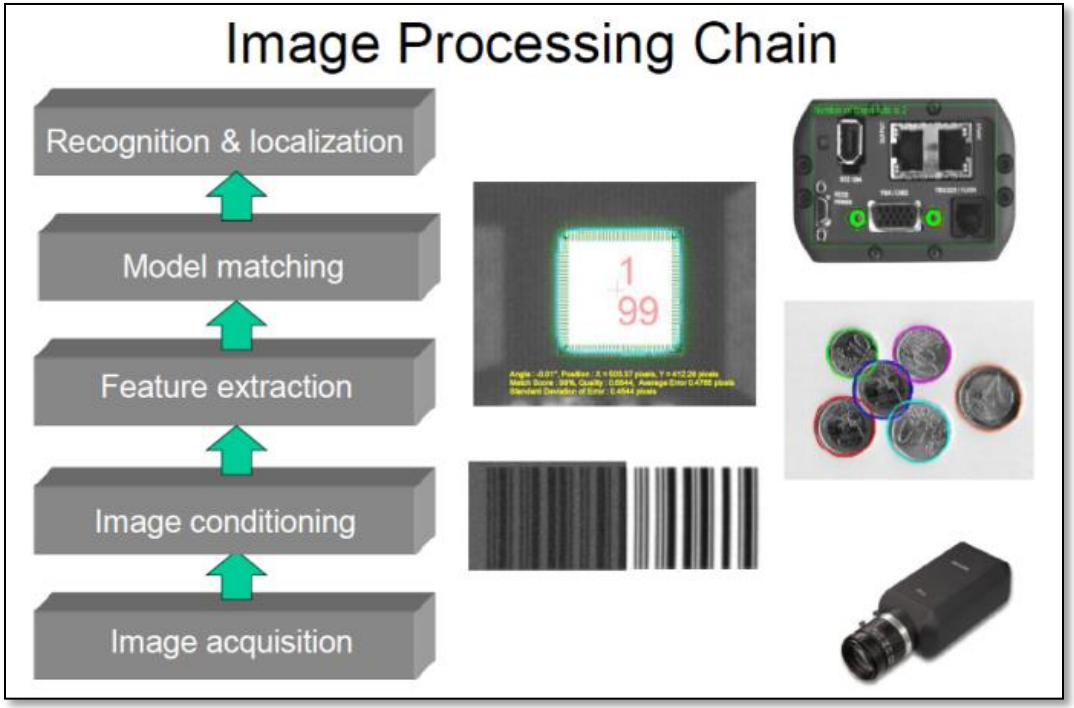
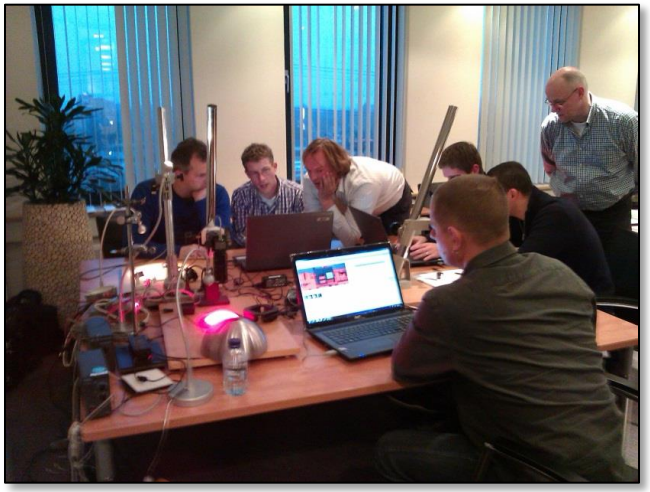
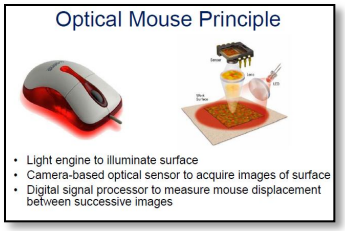
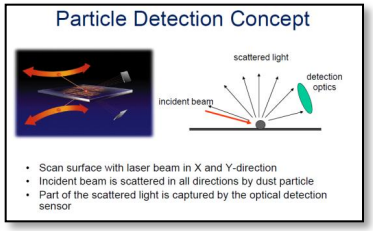
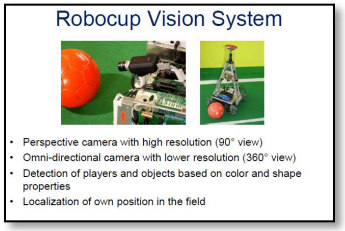
Machine Vision for Mechatronic Systems



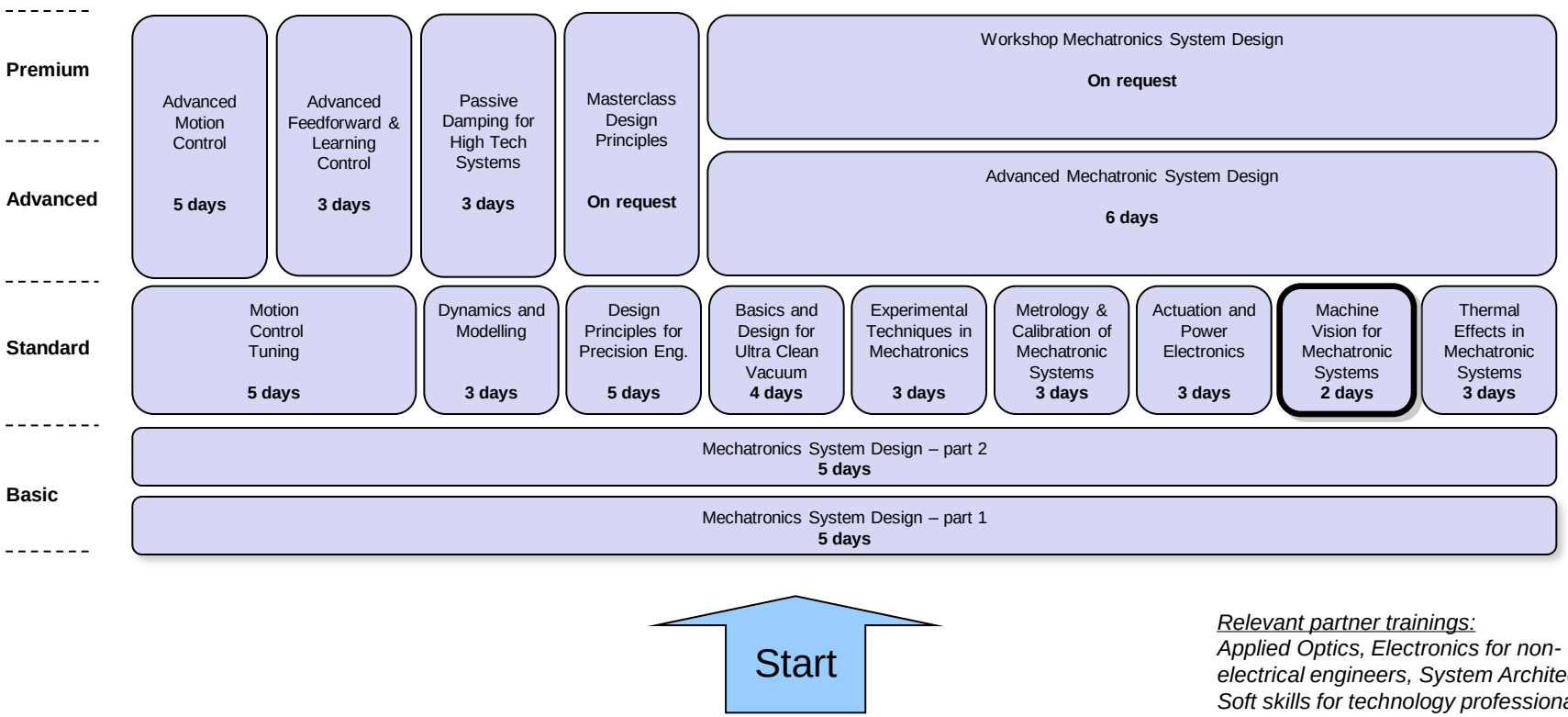








Mechatronics Training Curriculum



Relevant partner trainings:
Applied Optics, Electronics for non-electrical engineers, System Architecture, Soft skills for technology professionals, …

www.mechatronics-academy.nl

Mechatronics Academy

- In the past, many trainings were developed within Philips to train own staff, but the training center CTT stopped.
- **Mechatronics Academy B.V.** has been setup to provide continuity of the existing trainings and develop new trainings in the field of precision mechatronics. It is founded and run by:
  - Prof. Maarten Steinbuch
  - Prof. Jan van Eijk
  - Dr. Adrian Rankers
- We cooperate in the **High Tech Institute** consortium that provides sales, marketing and back office functions.

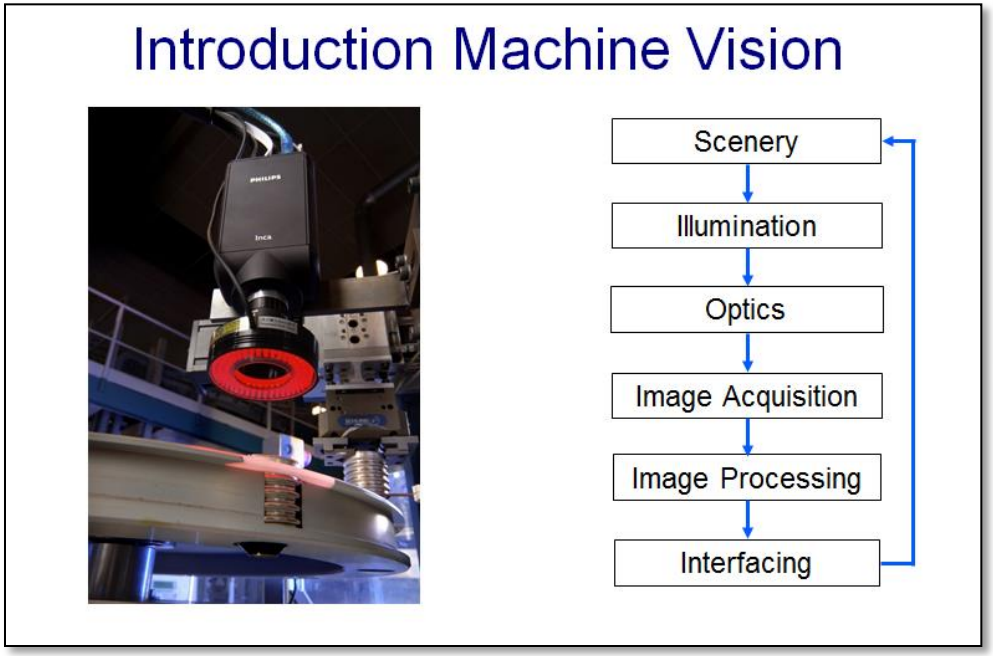
Machine Vision for Mechatronic Systems

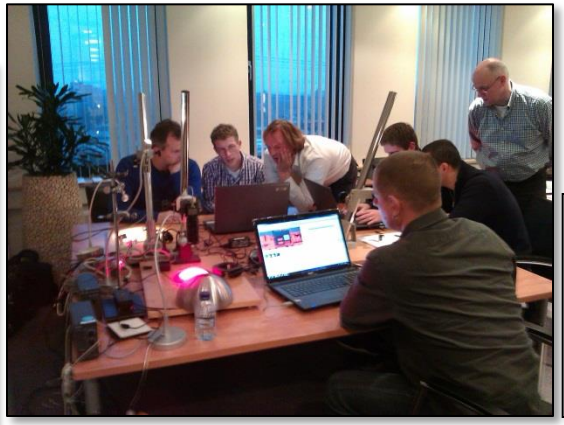
Trainers / Course Director(s)

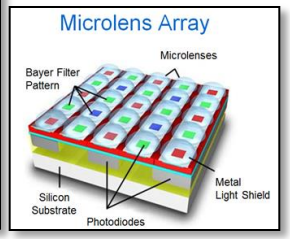
- Ir. Jef Horijon (Kulicke & Soffa)
- Ir. Harry Broers (Philips)
- Dr.ir. Adrian M. Rankers (Mechatronics Academy B.V.)

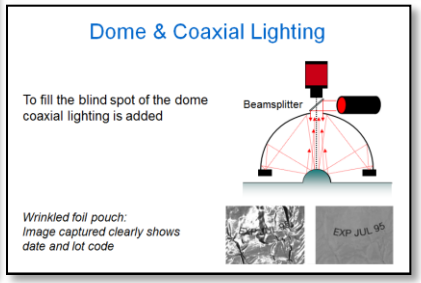
Day 1 (morning): Imaging

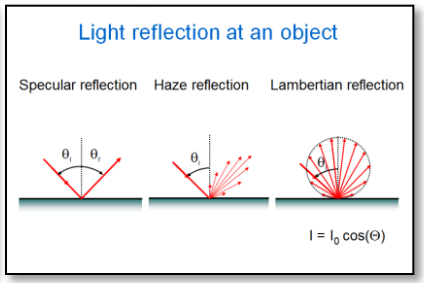
- Imaging Optics (lens laws, DOF, abberations, resolution, …)
- Illumination (set-ups, object reflection, spectral behaviour, …)
- Image sensors (CCD/CMOS, dynamic range, shutters, …)











Day 1 (afternoon): Image Processing

Image Processing Chain

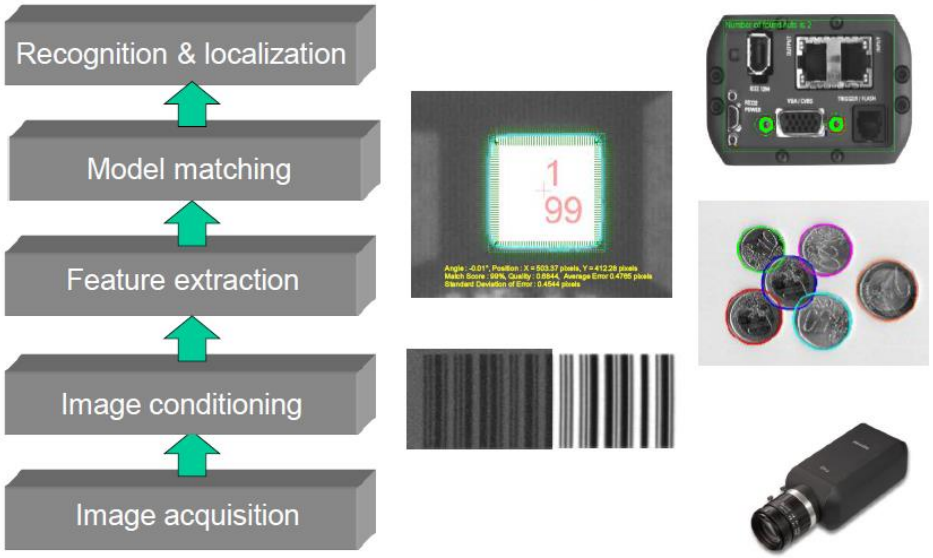
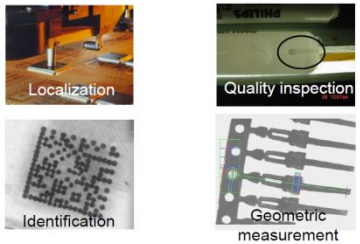
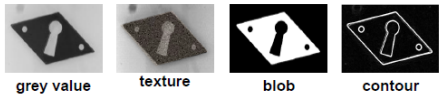


Image Processing Tasks



Basic Image Features

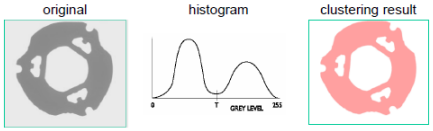


- Rich set of image features available
- Suitability of features depends on optical properties of objects and background

MVTec Halcon Vision Library

- Most extensive machine vision library on the market
- Application development with C, C++, C#, or Visual Basic
- Supports most operating systems and several platforms (multi-core, GPU, and embedded architectures)
- Supports many camera interfaces and suppliers
- Also available for many smart camera platforms

Blob Processing



- Binarization of images to separate objects from background
- Pixels are clustered based on connectivity into binary large objects (blobs)

Day 2 (morning): Vision System Design

- Processing Architectures
- Vision System Design
- Integration in Machine Design

Image Processing Hardware Architectures

- Camera Communication Interfaces
- Processing Hardware
- Smart Cameras


Processing Hardware


The Assembléon Case

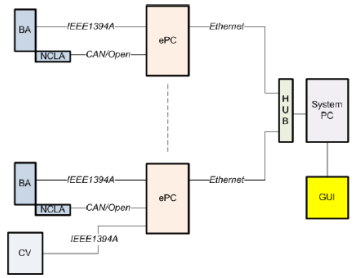
Assembleon designs and manufacturers pick and place systems for Electronics Assembly industry. The basic task of these systems is to accurately place electronic components on printed circuit boards (PCB). Next to, speed of placement is a dominant requirement, as SMT industry strives to ever lower cost per placement.


Key performance of Vision

- **Accuracy** of board measurement and component measurement are directly related to system accuracy
- **Speed/Output** is the most important system parameter for SMT equipment: it is the no. 1 selection criterium for most SMT customers
- **Robustness** of measurement is important for process quality. To yield lowest PPM and DPM numbers are very important selling arguments for Assembléon.
- **Cost** of Vision functions is important, as multiple cameras and processors are applied, due to the parallel placement concept.

Camera Communication Interfaces

Vision HW Architecture AX-3/AX-5



AX2 Isochronous Packets

With component align 3 cameras deliver simultaneously image data on the IEEE1394 bus. Bandwidth is divided over cameras:

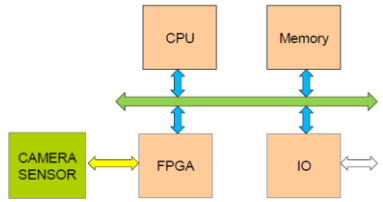
Camera	Bytes/packet	Max. image pixels	Image size kBytes	Transfer time
BA	1534	1024 x 768	768	64 ms
CA1	1700	1280 x 960	1200	91 ms
CA2	1700	1280 x 960	1200	91 ms
Total	4934			

BA alignment is performed first, next the first component to be placed, etc.

Note: most images are truncated, reducing transfer time

Smart Camera

A Smart Camera comprises all vision processing components:

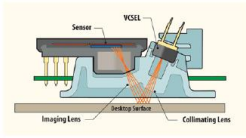


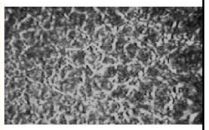
Day 2 (afternoon): Applications/Exercise

Optical Mouse Principle

- Light engine to illuminate surface
- Camera-based optical sensor to acquire images of surfac
- Digital signal processor to measure mouse displacement between successive images

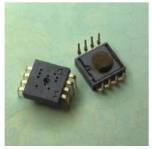
Laser Illumination

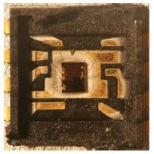




- The coherent laser light creates patterns of high contrast
- Laser source gives 20 times higher detail
- Laser good performance where LED-based optical mous has difficulties

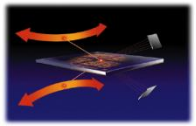
Optical Image Sensor

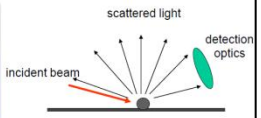




- Sensor with limited resolution (15x15 to 32x32)
- Frame rate can vary from 500 up to 6400 Hz
- High frame rate results in minimal displacement between successive images and enables tracking of fast movements

Particle Detection Concept



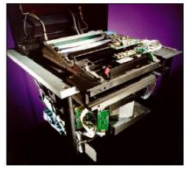


- Scan surface with laser beam in X and Y-direction
- Incident beam is scattered in all directions by dust particle
- Part of the scattered light is captured by the optical detection sensor

Specification

Reticle Z-position	± 0.5 mm
Mechanical free space	8 mm
Reticle glass (6 inch square)	to be scanned: 145 x 125 mm
Glass thickness	3.05 to 6.35 mm (= 0.12 to 0.25 Mil)
Pellicle frame thickness	2.5 to 5 mm
Min. detected particle diam.	10 micron (latex sphere equivalent)
Accuracy	± 3 µm for diameters 0 to 30 micron ±10% for diameters 20 to 100 micron
No false detection	> 10 micron
Particle location precision	< ± 0.5 mm in two directions
Inspection time	< 150 sec
Target repeat price	$ 25k including electronics

System Realization

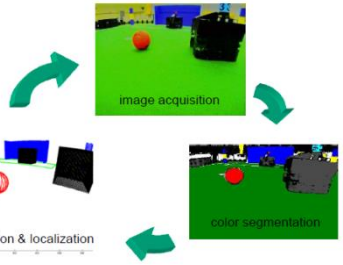


- Compact opto-mechatronic system
- Embedded vision solution with dedicated image processing and interfaces

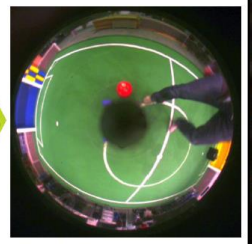
Robocup Vision System

- Perspective camera with high resolution (90° view)
- Omni-directional camera with lower resolution (360° view)
- Detection of players and objects based on color and shape properties
- Localization of own position in the field

Object Detection Principle



Omni-directional Camera



Sign-up for this training

Via the website of our partner

High Tech Institute