
PRACTICAL MACHINE VISION APPLICATIONS IN INDUSTRY



WHAT YOU WILL LEARN:

- The fundamentals of image processing and machine vision
- How to develop a simple machine vision system
- How to select cameras, lighting, frame grabbers and software
- How to assess resolution requirements
- Best practice in alignment and calibration procedures
- Identification and correction for sources of error
- Designing for harsh industrial applications
- Configuring of a machine vision system
- Selection of optimal lighting to achieve best contrast
- How to apply the best optics to achieve optimal resolution
- How to do a simple design for high-speed real time performance
- Troubleshooting simple machine vision problems

The Workshop

Machine vision has progressed in leaps and bounds since the disappointments in the eighties with tremendous results achievable today. Nowadays, machine vision systems are highly effective and a key part of many industrial systems ranging from mineral processing to manufacturing. The fundamentals of image processing and machine vision are covered in the beginning to give everyone a solid foundation to work from. The workshop commences with an examination of optics and lighting - as the experts say - machine vision is easy if you can get a good image into the system.

You will be shown how to select and design lighting to achieve the best contrast. The selection of cameras, frame grabbers and vision appliances are next covered in practical detail. Finally, you will be shown how to select and integrate all the varying components into a professional and working system.

The workshop will be presented with minimal use of mathematics and extensive use of practical concepts and applications. There will be extensive use of practical hands-on exercises ranging initially from illustrating the key concepts of image processing to setting up a complete working machine vision system. This experiential hands-on approach will ensure that you maximise your learning experience on this workshop.

However, despite the advances in technology don't expect your machine vision to have the versatility and brilliance of a human...yet. But if you apply the key concepts in this workshop to your machine vision application, you should have a reliable and effective solution.

Practical Sessions

- Fundamentals of image processing (five exercises)
- Lighting optimisation (one exercise)
- Camera set up
- Frame grabber set up
- Calibration
- Configuration of software program
- Troubleshooting of machine vision system
- Integration into complete system



The Program

INTRODUCTION

- Overview of workshop
- Systems approach to machine vision
- Machine vision vs image processing
- Human and computer vision
- Basics of image processing
- Pattern recognition
- Practical Fast Fourier Transforms
- Filtering
- Inverse filtering
- Seeing problem
- Colour properties and the eye
- Colour properties of image input and output devices

DIGITAL IMAGE PROCESSING BASICS

- Fast Fourier Transform
- Digital Fast Fourier Transform
- Sampling theory
- Aliasing
- Bits and pixels
- Trade-offs
- Demonstrations

MACHINE VISION SYSTEM COMPONENTS

- Lighting, filters and optics
- Image sensor (camera)
- Image processor and analysis (frame grabber, vision processor/computer, image analysis software and interpretation)
- Mechanical interface (part conveyor/feeder)
- An example of a machine vision system

LIGHTING

- Why is lighting critical?
- Lighting techniques
- Light sources
- Beyond visible spectrum-IR and UV radiation
- Laser light in machine vision
- Use of strobe lighting in machine vision
- Placement of sources
- Effect of stray and ambient light
- Enclosing the object to eliminate stray light
- Filters and their use
- Optical devices for image enhancement

CAMERAS AND SENSORS

- CMOS and CCD sensors
- CCD arrays
- Color vs monochrome applications
- Charge transfer device and charge injection device
- 3D sensing applications
- Sensor positioning
- Sensors for difficult environment
- Speed vs resolution
- Types of cameras
- Camera viewpoint
- Field of view
- Resolution evaluation
- Selection of a lens

IMAGE PROCESSING

- Real time processing
- Precision and accuracy
- Selection of frame grabber and vision appliance
- Frame grabbing
- Use of multiplexing
- IEEE 1394 'FireWire' serial bus standard interface
- Image processing for dummies
- Image analysis
 - Common algorithms
 - Enhancing the image
 - Blob analysis
 - Pattern matching
 - Optical character recognition
 - Read bar codes and data matrix
 - Perform measurements
 - Overlay graphics
- Basic approach of image representation and processing software applications
- Interactive image processing for system prototyping
- High speed vs real time approaches
- Selection of software packages

EXTERNAL INTERFACE

- Function of external interface
 - Input and output
- Object presentation
- Physical tolerances
- Handling special objects
 - Flexible, articulated and semi-fluid
- Actions after image processing
- Interfacing through Programmable Logic Interface
- Interfacing machine vision with industrial robots
- Industrial challenges - heat, cold, vibration and EMI/EMC issues

CONSTRUCTING A MACHINE VISION SYSTEM

- Selecting an application for machine vision implementation
 - Perceived value addition
 - Cost justification
 - Alteration in process line
- Building a system with off-the-shelf components
- Integration requirements
- Buying turn-key solutions
- Obsolescence and expandability issues
- Budgeting

TYPICAL APPLICATIONS

- Application profiles
- Component inspection
- Pharma applications
- Packaging applications
- Road inspection using vehicle mounted sensors
- 3D application examples