00:24

Digital Image Processing

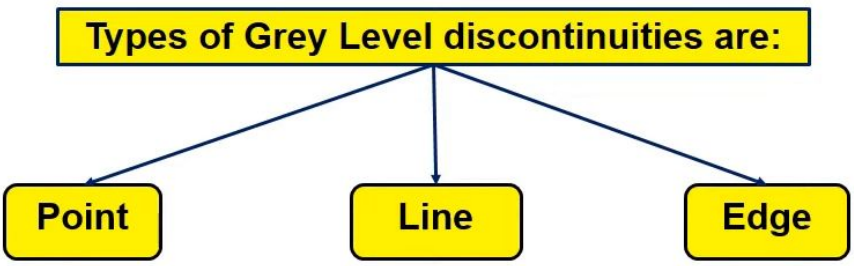
Lecture No – 51

Detection of Discontinuities

Dr. Sapna Katiyar
Professor, ECE Department

00:56

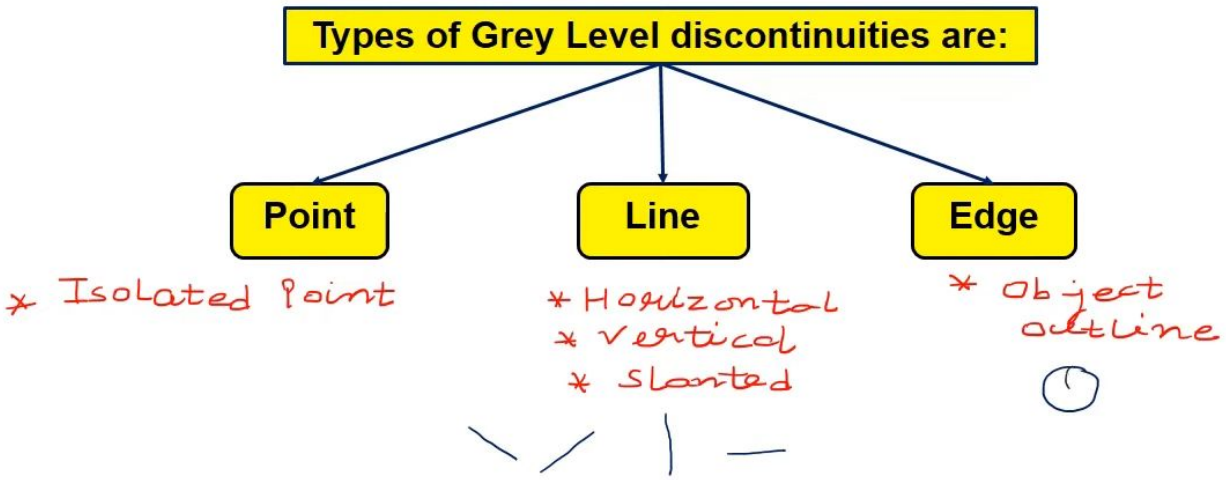
Detection of Discontinuities



02:20

02:24

Detection of Discontinuities



02:47

02:58

Detection of Discontinuities

Point Detection

An isolated point is a point whose grey level is significantly different from its background in a homogeneous area

03:55

Detection of Discontinuities

Point Detection

An isolated point is a point whose grey level is significantly different from its background in a homogeneous area

3x3

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

Mask

3x3

z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

Image

Response of the mask:

$$R = \sum_{i=1}^{9} w_i z_i$$

04:22

Detection of Discontinuities

Point Detection

An isolated point is a point whose grey level is significantly different from its background in a homogeneous area

3x3

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

Mask

3x3

z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

Image

Response of the mask:

$$R = \sum_{i=1}^{9} w_i z_i$$

If,
|R| ≥ T, a point is detected
where,
T is a non negative integer

−1	−1	−1
−1	8	−1
−1	−1	−1

Sample Mask for Point Detection

05:42

Detection of Discontinuities

Line Detection

In line detection, **four types of masks** are used to get the responses i,e, R_1, R_2, R_3 and R_4 for the directions vertical, horizontal, $+45^0$ and -45^0 respectively

→

−1	−1	−1
2	2	2
−1	−1	−1

Horizontal

−1	2	−1
−1	2	−1
−1	2	−1

Vertical

−1	−1	2
−1	2	−1
2	−1	−1

$+45^0$

2	−1	−1
−1	2	−1
−1	−1	2

-45^0

06:24

Detection of Discontinuities

Line Detection

In line detection, **four types of masks** are used to get the responses i,e, R_1, R_2, R_3 and R_4 for the directions vertical, horizontal, $+45^0$ and -45^0 respectively

−1	−1	−1	
2	2	2	
−1	−1	−1	
Horizontal			

−1	2	−1
−1	2	−1
−1	2	−1
Vertical		

−1	−1	2
−1	2	−1
2	−1	−1
+45⁰		

2	−1	−1
−1	2	−1
−1	−1	2
-45⁰		

Response of the mask:

$$R_k = \sum_{k=1}^{4} \omega_k z_k$$

If, at a certain point in the image, $|R_i| > |R_j|$ for all $j \neq i$, that **point** is said to be more likely associated with a **line** in the direction of mask i

07:42

Detection of Discontinuities

Line Detection

In line detection, **four types of masks** are used to get the responses i,e, R_1, R_2, R_3 and R_4 for the directions vertical, horizontal, $+45^0$ and -45^0 respectively

−1	−1	−1	
2	2	2	
−1	−1	−1	
Horizontal			

−1	2	−1
−1	2	−1
−1	2	−1
Vertical		

−1	−1	2
−1	2	−1
2	−1	−1
+45⁰		

2	−1	−1
−1	2	−1
−1	−1	2
-45⁰		

Response of the mask:

$$R_k = \sum_{k=1}^{4} \omega_k z_k$$

If, at a certain point in the image, $|R_i| > |R_j|$ for all $j \neq i$, that **point** is said to be more likely associated with a **line** in the direction of mask i

08:30

Detection of Discontinuities

Detection of Discontinuities

Edge Detection

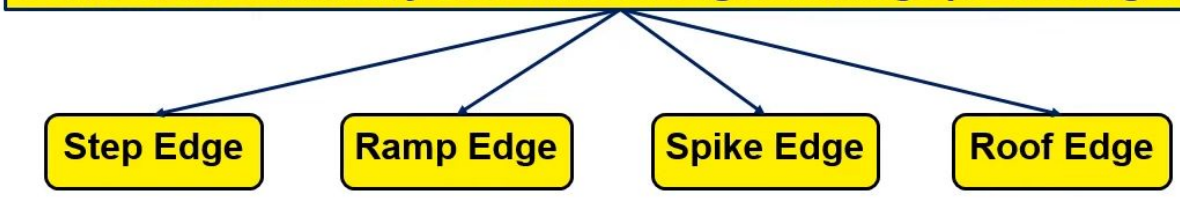
- An edge is a set of connected pixels that lies on the boundary between two regions which differ in grey value. Pixels on edge is known as edge points
- **Edges provide an outline of the object**

12:00

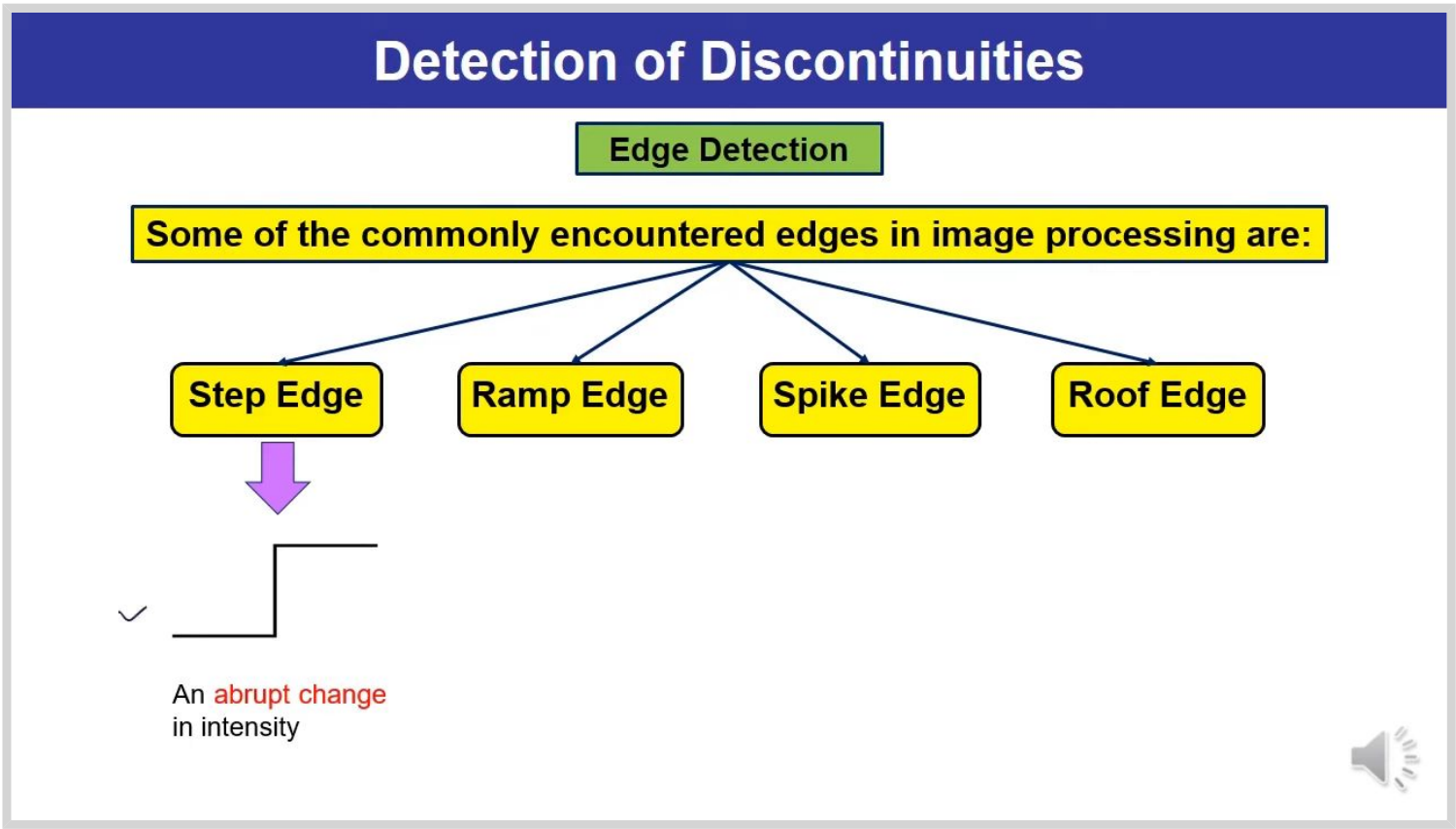
Detection of Discontinuities

Edge Detection

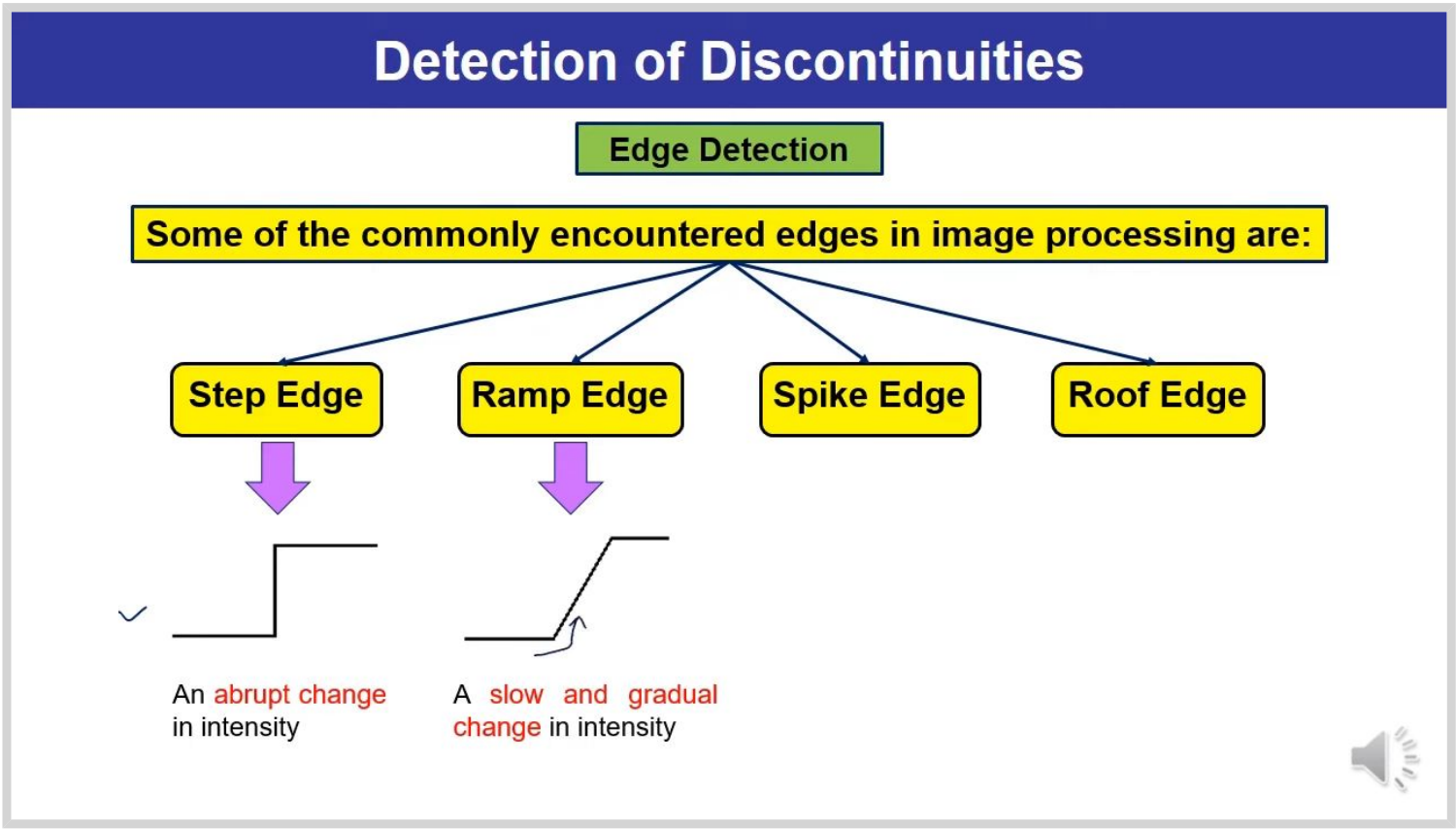
Some of the commonly encountered edges in image processing are:



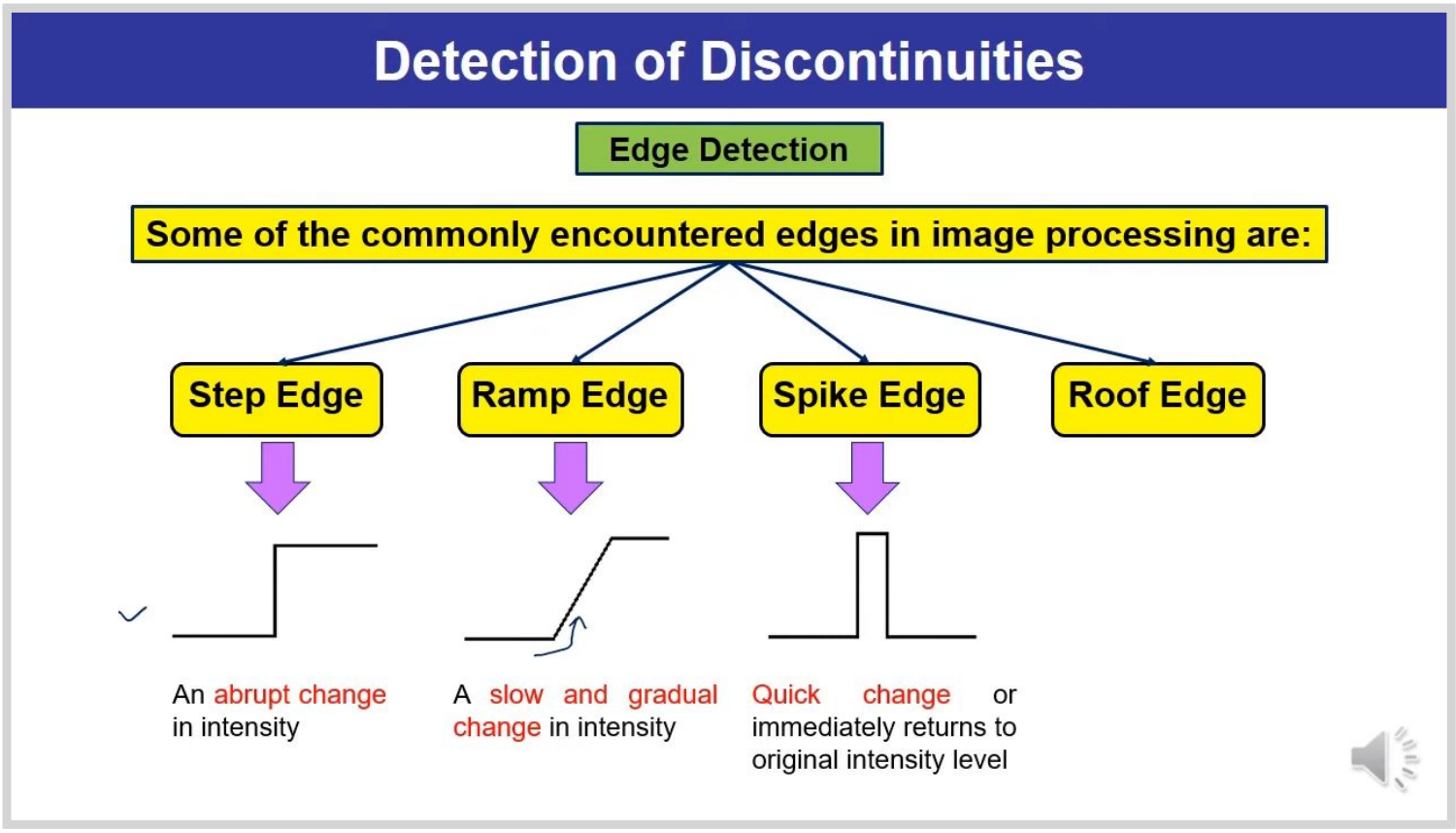
12:15


Detection of Discontinuities
Edge Detection
Some of the commonly encountered edges in image processing are:
Step Edge
Ramp Edge
Spike Edge
Roof Edge
An abrupt change in intensity

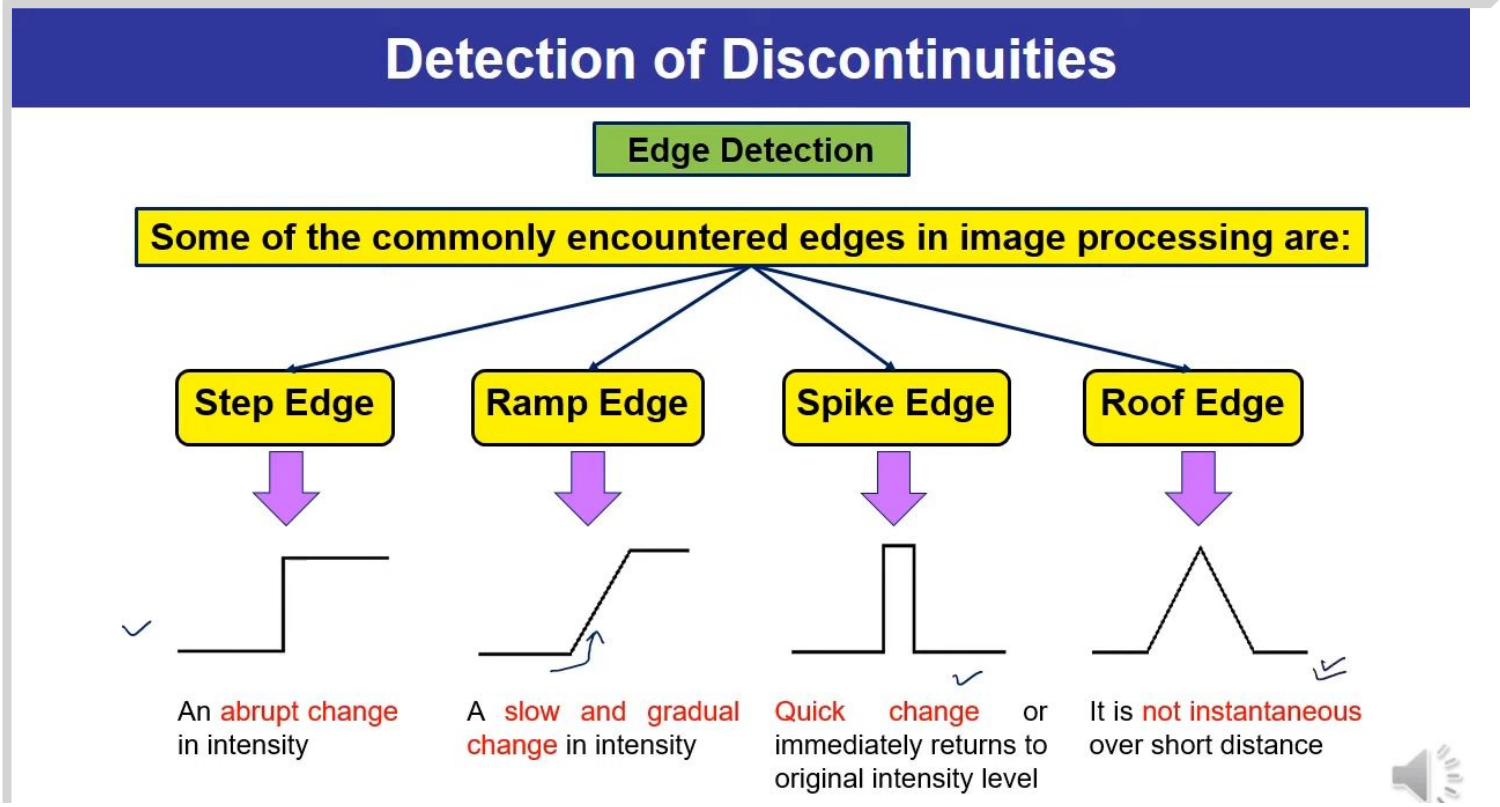
12:35


Detection of Discontinuities
Edge Detection
Some of the commonly encountered edges in image processing are:
Step Edge
Ramp Edge
Spike Edge
Roof Edge
An abrupt change in intensity
A slow and gradual change in intensity

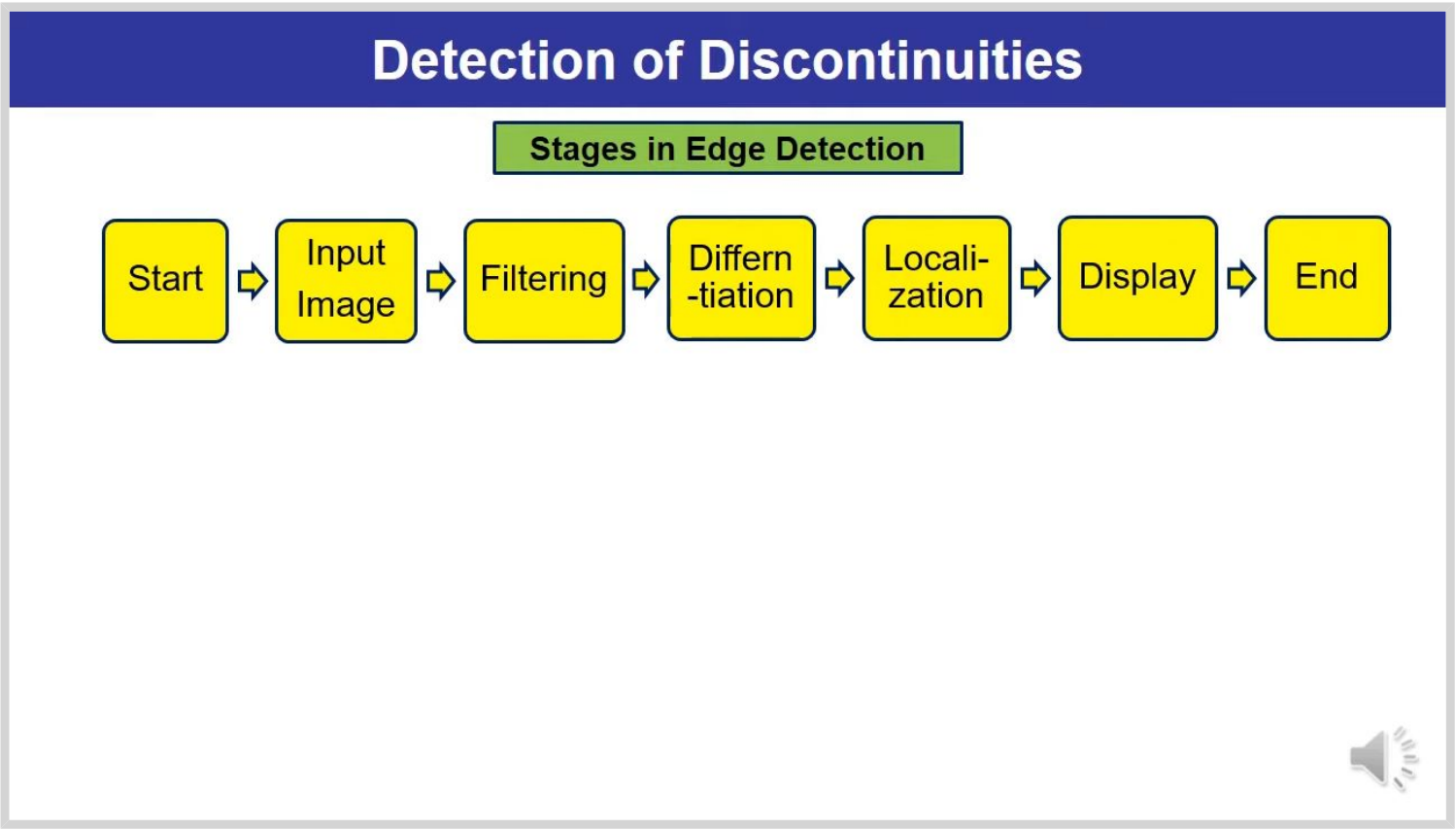
12:51


Detection of Discontinuities
Edge Detection
Some of the commonly encountered edges in image processing are:
Step Edge
Ramp Edge
Spike Edge
Roof Edge
An abrupt change in intensity
A slow and gradual change in intensity
Quick change or immediately returns to original intensity level

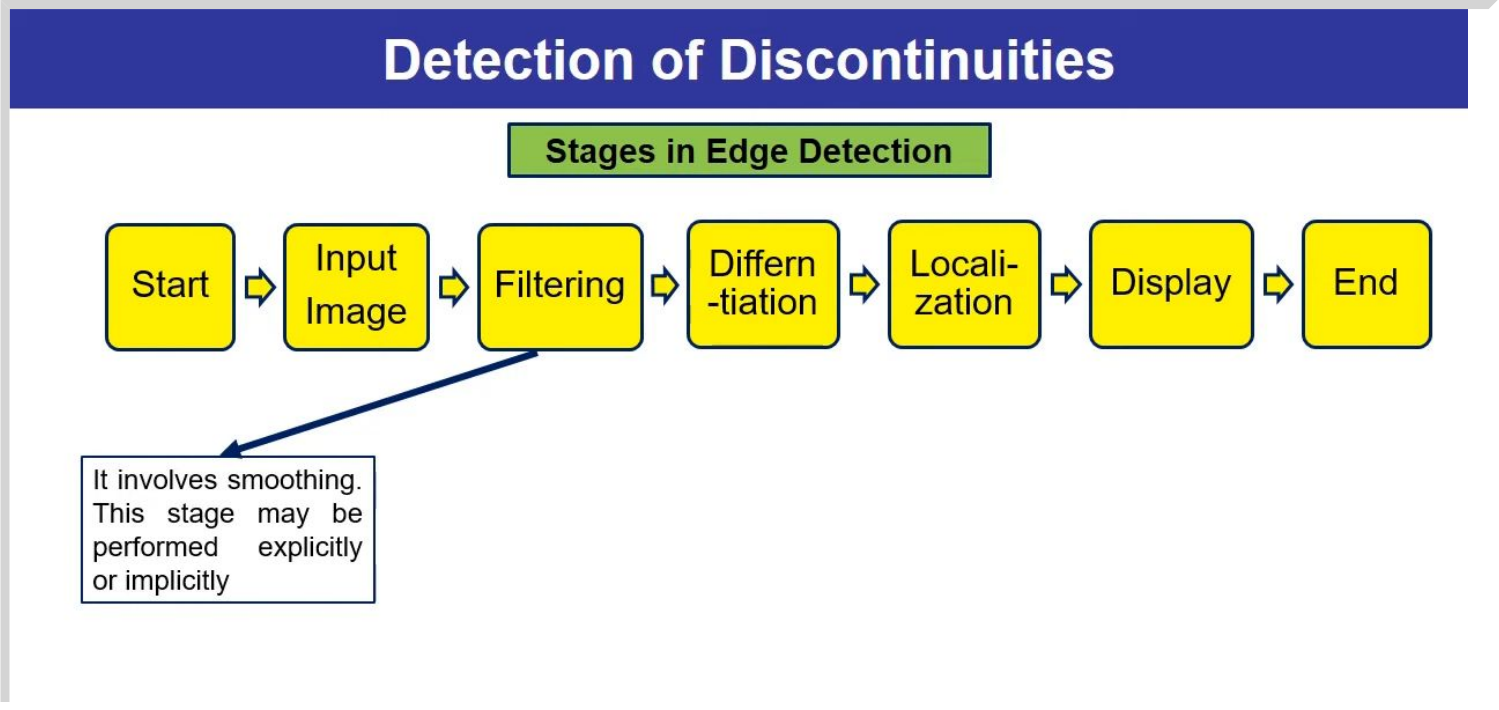
13:18


Detection of Discontinuities
Edge Detection
Some of the commonly encountered edges in image processing are:
Step Edge
Ramp Edge
Spike Edge
Roof Edge
An abrupt change in intensity
A slow and gradual change in intensity
Quick change or immediately returns to original intensity level
It is not instantaneous over short distance

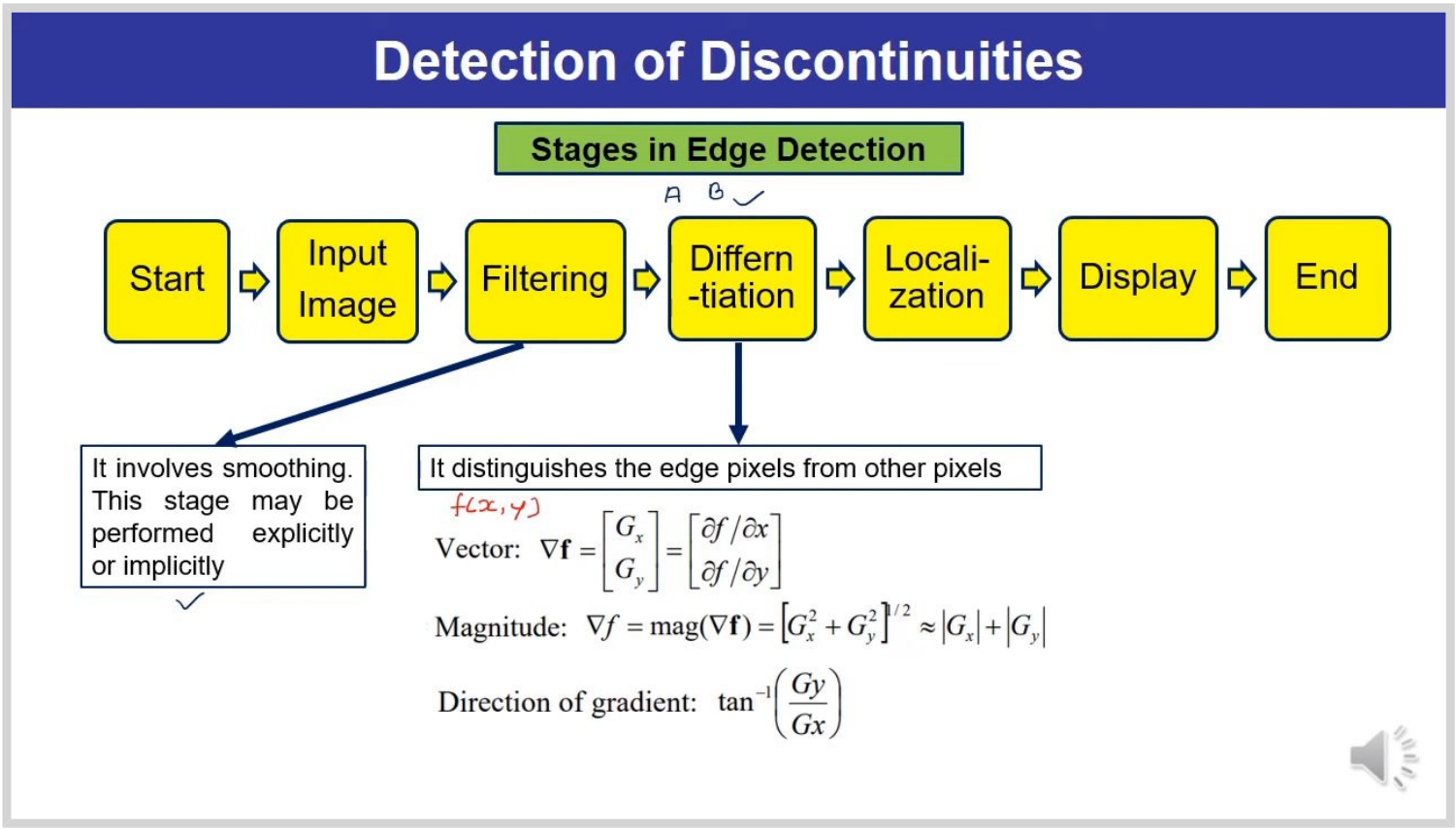
13:54


Detection of Discontinuities
Stages in Edge Detection
Start
Input Image
Filtering
Differn -tiation
Locali- zation
Display
End

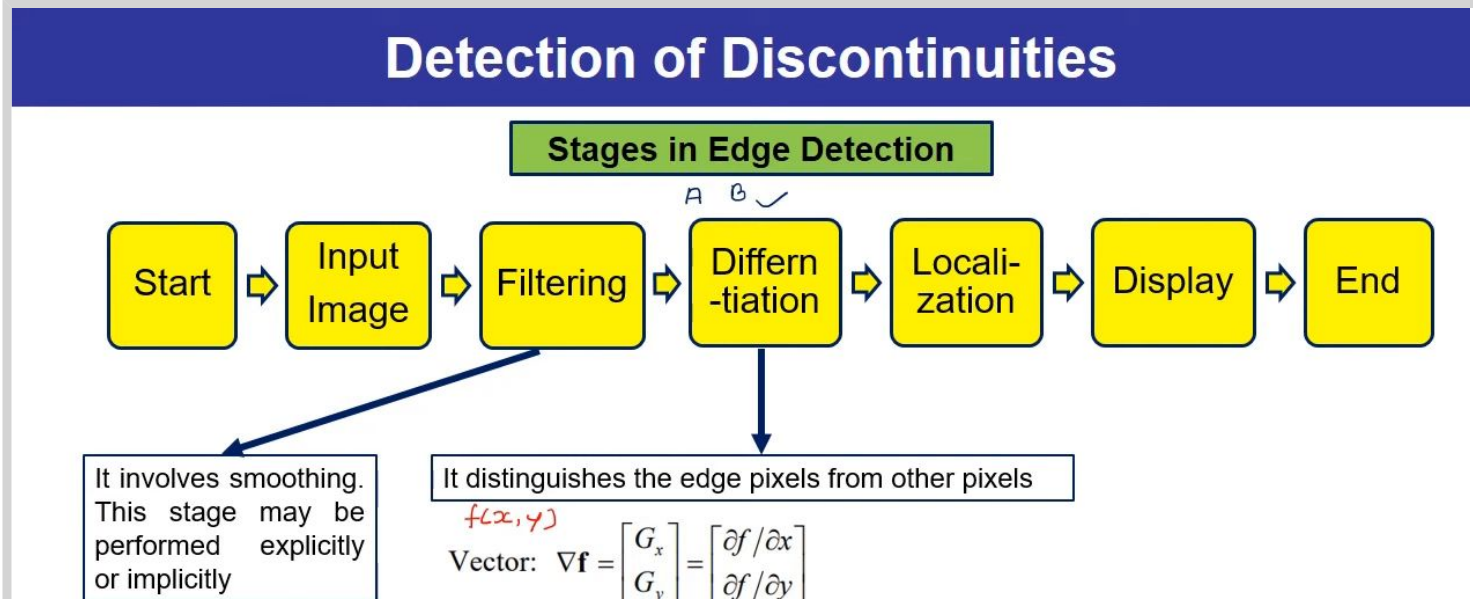
14:36


Detection of Discontinuities
Stages in Edge Detection
Start
Input Image
Filtering
Differn -tiation
Locali- zation
Display
End
It involves smoothing. This stage may be performed explicitly or implicitly

17:02


Detection of Discontinuities
Stages in Edge Detection
Start
Input Image
Filtering
Differ-tiation
Locali-zation
Display
End
It involves smoothing. This stage may be performed explicitly or implicitly
It distinguishes the edge pixels from other pixels
Vector: $\nabla \mathbf{f} = \begin{bmatrix} G_x \\ G_y \end{bmatrix} = \begin{bmatrix} \partial f / \partial x \\ \partial f / \partial y \end{bmatrix}$
Magnitude: $\nabla f = \text{mag}(\nabla \mathbf{f}) = \left[G_x^2 + G_y^2\right]^{1/2} \approx |G_x| + |G_y|$
Direction of gradient: $\tan^{-1}\left(\frac{Gy}{Gx}\right)$

18:04


Detection of Discontinuities
Stages in Edge Detection
Start
Input Image
Filtering
Differ-tiation
Locali-zation
Display
End
It involves smoothing. This stage may be performed explicitly or implicitly
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Vector: $\nabla \mathbf{f} = \begin{bmatrix} G_x \\ G_y \end{bmatrix} = \begin{bmatrix} \partial f / \partial x \\ \partial f / \partial y \end{bmatrix}$

Magnitude: $\nabla f = \text{mag}(\nabla \mathbf{f}) = \left[G_x^2 + G_y^2\right]^{1/2} \approx |G_x| + |G_y|$

Direction of gradient: $\tan^{-1}\left(\frac{Gy}{Gx}\right)$

18:31

Detection of Discontinuities

Stages in Edge Detection

Start → Input Image → Filtering → Differ-tiation → Locali-zation → Display → End

It involves smoothing. This stage may be performed explicitly or implicitly

It distinguishes the edge pixels from other pixels

Vector: $\nabla \mathbf{f} = \begin{bmatrix} G_x \\ G_y \end{bmatrix} = \begin{bmatrix} \partial f / \partial x \\ \partial f / \partial y \end{bmatrix}$

Magnitude: $\nabla f = \text{mag}(\nabla \mathbf{f}) = \left[G_x^2 + G_y^2\right]^{1/2} \approx |G_x| + |G_y|$

Direction of gradient: $\tan^{-1}\left(\frac{Gy}{Gx}\right)$

19:10

Detection of Discontinuities

Stages in Edge Detection

Start → Input Image → Filtering → Differ-tiation → Locali-zation → Display → End

It involves smoothing.

It distinguishes the edge pixels from other pixels

It determine the exact

This stage may be performed explicitly or implicitly

$f(x,y)$

Vector: $\nabla \mathbf{f} = \begin{bmatrix} G_x \\ G_y \end{bmatrix} = \begin{bmatrix} \partial f / \partial x \\ \partial f / \partial y \end{bmatrix}$

Magnitude: $\nabla f = \text{mag}(\nabla \mathbf{f}) = \left[G_x^2 + G_y^2\right]^{1/2} \approx |G_x| + |G_y|$

Direction of gradient: $\tan^{-1}\left(\frac{Gy}{Gx}\right)$

θ

location of edge

19:31

Detection of Discontinuities

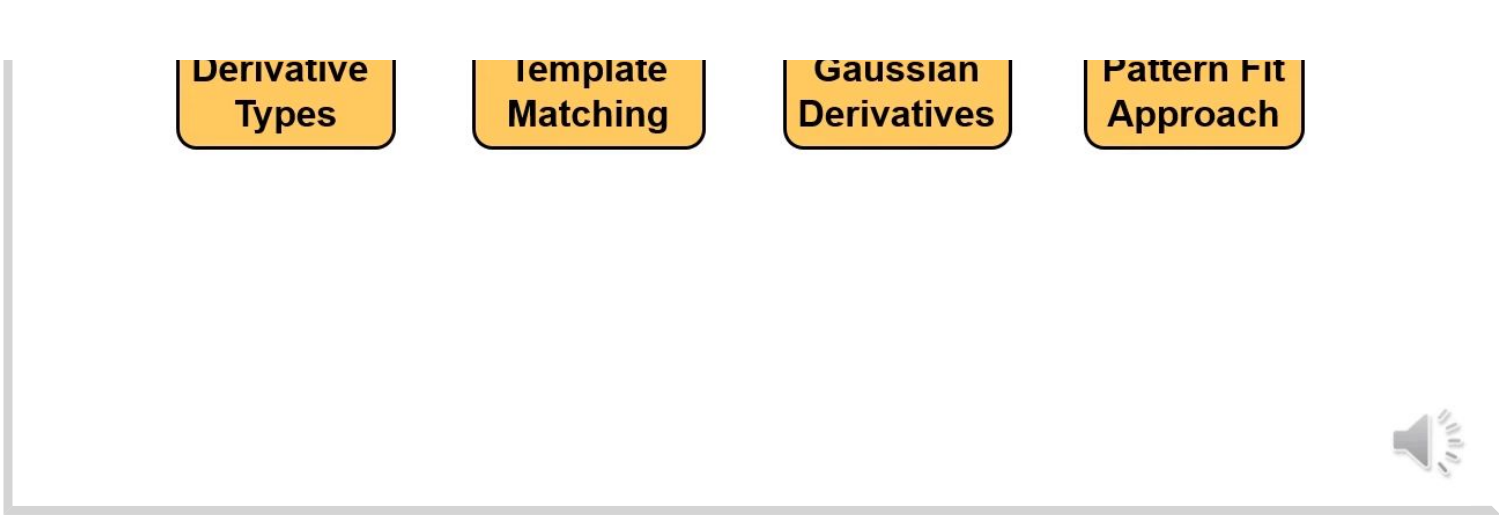
Edge Detection

20:00

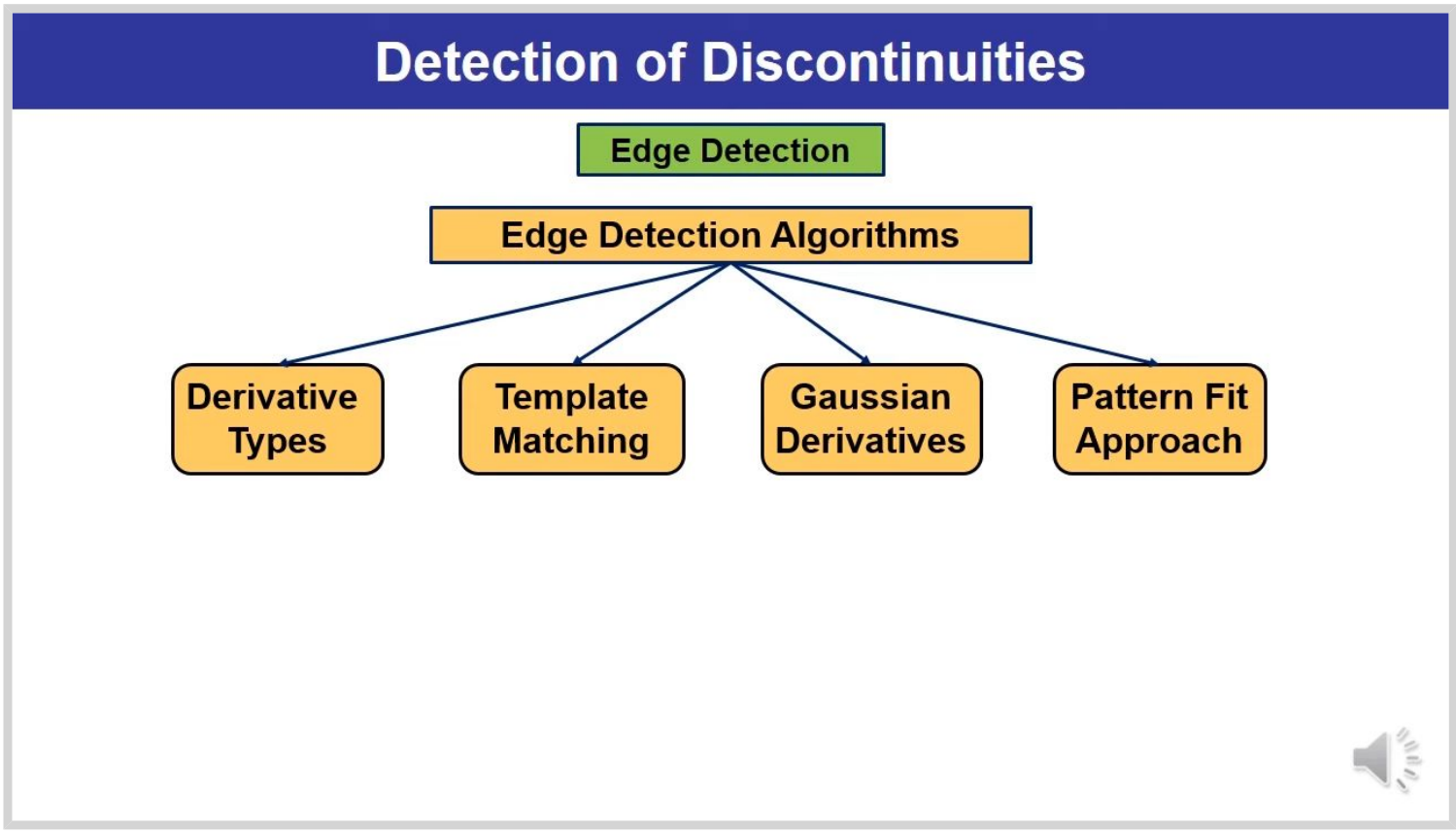
Detection of Discontinuities

Edge Detection

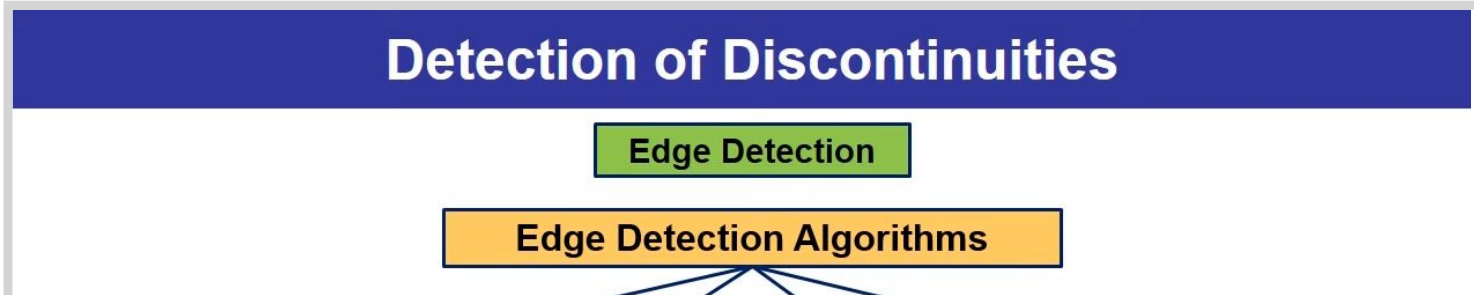
Edge Detection Algorithms

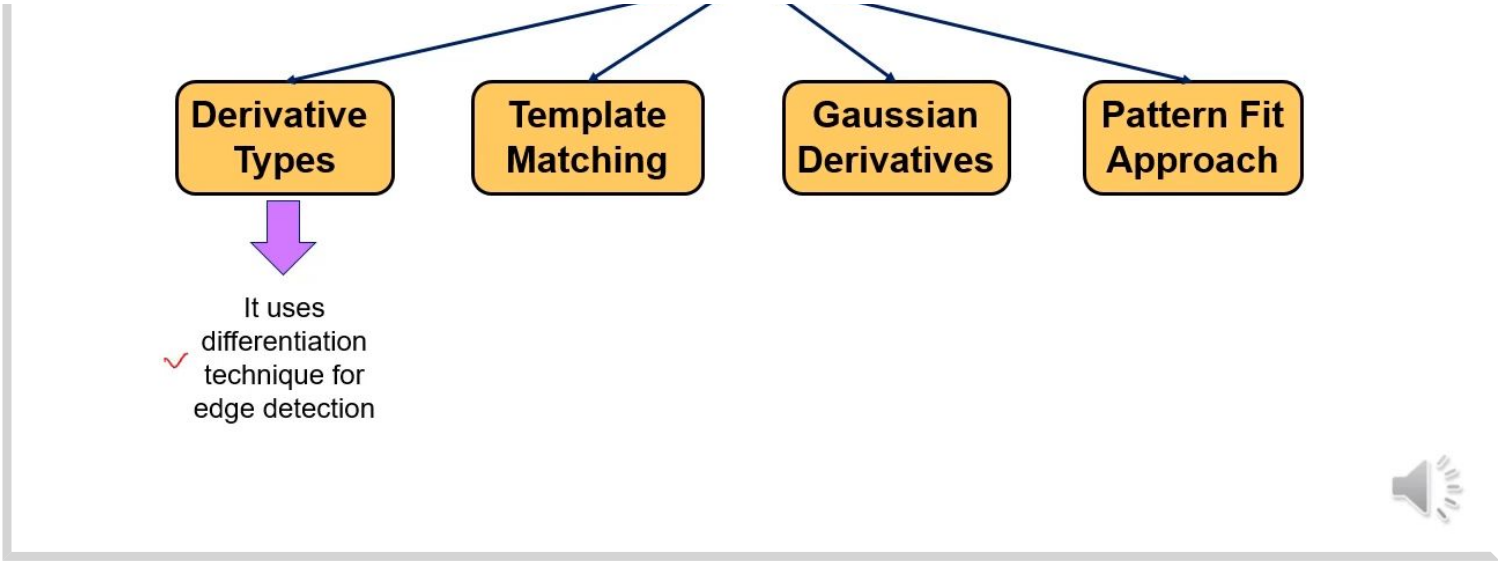

Derivative Types
Template Matching
Gaussian Derivatives
Pattern Fit Approach

20:01

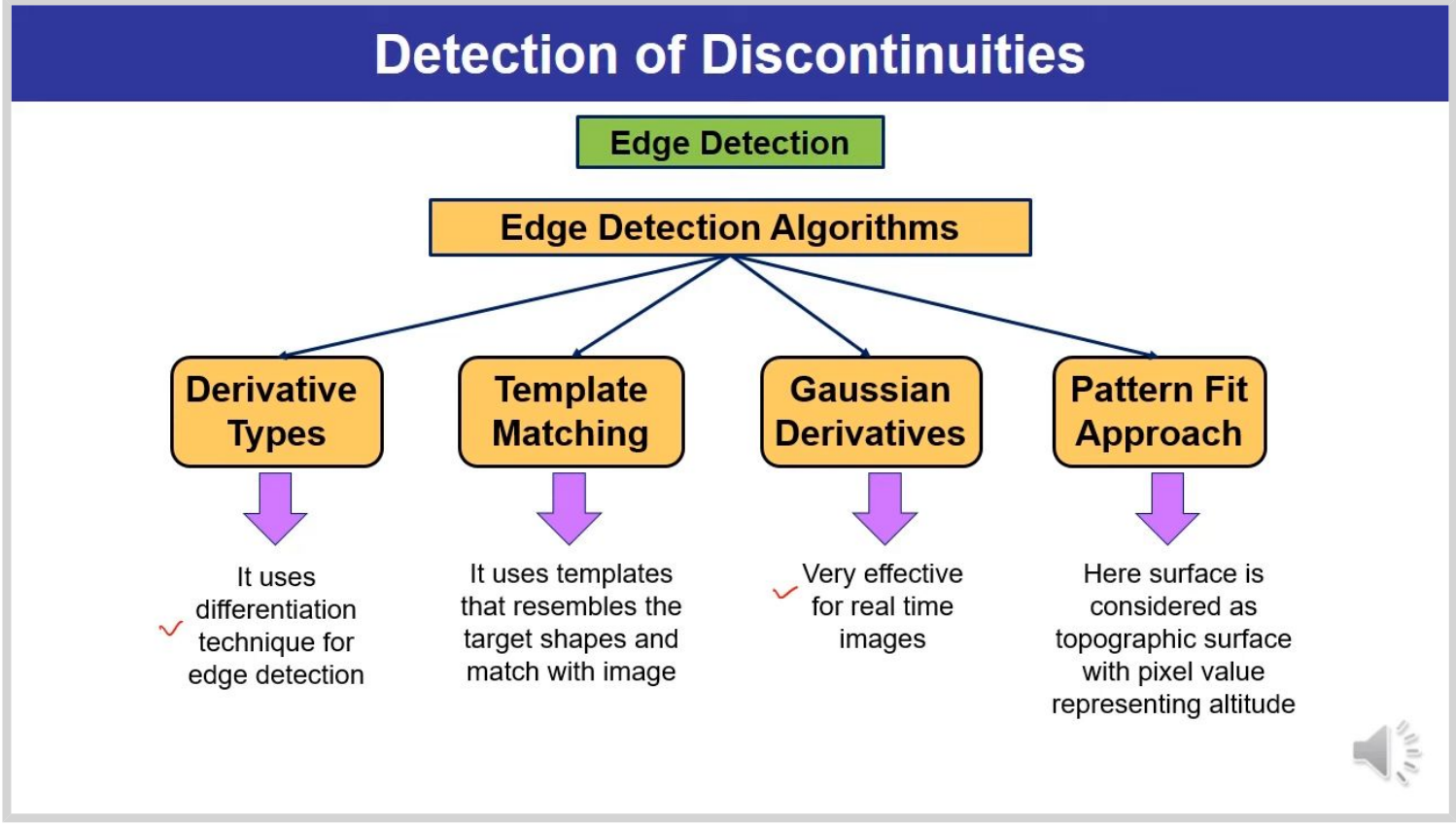

Detection of Discontinuities
Edge Detection
Edge Detection Algorithms
Derivative Types
Template Matching
Gaussian Derivatives
Pattern Fit Approach

20:15


Detection of Discontinuities
Edge Detection
Edge Detection Algorithms


Derivative Types
Template Matching
Gaussian Derivatives
Pattern Fit Approach
It uses differentiation technique for edge detection

21:27


Detection of Discontinuities
Edge Detection
Edge Detection Algorithms
Derivative Types
Template Matching
Gaussian Derivatives
Pattern Fit Approach
It uses differentiation technique for edge detection
It uses templates that resembles the target shapes and match with image
Very effective for real time images
Here surface is considered as topographic surface with pixel value representing altitude


Detection of Discontinuities
Edge Detection

- An edge is a set of connected pixels that lies on the boundary between two regions which differ in grey value. Pixels on edge is known as edge points
- **Edges provide an outline of the object**

In physical plane, **edge corresponds** to the **discontinuities in** depth, Surface orientation, change in material properties, light variations etc.

- It locates sharp changes in the intensity function
- Edges are pixels where brightness changes abruptly
- An edge can be extracted by computing the derivative of the image function
  - ✓ Magnitude of the derivative, indicates the strength or contrast of edge
  - ✓ Direction of the derivative vector, indicates the edge orientation