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Lecture 17
Color Image Processing Contd.
&
Image Segmentation

→ Histogram equalisation can also be done on HSI space

→ Grayscale quantisation
  → Reduces no. of unique intensities
  → Can be extended to colored images

→ Color quantisation
  → Apply k-means on RGB
  → No. of unique colors reduce
  → Tends to create patches of uniform intensity
    ↳ Partitioning of patches

→ Color Image filtering can be done by median filtering

→ Color edge detection:

→ Method 1:

→ Method 2:

→ How fast these values are changing
→ Respond to finding Color change

Convolutional neural networks

→ Identifies low-level features

Image Segmentation:

→ Partition into

1) Regions that covers image
2) Linear structures such as
   i) Line segement
   ii) Curve segement
3) 2D shapes such as
   i) Circles
   ii) Ellipses
   iii) Ribbons (long, symmetric regions)

Approaches:

1) Edge-based → Points, Edges, Lines } Detection of discontinuity
2) Thresholding
3) Region-growing
4) Morphological Watersheds
5) Motion

Edges & Derivatives:

1st deriv → edge location
2nd deriv → Edge direction

Oriented Line Detection:

→ Lines at particular angles

Horiz → $\begin{bmatrix} -1 & -1 & -1 \\ 2 & 2 & 2 \\ -1 & -1 & -1 \end{bmatrix}$ $+45 \rightarrow \begin{bmatrix} -1 & -1 & 2 \\ -1 & 2 & -1 \\ 2 & -1 & -1 \end{bmatrix}$ $-45 \rightarrow \begin{bmatrix} 2 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & 2 & -1 \end{bmatrix}$ Vertical → $\begin{bmatrix} -1 & 2 & -1 \\ -1 & 2 & -1 \\ -1 & 2 & -1 \end{bmatrix}$

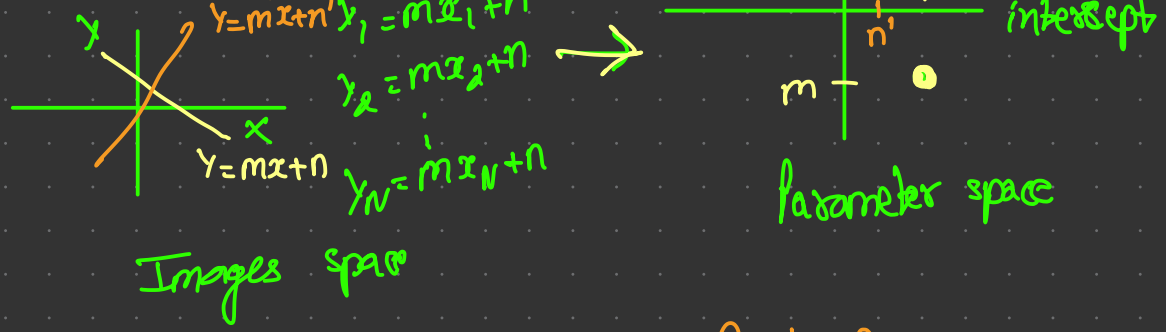
Hough Transform

→ Used to identify
- → Straight lines
- → Circles
- → Algebraic curves
- → Arbitrary specific shapes of image

For lines:

Image and parameter spaces

Think of coordinates system



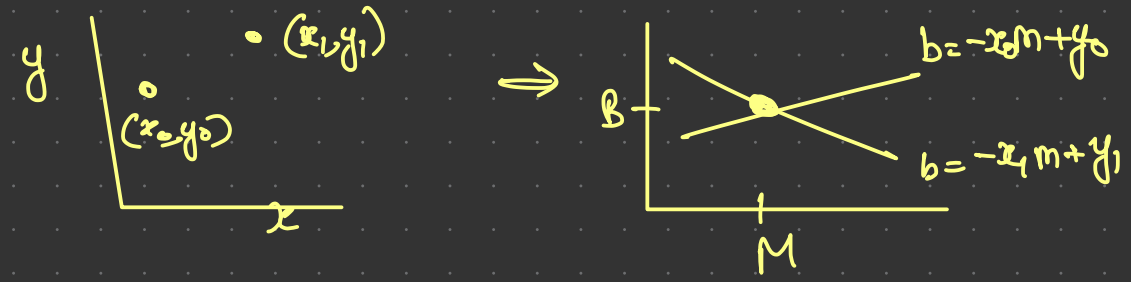
Line in img space ⇒ Points in param space

Points in img space ⇒ Lines (Infinite no. of lines passing through it)

Collinear points in img space ⇒ Intersecting lines

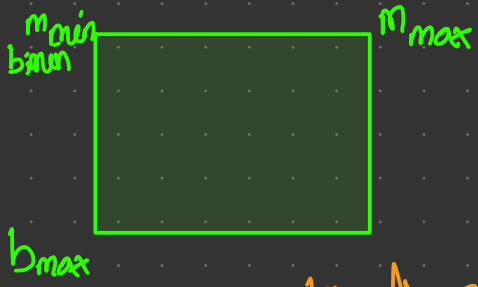
Img space and param space are duals of each other

2 points



Hough Transform Algorithm

→ Initialise accumulator array A(m,b) to 0
→ Foreach edge element (x,y) increment all cells that satisfy b = -xm+y
→ Local maxima in A(m,b) correspond to lines



Threshold edge image → Visualise accum space [Height of peak defined by no. of pixels in line → Thresh accum space and superimposing this onto edge image

Issue:
→ Slope goes from $-\infty < m < \infty$ (∞ param space)
→ $y = mx + n$ doesn't express lines of form $x = k$

Solution:
'Normal' equation of line

$\rho = x\cos\theta + y\sin\theta$
↳ Line orientation
↳ Dist b/w origin & line

Point in img space ⇒ sinusoid in param space
Collinear points ⇒ Intersecting sinusoids

→ New space is finite [$0 < \rho < D$, D = Image diagonal]
→ Represent all lines

Algorithm:
1) Discretise θ, ρ in increments of $d\theta, d\rho$. Let $A(\theta, \rho)$ be accum with 0 init
2) For all pixel i) $\rho = j\cos(h d\theta) + i\sin(h\theta)$ ii) find closest k iii) Increment $A(h,k)$
3) Find local maxima

→ Computationally expensive

↳ Solution:

Orientation of edge : $\operatorname{atan}\left(\frac{G_y}{G_x}\right)$

↳ Fix Θ in param space and increment only one counter