1. Introduction

1.1 Machine Vision

Model of the real world from images
3D information to 2D projection
Recovering 3D information needs many to one mapping

Applications; medical images – diagnosis
measurement of a area
quality control
mobile robot guide – road map : stereo pair , 3D range
satellite image analysis – forcasting, global change

1.2 Relationships to other fields

Image processing; transform image to another image, used in early stage
Computer graphics; synthesis of image, machine vision is the analysis of image
Pattern recognition; important role in machine vision
Artificial intelligence; perception, cognition, action
Psychophysics; human vision

vision = geometry + measurement + interpretation

1.3 Role of Knowledge

Maximize automatic operation at each stage

1.4 Hardware

Camera;

Vidicon, CCD

CCD(Charge Coupled Device):

γ parameter

$$\gamma = \log(I/I_w)/\log(E/E_w)$$

I_w ; signal reference , E_w ; illumination reference

RS-170 Standard Specification

RS-170 Composite Video Signal

Frame
Field
2:1 Interlace
Non-Interlace

Cemera system connection;

Image Processing Board
Frame Grabber

synchronization
A/D Converter
Look Up Table
Memory
Processor; ALU, DSP

1.4 Image Geometry

(1) Geometry of image formation
(2) Physics of light; brightness to illumination/surface property

pin hole camera

line of sight; point of interest to the center of projection
image plane; focal length behind projection center

1.4.1 Perspective Projection

$$x' = \frac{f}{z} x$$
$$y' = \frac{f}{z} y$$

1.4.2 Coordinate System

World Coordinate ; (x_w, y_w, z_w)
Camera Coordinate; (x_c, y_c, z_c)

1.5 Sampling and Quantization

Sampling; spatial digitization
Quantization ; gray level digititzation -> gray level
pixel; one sample point

1.6 Image definitions

assume; origin of image plane coord. = center of array
for mXn image

$$x = j - \frac{m-1}{2}$$
$$y = -(i - \frac{n-1}{2})$$

assume; image pixel is square
center of pixel

calibration; different x- y- spaceing
lens distortion
camera mechanical error ; CCD align, lens align etc.

1.7 Levels of Computation

input ; image
output ; symbolic quantities-location, identy

1.7.1 Point level

$$f_B[i,j] = O_{point}\ \{f_A[i,j]\}$$

1.7.2 Local level

$$f_B[i,j] = O_{local}\ \{f_A[i_k,j_l];[i_k,j_l] \in N[i,j]\}$$

1.7.3 Global level

$$P = O_{global}\ \{f[i,j]\}$$

1.7.4 Object level

catch-22
figure-ground probelm; forground from background