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FACULTY OF EGINEERING

Digital Image Processing
LECTURE-22

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OUTLINE

- IMAGE RESTORATION
- Degradation Model
- Models of Blur
- Defocus Blur
- Motion blur
- Blurring with Holes
- Flutter Shutter Camera
- MCQ
- References

IMAGE RESTORATION

•Restoring an image from the noise.

•What way it is different from the image enhancement technique , which are used for the noise removal.

•More complex and mathematical than enhancement

Image restoration = task of recovering an image from its degraded version assuming some knowledge of the degradation phenomenon.

• Models the degradation process and inverts it to obtain the original from the degraded (observed) image.

• Differs from image enhancement – which does not fully account for the nature of the degradation.

Degradation Model

Many real-world phenomena can be approximated as linear and space-invariant.

• Non-linear and space-variant models are more accurate, more general but more complex.

• Even with the simplifying assumption of linearity and space-invariance, we will see that inverting the degradation model has many challenges.

Models of Blur

•In image restoration, the most commonly encountered problem is that of blur removal given a known blur model.

• An image is said to be blurred when it is convolved with a low-pass filter of a certain kind.

- •Defocus blur
- • Motion Blur

Defocus Blur

Occurs when the scene being observed is not in focus. It is actually spatially variant dependent on the depth of each point (i.e. its distance from the camera), but we will model it here as spatially uniform for simplicity.

Motion blur

•A commonly occurring form of blur – when there is relative motion between the camera and the object/scene being imaged – during the process of image acquisition.

Motion Blur

A camera gathers the image of a scene as follows:

• Light from the scene enters the camera during the exposure time, i.e. when the shutter is open.

• The light passes through the lens and hits a sensor array (CCD array)

• The CCD array performs an integration operation during the entire exposure time.

• The image is formed on the CCD array after the shutter closes.

•Imagine an object undergoing motion parallel to the plane of the camera sensor array.

•Let the motion be translation (for simplicity) given by x0 (t) and y0 (t), i.e. the motion is a function of time.

• Let f(x,y) be the intensity at point (x,y) of the true (underlying) image.

Blurring with Holes

Let us say we put in a cardboard piece with holes inside the camera aperture.

• The defocus blur can no more approximated as a Gaussian function.

• Rather, the blur kernel is now represented as a Gaussian dot-multiplied with a binary pattern (with values of 1

– wherever there was a hole and a 0 wherever there was no hole).

Flutter Shutter Camera

The same principle is used in the flutter shutter camera to deal with motion blur.

• The shutter of a normal camera is usually open throughout the exposure duration (denoted by T in the derivation for motion blur).

• This is equivalent to convolution with a temporal box filter (a low-pass filter).

• In a flutter-shutter camera, the shutter is made to flutter (open and close) during the exposure time - as per a randomly generated binary sequence.

MCQ

1. Electromagnetic waves can be visualised as a
   a) sine wave
   b) cosine wave
   c) tangential wave
   d) None of the mentioned

2. How is radiance measured?
   a) lumens
   b) watts
   c) armstrong
   d) hertz

3. Which of the following is used for chest and dental scans?
   a) Hard X-Rays
   b) Soft X-Rays
   c) Radio waves
   d) Infrared Rays

MCQ

4. Which of the following is impractical to measure?

a) Frequency

b) Radiance

c) Luminance

d) Brightness

5. Massless particle containing a certain amount of energy is called

a) Photon

b) Shell

c) Electron

d) None of the mentioned

References

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