2A - L1 images as functions

1. 2017/11/02 15:21
2. Sum

a. one image is a function

b. manipulation of the image through the matrix

i. add, multiply, subtract, blend, crop

c. display the image

i. imshow, plot

d. Octave/matlab functions

i. imread, imshow, hist,

e. noise

i. Gaussian noise

ii. sigma

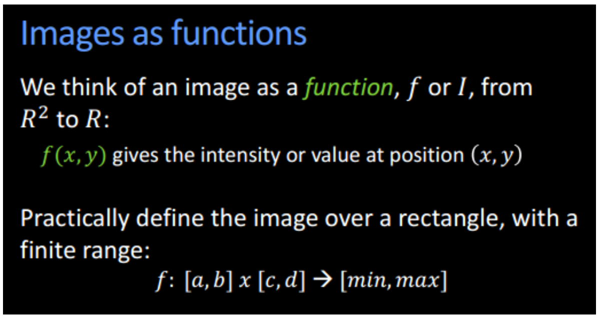
3. Images as Functions - mathematical view

a. One image can be regarded as a function. I(x, y), the value of the light intensity

i. can be shown in matlab

ii. function - grey scaled

1. mapping: R x R → R
2. f: [a, b] x [c, d] → [min, max]
3. each (x,y) corresponding to a value i



Images as functions

We think of an image as a *function*, f or I, from R^2 to R:

$f(x,y)$ gives the intensity or value at position (x,y)

Practically define the image over a rectangle, with a finite range:

$f\colon [a,b] \ x \ [c,d] \rightarrow [min, max]$

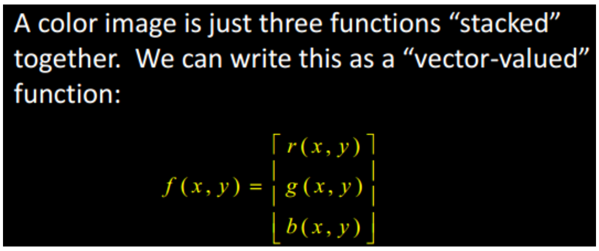
b. function - colored

i. mapping: R x R → R x R x R

ii. f: [a, b] x [c, d] → [min, max] x [min, max] x [min, max]

iii. each (x,y) corresponding to a vector (r, g, b)

iv. each channel can be taken out alone as a r/g/b plane to be processed



A color image is just three functions "stacked" together. We can write this as a "vector-valued" function:

$$f(x,y)=\begin{bmatrix} r(x,y) \\ g(x,y) \\ b(x,y) \end{bmatrix}$$

c. #we do in grey scale images, it's easier cuz it only has one channel

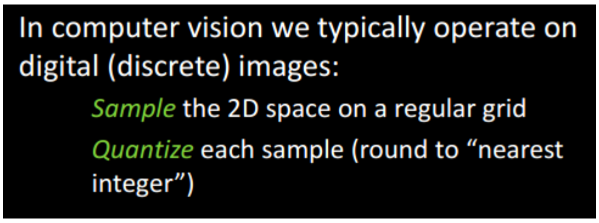
i.

1. Digital Images

    a. It's the discrete-valued image. so we require two discretions: Sample and Quantize

        i. ATT: when computing, regard the value as floating point

        ii. # pixel : an image element



In computer vision we typically operate on digital (discrete) images:

Sample the 2D space on a regular grid

Quantize each sample (round to "nearest integer")

    b. Image thus represented as a **matrix** of integer values.

        i. matlab typically with interger values

        ii. index

            1. x, y used in math, x is along the column, y is along the row

            2. i, j used in computation, i is along the row, j is along the column

        iii. 1 D signals are just represented as vectors

1. Quiz: Compute Image Size Quiz

    a. image size = #row x #column x #channel #value size

2. Matlab Images are Matrices

    a. Matlab Images are Matrices, (r, c, rgb), so that you can manipulate them as matrices.

3. Load and Display an Image

    a. imread('xx.xxx')

4. Quiz: Image Size and Data Type Quiz

a. size

    i. size()

b. class type

    i. e.g. uint8

        1. u: unsigned means only non-negative value
        2. int: integer
        3. 8: 8 bits, 1 byte
        4.

5. Inspect Image Values
    a. as to access matrix
        i. but to show a row/column, better to use plot(img(1,:))
6. Crop an Image
    a. to take a big part of the image
    b. for index, both the start and end row/column are included
7. Color Planes
    a. im images, bright area represents higher values, while dark area represents lower values.
8. Add 2 Images Demo
    a. img [0, 255], when the value exceeds, round to 255;
    b. Octave rounds the value to the nearest integer for uint8, 1.5 => 2
    c. add
    d. average: /2 => +; not + => /2
9. Multiply by a Scalar Demo
10. Quiz: Blend 2 Images
    a. Rule: keep the sum of the weights equal to 1; the bigger the weight, the more the effect of this image.
11. Common Types of Noise
    a. η(x,y)
    b. salt and pepper noise: random occurrences of black and white pixels
    c. Impulse noise: random occurrences of white pixels
    d. Gaussian noise -- most common
        i. variations in intensity drawn from a Gaussian normal distribution
        ii. rand(size(img)) .* sigma

        1. zero mean, sigma standard deviation

    iii. imgnew = img + noise

12. Image Difference Demo

    a. directly substract may lose some values, since unit8 is [0,255];

    b. so use imabsdiff(a,b) - order doesn't matter

13. Generate Gaussian Noise

    a. e.g.

        i. noise = randn(1,10000);

        ii. noise2 = noise .* 2;

        iii. std(noise)

        iv. % noise2 has doubled standard deviation of noise

        v. because the GD represents the distribution the number of values in certain bin rather than the values themselves.

    b. when add the noise to certain signal, what should be the concern is the noise magnitude compared to image magnitude. that's the effect of the sigma

14. Displaying Images in Matlab

    a. determine how to show the image

        i. imshow(im)

            1. original range

        ii. imshow(im, [low, high])

            1. rescaled, low represents the darkest black, high represents the whitest white

        iii. imshow(im, [])

            1. rescaled, low is the min, high is the max in the original image

    b. ATT

        i. only the display may require rescale, never the computation

15.