

KEY POINTS

1-IMAGE FORMATION AND SENSING:

Sensor: a device to measure a signal which can be converted into a digital image

Electromagnetic spectrum: electromagnetic signals which, at various wavelengths, consists of gamma rays, x-rays, ultraviolet light, visible light, infrared, microwaves, and radio waves, and can be measured by sensors to produce images

Photon: massless particles which correspond to the minimum amount of energy, the quantum, which can be measured in the electromagnetic signal

Range image: created by radar, sonar, or lasers to produce an image which depicts distance as brightness

Image formation: two key components: (1) where will the image point appear, the row and column coordinates and (2) what value will be assigned to that point, the brightness value

Optics: the physics of light and the study of lenses, required to determine where an image point appears

Reflectance function: defines how an object reflects light

Irradiance: the amount of light energy falling on a surface, measured by a sensor to create an image

Radiance: the amount of light energy emitted, or reflected, from an object into a solid unit angle.

Imaging outside of visible: electromagnetic (*EM*) *spectrum*: used in medicine, astronomy, microscopy, satellite imaging, military, law enforcement, and industrial applications

Thermographic imaging: infrared imaging as a diagnostic aid for medical professionals, an active research area, it is believed thermographic patterns can be used in the diagnosis of various pathologies (diseases) in both animals and humans

Acoustic imaging: measures reflected sound waves, applications in medicine, military, geology, and manufacturing

Electron imaging: using a focused beam of electrons to magnify up to about ten million times

Laser imaging: used to create range images

CVIPtools: a comprehensive computer vision and image processing (CVIP) software package to allow for the exploration of image processing and analysis functions, including algorithm development for applications.

2-IMAGE REPRESENTATION & COLOR IMAGE PROCESSING:

Optical image: a collection of spatially distributed light energy to be measured by an image sensor to generate $I(r,c)$

Binary image: a simple image type that can take on two values, typically black and white, or '0' and '1'

Grayscale image: monochrome or "one color" image that contains only brightness information, no color information, it is a one band image

Color image: modeled as a three-band monochrome image; the three bands are typically red, green, and blue (RGB)

Color pixel vector: a single pixel's values for a color image (R,G,B)

Color transform/color model: a mathematical method or algorithm to map RGB data into another color space, typically to decouple brightness and color information

HSL (Hue/Saturation/Lightness): a color transform that describes colors in terms that we can easily relate to the human visual system's perception, where *hue* is the "color," for example, red or yellow, *saturation* is the amount of white in the color, and *lightness* is the brightness

HSV (Hue/Saturation/Value): similar to HSL, but *value* is the maximum of (R,G,B)

HSI (Hue/Saturation/Intensity): similar to HSL, but *intensity* is average of (R,G,B).

Chromaticity coordinates: normalizes RGB values to the sum of all three

CIE L*u*v*/CIE L*a*b*: perceptually uniform color spaces defined by the Commission Internationale de l'Eclairage (CIE or International Commission on Illumination), the international standards group for color science

CMY (Cyan, Magenta, Yellow)/CMYK: color transforms based on a subtractive model, used for color printing; K is added as a separate ink for black.

PCT (Principal Components Transform): decorrelates RGB data by finding a linear transform using statistical methods to align the coordinate axes along the path of maximal variance in the data (see Figure 4.3-9)

Multispectral image: images of many bands containing information outside of the visible spectrum.

3-DIGITAL IMAGE FILE FORMATS:

Bitmap images: images we can represent by our model, $I(r,c)$, also called raster images

Vector images: artificially generated images by storing only mathematical descriptions of geometric shapes using *Key Points*

Rendering: the process of turning a vector image into a bitmap image

Image file header: a set of parameters normally found at the start of the image file and must contain information regarding: (1) the number of rows (height), (2) the number of columns (width), (3) the number of bands, (4) the number of bits per pixel, and (5) the file type; additional information may be included

Common image file formats: BIN, PPM, PBM, PGM, BMP, JPEG, JPEG2000, TIFF, GIF, RAS, SGI, PNG, PICT, PDF, EPS, and VIP

LUT: look-up table, used for storing RGB values for 8-bit color images

References:

1-Digital Image Processing and Analysis: Application with MATLAB and CVIPtools, 3rd Edition, SE Umbaugh, Taylor&Francis/CRC Press, 2018.