System Engineering and Automation Division

Universitas Miguel Hernández

INTRODUCTION

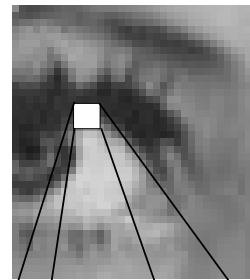fachhochschule
stralsund

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- Definition

- Digital Images

- Image projection

- Components in a Vision System

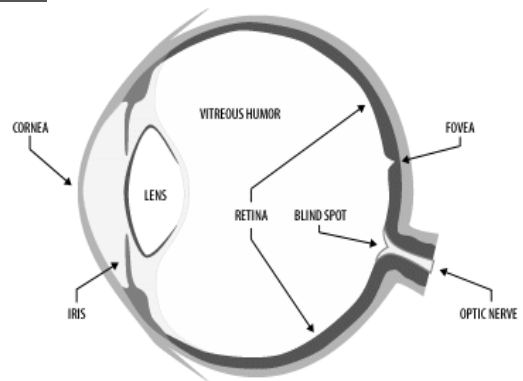- Human Vision vs. Computer

- Related fields and applications

Introduction

Computer Vision:

Computer vision aims at extracting
information from the 3D world by means
of a set of images and a computer

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A digital image is a 2D matrix of pixels (picture elements).

Each value stores its intensity.

47	54	77	64	70
68	72	80	78	65
100	104	110	90	101
135	124	120	138	112
165	170	165	163	160

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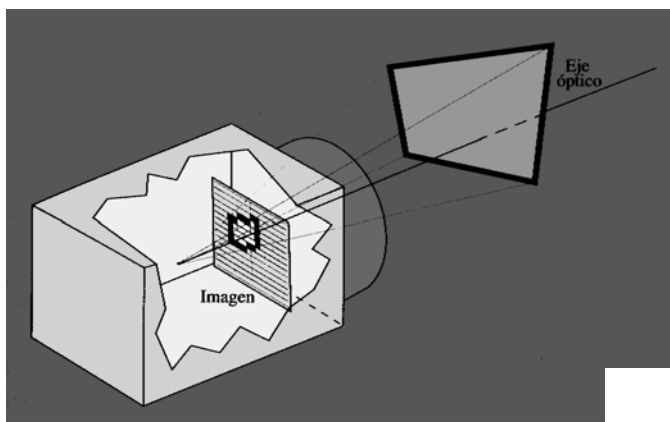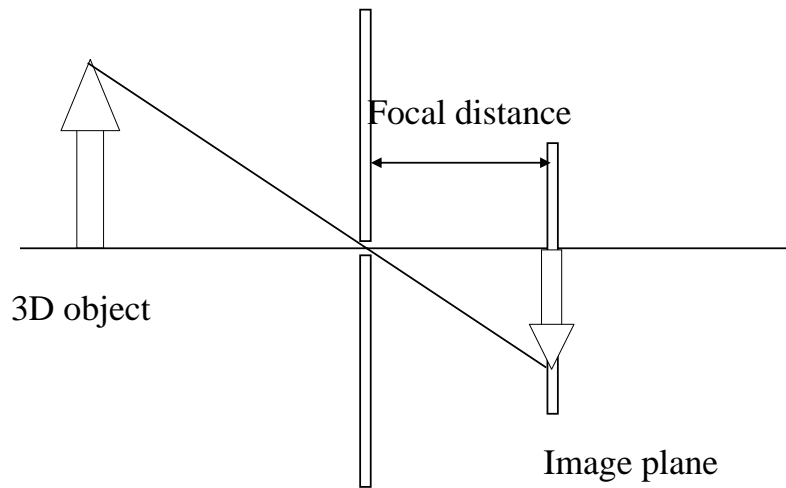- • Human Vision vs. Computer

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Introduction

Imagen

Eje óptico

CORNEA

VITREOUS HUMOR

FOVEA

LENS

RETINA   BLIND SPOT

IRIS

OPTIC NERVE

Introduction

Optics

- 'pin-hole' model
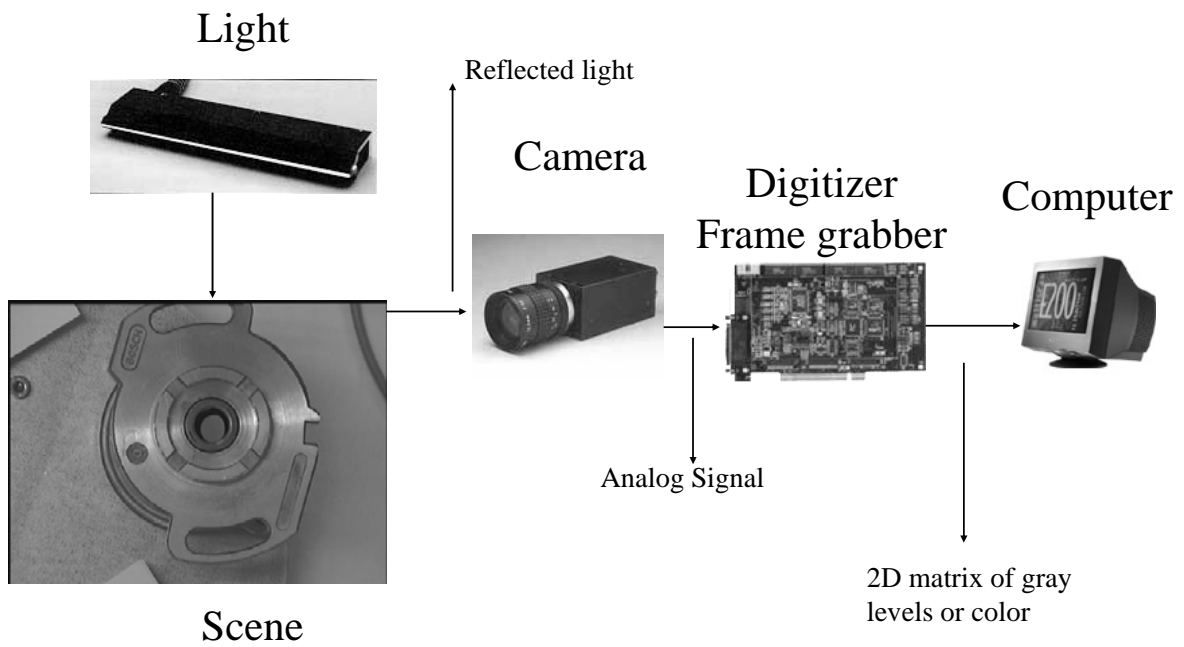
Focal distance

3D object

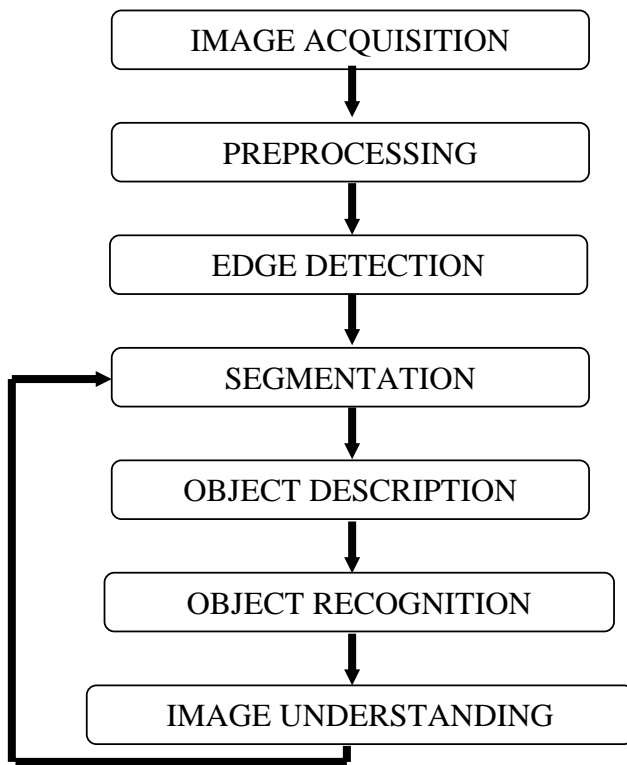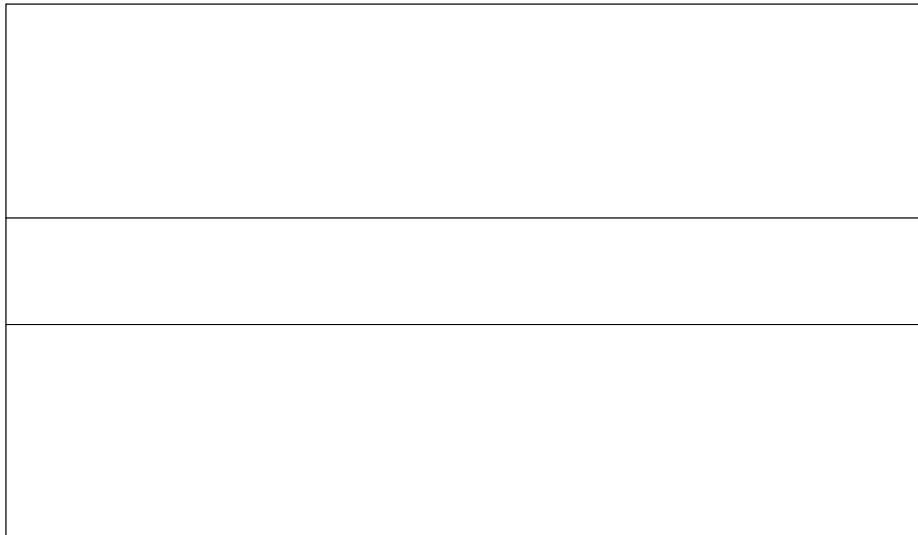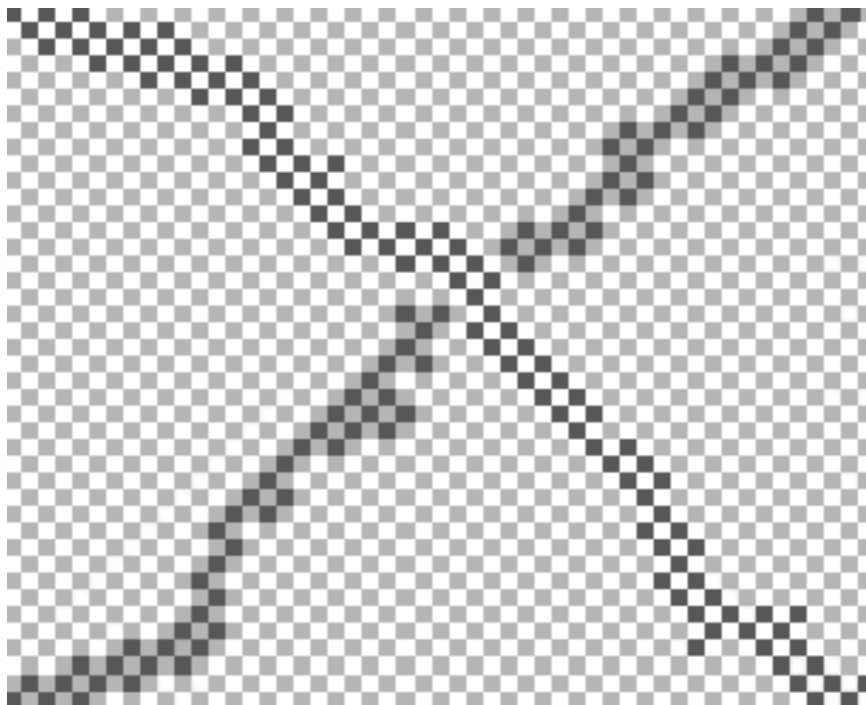Image plane

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Typical configuration

Light

Reflected light

Camera

Digitizer
Frame grabber

Computer

Analog Signal

2D matrix of gray
levels or color

Scene

Introduction

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        ┌─────────────────────────┐
        │    IMAGE ACQUISITION    │
        └─────────────────────────┘
                     │
                     ▼
        ┌─────────────────────────┐
        │      PREPROCESSING      │
        └─────────────────────────┘
                     │
                     ▼
        ┌─────────────────────────┐
        │     EDGE DETECTION      │
        └─────────────────────────┘
                     │
                     ▼
        ┌─────────────────────────┐
   ┌───▶│      SEGMENTATION       │
   │    └─────────────────────────┘
   │                 │
   │                 ▼
   │    ┌─────────────────────────┐
   │    │   OBJECT DESCRIPTION    │
   │    └─────────────────────────┘
   │                 │
   │                 ▼
   │    ┌─────────────────────────┐
   │    │   OBJECT RECOGNITION    │
   │    └─────────────────────────┘
   │                 │
   │                 ▼
   │    ┌─────────────────────────┐
   │    │   IMAGE UNDERSTANDING   │
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   │                 │
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- General comparison
  - Human Vision System
    - Better recognition skills
    - It is able to respond to unexpected situations
    - It uses prior knowledge
    - Natural learning capability.
  - Computer Vision Systems
    - They are able to measure physical magnitudes (distance, intensity, color…)
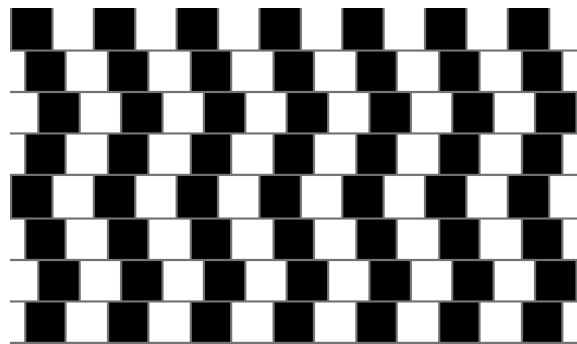   - Can easily work without fatigue in routinary chores.

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- We have difficulties in measuring intensities
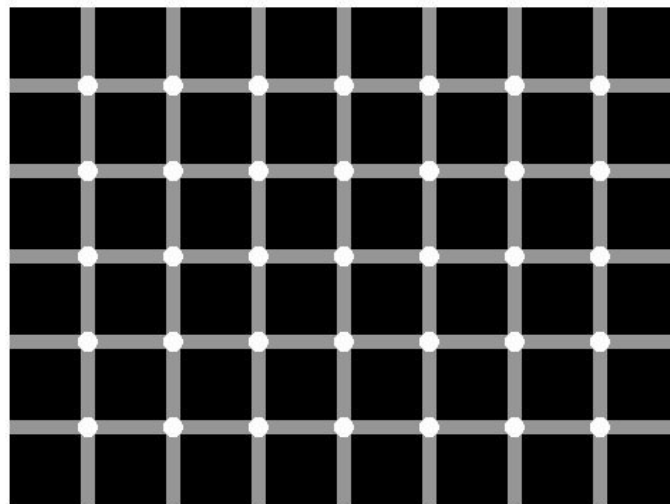
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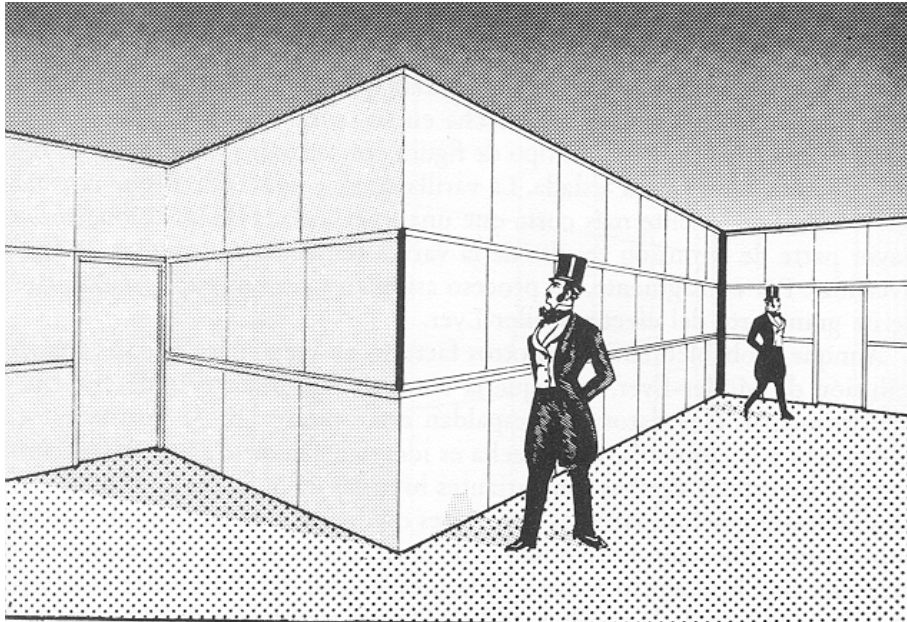- Difficult to measure geometric relations

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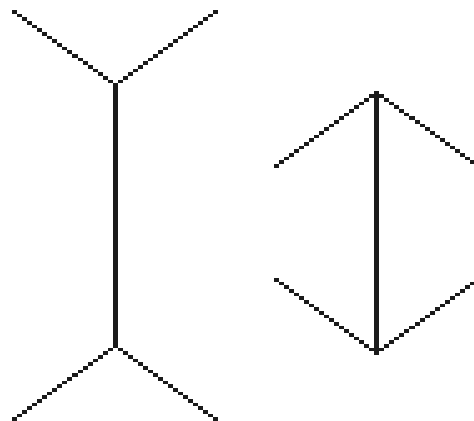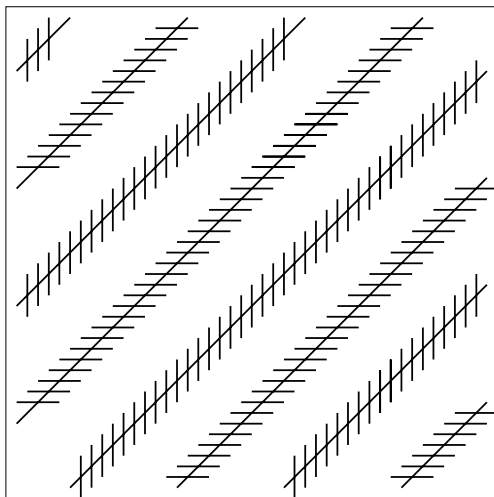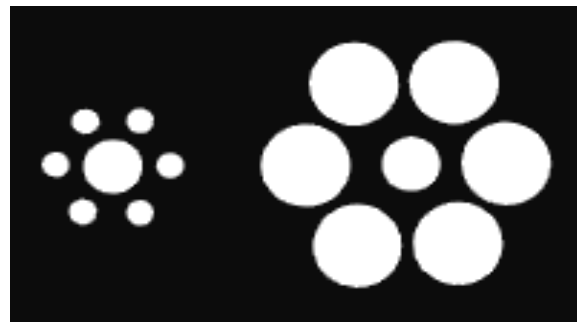
- Illusory optical effects

- Influence of near objects
  - Müller-Lyer illusion

- Ponzo illusion

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- Complex information recognition
  - How??

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Related fields

- Image processing:
  - How to transform an image to obtain a better one which can be easily interpreted.
- Pattern recognition:
  - How to classify a set of patterns (examples) to a set of classes.
- Computer graphics:
  - How to represent the real world and project it to a 2D image (the opposite problem of computer vision).
- Mobile robotics:
  - Aims at extracting information from the environment using cameras in order to navigate.

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- Industrial production:
  - Can substitute human worker:
    - Important to avoid human presence in dangerous environments:
      - Thermic, nuclear, high loud,...
    - Can increase the capacity of inspection (i.e. little details).
    - Make production cheaper.
    - Can be integrated into an automated system.
    - Subjective criteria are eliminated:
      - Rutinary chores (fatigue).
      - Different workers can have different criteria.

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- Restrictions to the applications in industrial environments:
  - Systems cannot adapt to unforeseen situations.
    - It will fail in case of an unpredicted situation.
  - Sometimes, we can easily use another method to estimate a measure. E.g. using a laser to extract a dimension.

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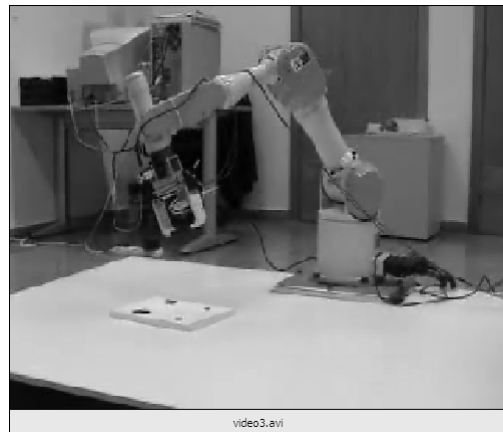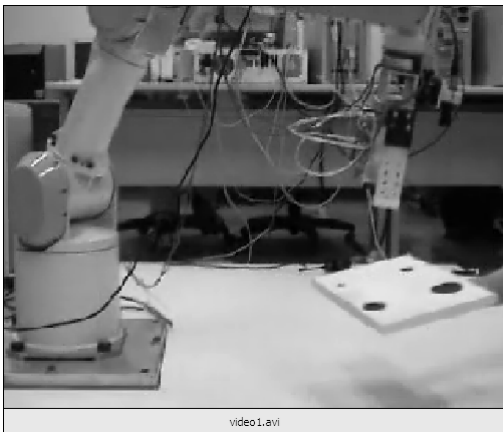• Details difficult to detect by a human inspector.
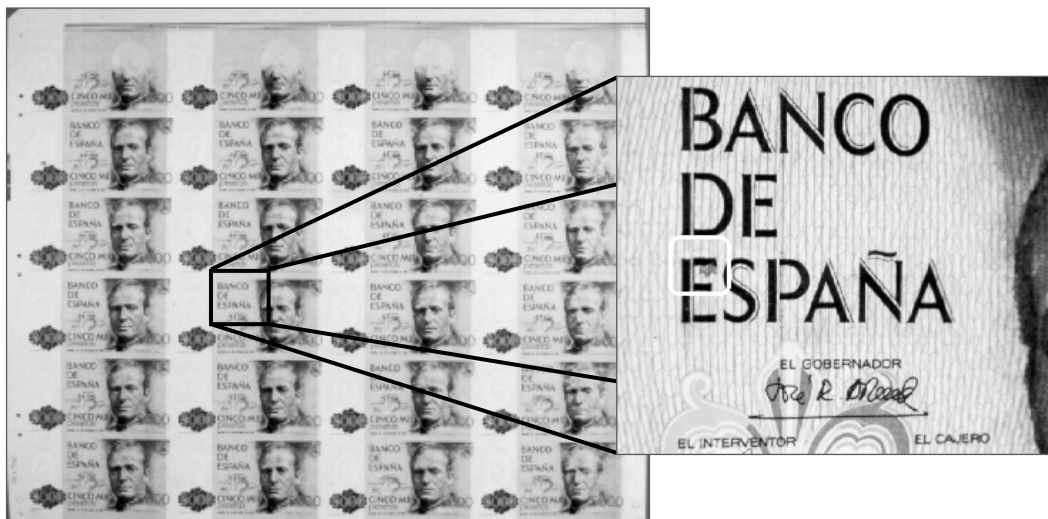
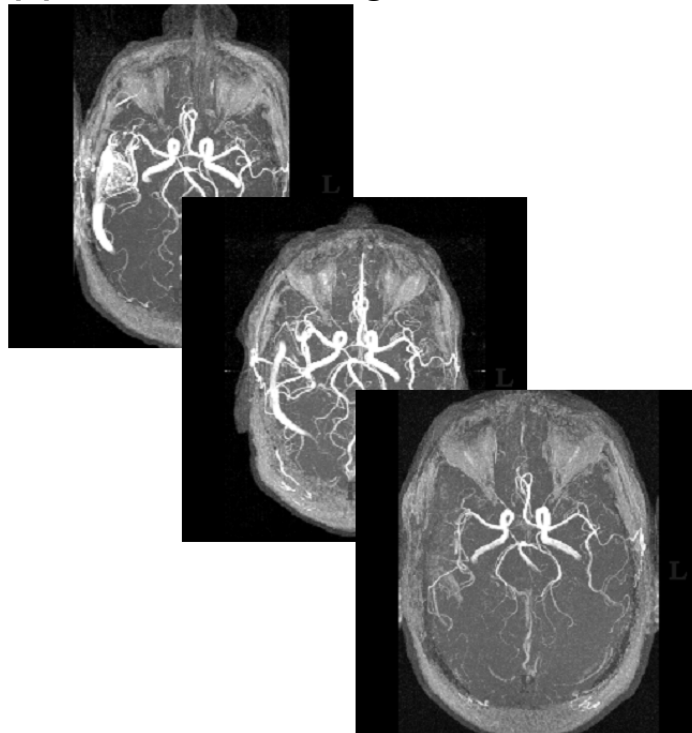- Quality control. Back illumination.
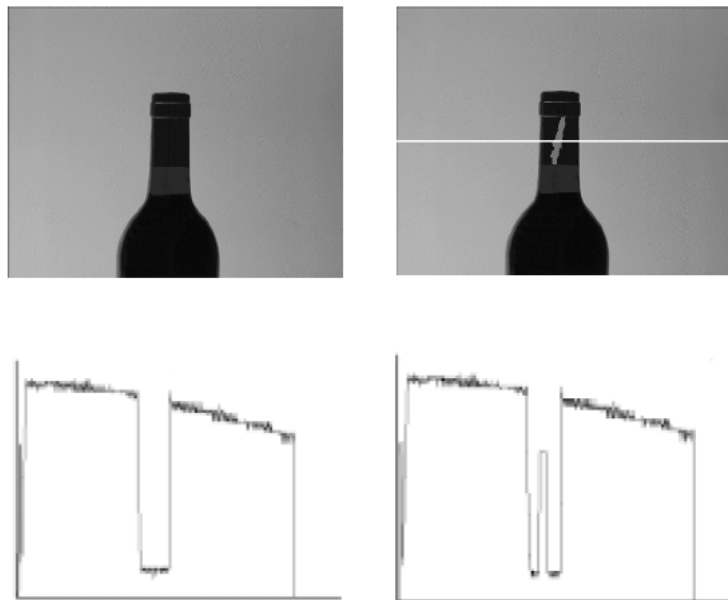
- Color produces a better perception and less fatigue.
- Color information is added in relation to brightness and texture.

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- Robot guidance. Parts insertion.

video1.avi

video3.avi

Introduction

- Medical applications. Image enhancement.

Introduction

- ## Face recognition.

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- Mobile robot navigation.

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