EECS 442

Computer Vision

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Contents

Abstract

Computational methods for the recovery, representation and application of visual information. Topics from image formation, binary images, digital geometry, similarity and dissimilarity detection, matching, curve and surface fitting, constraint propagation relaxation labeling, stereo, shading texture, object representation and recognition, dynamic scene analysis and knowledge based techniques. Hardware, software techniques.

1 Stanford Notes - CS 131

1.1 Pixels, Feature, and Cameras

Pixels and Filters

- An image contains a discrete number of pixels
- An image is a function $\mathbb{R}^2 \to \mathbb{R}^M$
- $f(x, y)$ gives the intensity at position (x, y)
- **Filtering**: forming a new image whose pixels are a combination of the original image's pixel values
- We filter to modify or enhance image properties (super-resolution, in-painting, de-noising)
- **2D Discrete-Space Systems (Filters)**

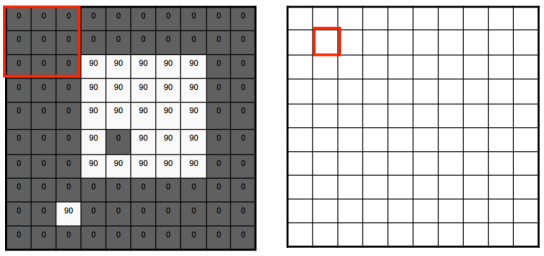
$$f(n, m) \to \text{System } \mathcal{S} \to g(n, m)$$

$$g = \mathcal{S}(f),\ g(n, m) = \mathcal{S}\{f(n, m)\}$$

$$f(n, m) \xrightarrow{\mathcal{S}} g(n, m)$$

- **Moving average**: create a series of averages of different subsets of the full data set
- An example of a filter is the moving average where you take the average over a 3×3 subset of pixels

$$g(n, m) = \frac{1}{9} \sum_{k=n-1}^{n+1} \sum_{l=m-1}^{m+1} f(k, l)$$



- Another simple filter is segmenting an image based on a threshold of pixel intensity

$$g(n, m) = \begin{cases} 255, & f(n, m) > 100 \\ 0, & \text{otherise} \end{cases}$$

- This threshold will seperate pixels whose intensities are greater than 100 into two categories: black (255), or white (0).
- There are many ways to classify systems:
  - Amplitude properties
    - Linearity
    - Stability
    - Invertibility
  - Spatial properties
    - Causality
    - Separability
    - Memory
    - Shift invariance
    - Rotation invariance

1.2 Regions of Images, and Segmentation

1.3 Recognizing Faces and Objects