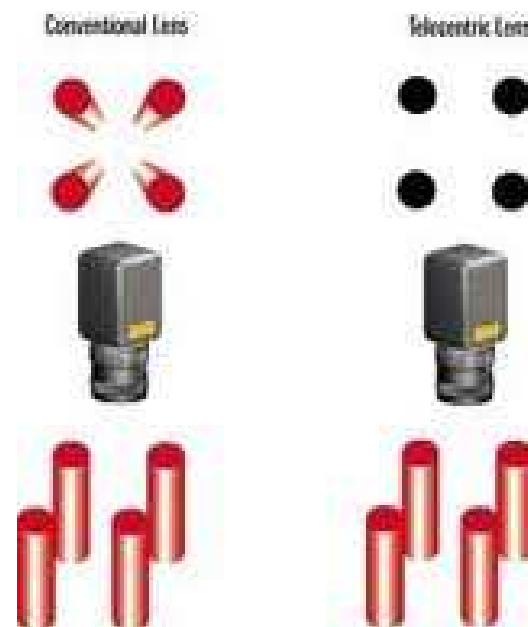
1.1 2D Vision systems. Light

- Photography techniques
- Backlight. Contour measurement
- Cloudy day
- Darkfield



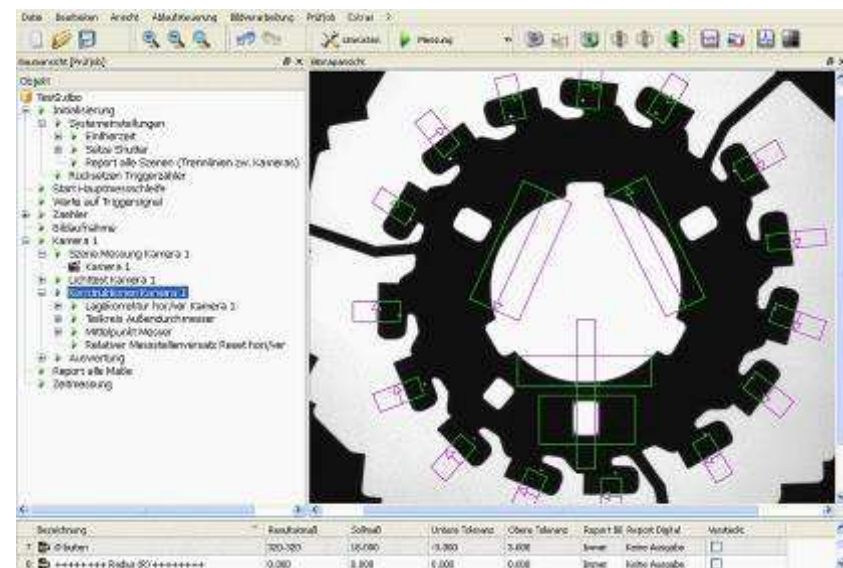
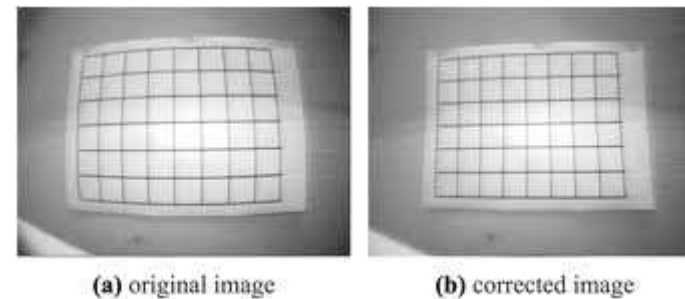
1.1 2D Vision systems. Optics and sensors

- Conversion of a scene from 3D space to a 2D plane.
- Optics
 - Aberration
 - Telecentrics
- Line scan and matrix cameras



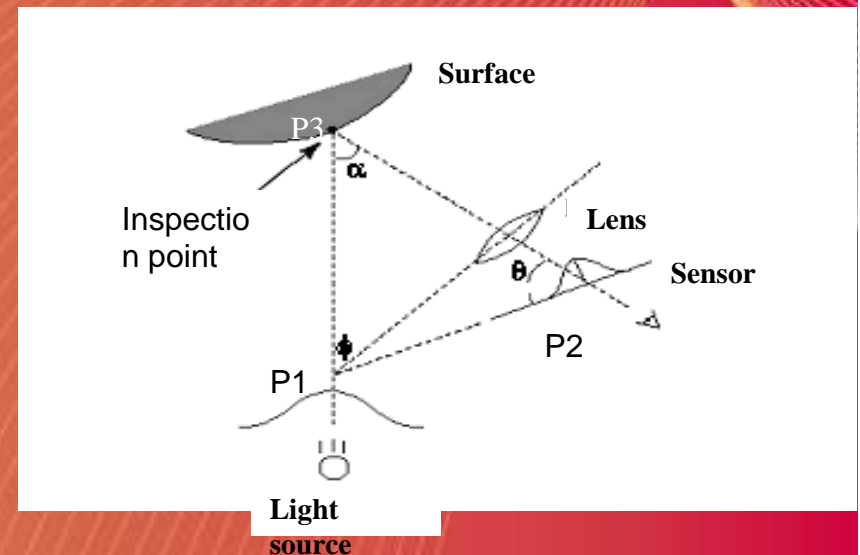
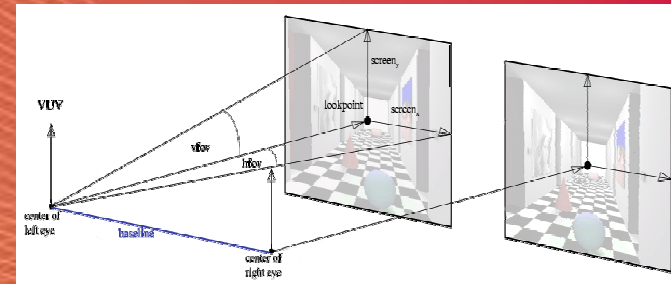
1.1 2D Vision systems. Software

- Threshold, conversion of grey levels to "object of interest" and "background"
- Focusing
- Measurement, calibration
- Subpixel
- Pattern search



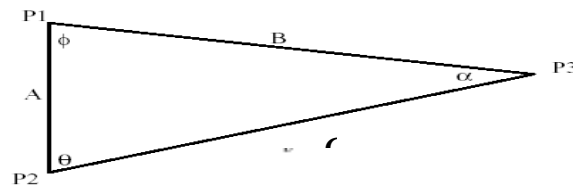
1.2 3D Vision systems

- Methods of **measurement and modelling** without NDT contact.
- Different techniques
 - Stereo vision
 - Time of flight
- Optical triangulation is a procedure for **obtaining three-dimensional information through optical methods without contact**. Provides large amounts of precise data at high speeds. Most common technique employed in industry

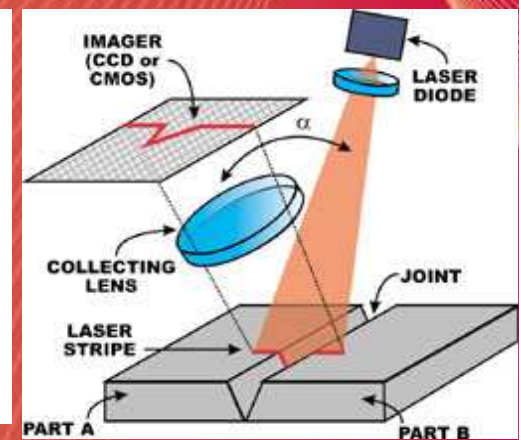
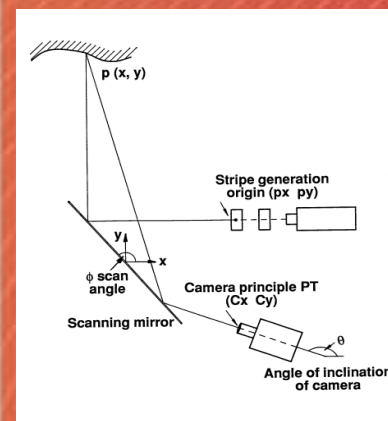
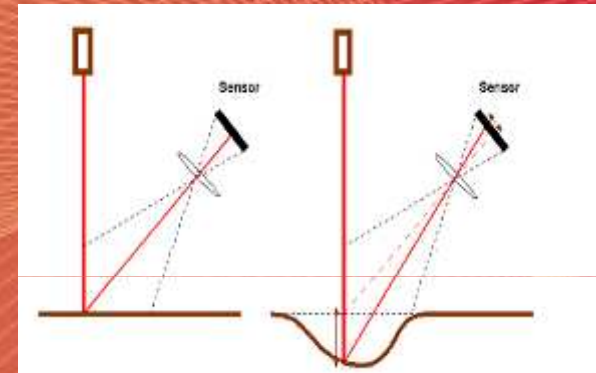


1.2 Optical Triangulation

- The triangulation principle is based on the **relation of angles and lengths** established in the triangle whose vertices are:
 - ▶ Origin of the illumination beam.
 - ▶ Point of inspection of the object.
 - ▶ Point of impact of the reflected beam in the detection sensor
- **Indirect method for obtaining 3D information.** The position of the reflected luminous beam measures the 3D information. This position depends on the observer - laser and object layout.
- Normally 1 1/2D or 2 1/2 D. Slice.



$$B = A \frac{\sin \theta}{\sin \alpha} = A \frac{\sin \theta}{\sin (\theta + \phi)}$$



2. Issues to take into account in machine vision systems design

- **Optical sensor:** Special designs. PSDs, CCDs and CMOS, mono- and bi-dimensional. Important: Speed of capture, maximum resolution of the sensor, sensibility.
- **Laser Illumination:** advantages monochrome, structured light, collimated and intense with relatively low powers. Important: Power, the aperture angle, uniformity of the distribution, the quality of the spot, wavelength and "speckle". Cylindrical lens / Scanner (rotating mirror)
- **Filters:** pass-band filters
- **Triangulation angle:** Greater angle, greater resolution but more occlusions
- **Motion elements:** precision and resolution must be as good as those of the sensor.
- **Calibration.** Relation between real space and measurement units. It must absorb optical distortions and aberrations. It is not trivial. It is usually based on error minimisation methods between real world coordinates– measured coordinates pairs.



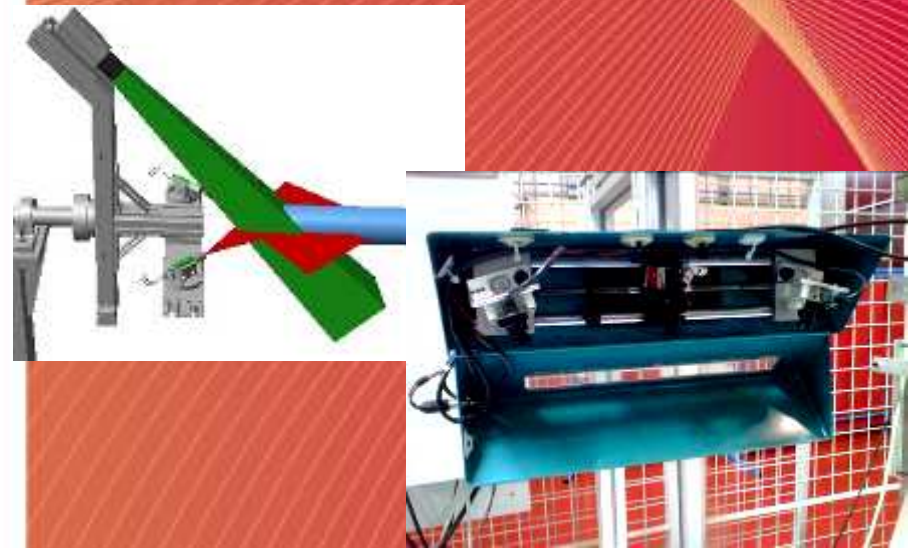
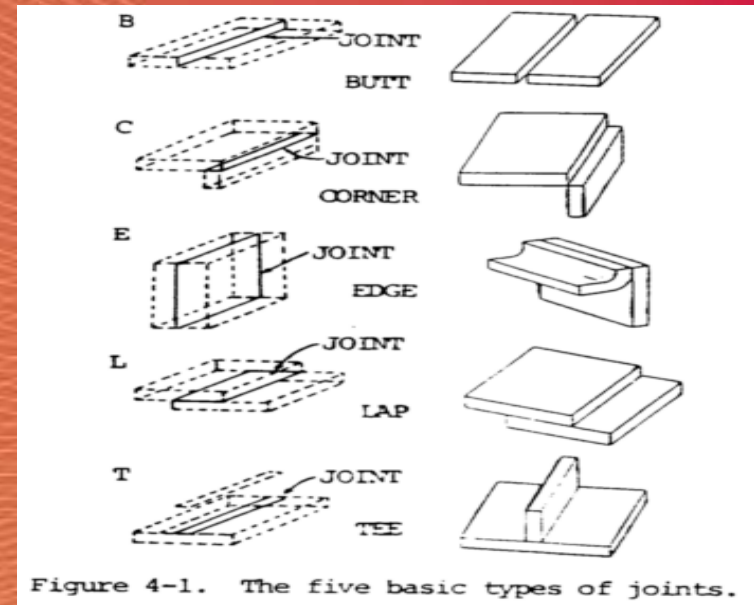
3. Machine vision application video samples

- [AEi High Power Laser Welding.mp4](#)
- [Perceptron Helix 3D Metrology Solution.mp4](#)
- [Barrido.avi](#)



4. Application to laser polymer part tracking and process control. Considerations:

- Shaded – Occluded zones. Dual sensor, dual illumination?
- Difficulties in perforations and exemptions.
- Surface Finishes. Reflective / absorption characteristics.
- Protection: temperature, dirt and electromagnetic noise



4. Application to laser polymer part tracking and process control: Usual Suppliers

- Software

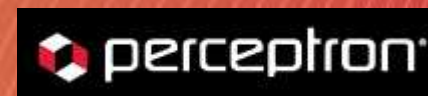
Tecnalia ;-), MVtec
Halcon, NI vision, Common
Vision Blox, Matlab

- Hardware








Sick-ivp, Dalsa, Jai, DCM
sistemas, imagingsource...

- Specialised:

Oxford sensor technology
Meta systems, servorobot,
perceptron...



5. Conclusions

- Characteristics of machine vision systems
 - Much greater repetition than with human control
 - Speed
 - In no case do they reach the flexibility of human vision
- Clichés
 - "Machine vision is artificial intelligence" 
 - "...These are lab applications, not real applications" 
 - "What has to be detected is more or less this ..." 
 - "If it can be seen at first glance, then it can be resolved via (machine) vision" 
 - "... With any light you are ready to go" 
 - "Let's configure at maximum sensitivity" 
 - "The system must detect all my defects" 
- Recommendations
 - Good input data, more robust solution and simpler software
 - "Never trust a pixel, never trust an image"

Thanks for your attention!

Any questions?

joseangel.gutierrez@tecnalia.com

www.tecnalia.com