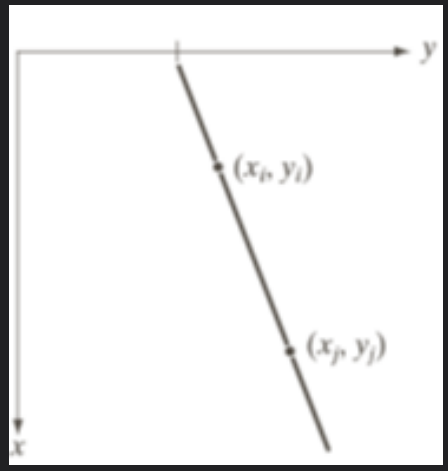
Hough Transform

Line detection

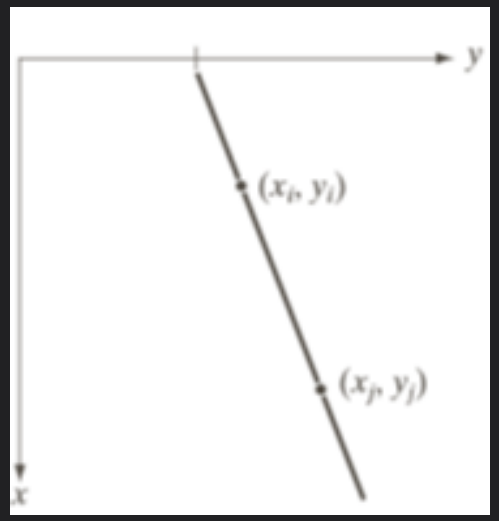
Problem under consideration

How to fit a Line

- Least square Fit (over constraint)
- RANSAC (constraint)
- Hough Transform (under constraint)



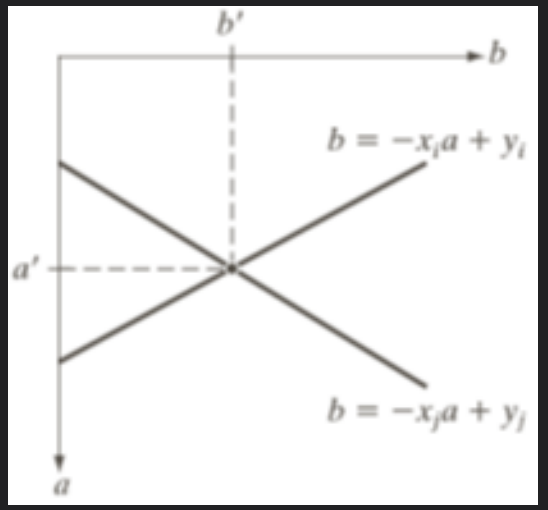
Hough Transform



$y_i = ax_i + b$

Infinitely many lines passes through (x_i, y_i)

$b = -x_i a + y_i$ (parameter space)



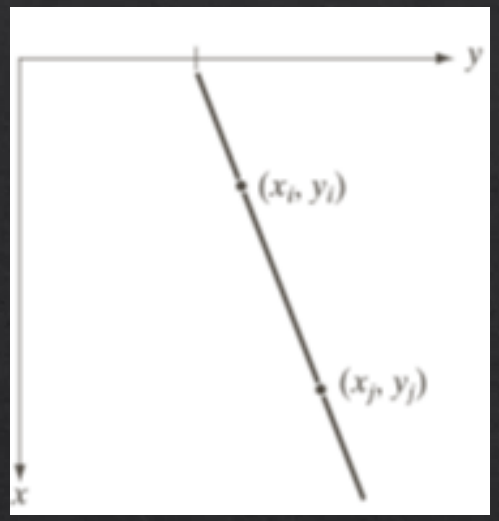
Hough Transform Algo for fitting Straight line

1. Quantize the parameter space $P[c_{min}, \ldots\ldots, c_{max}, m_{min}, \ldots\ldots, m_{max}]$.

2. For each edge point (x, y) do
   for $(m = m_{min}, m \leq m_{max}, m++)$ do
   $c = (-x)m + y,$
   $P[c, m] = P[c, m] + 1.$

3. Find the local maxima in the parameter space.

Hough Transform

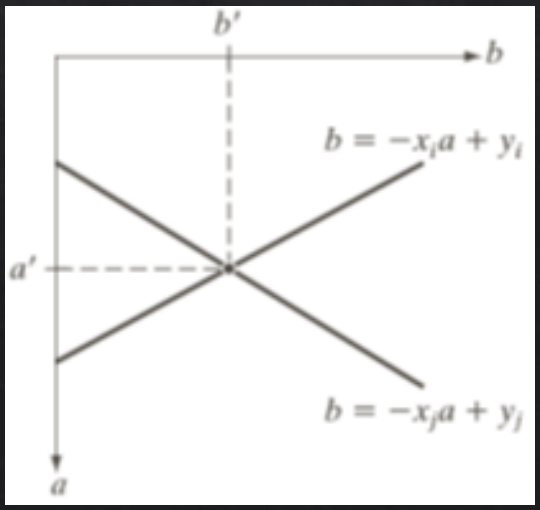


$y_i = ax_i + b$

Infinitely many lines passes through (x_i, y_i)

$b = -x_i a + y_i$ (parameter space)

Slope of the line (a) approaches infinity as the line approaches the vertical direction.



Normal (Polar) representation of Line

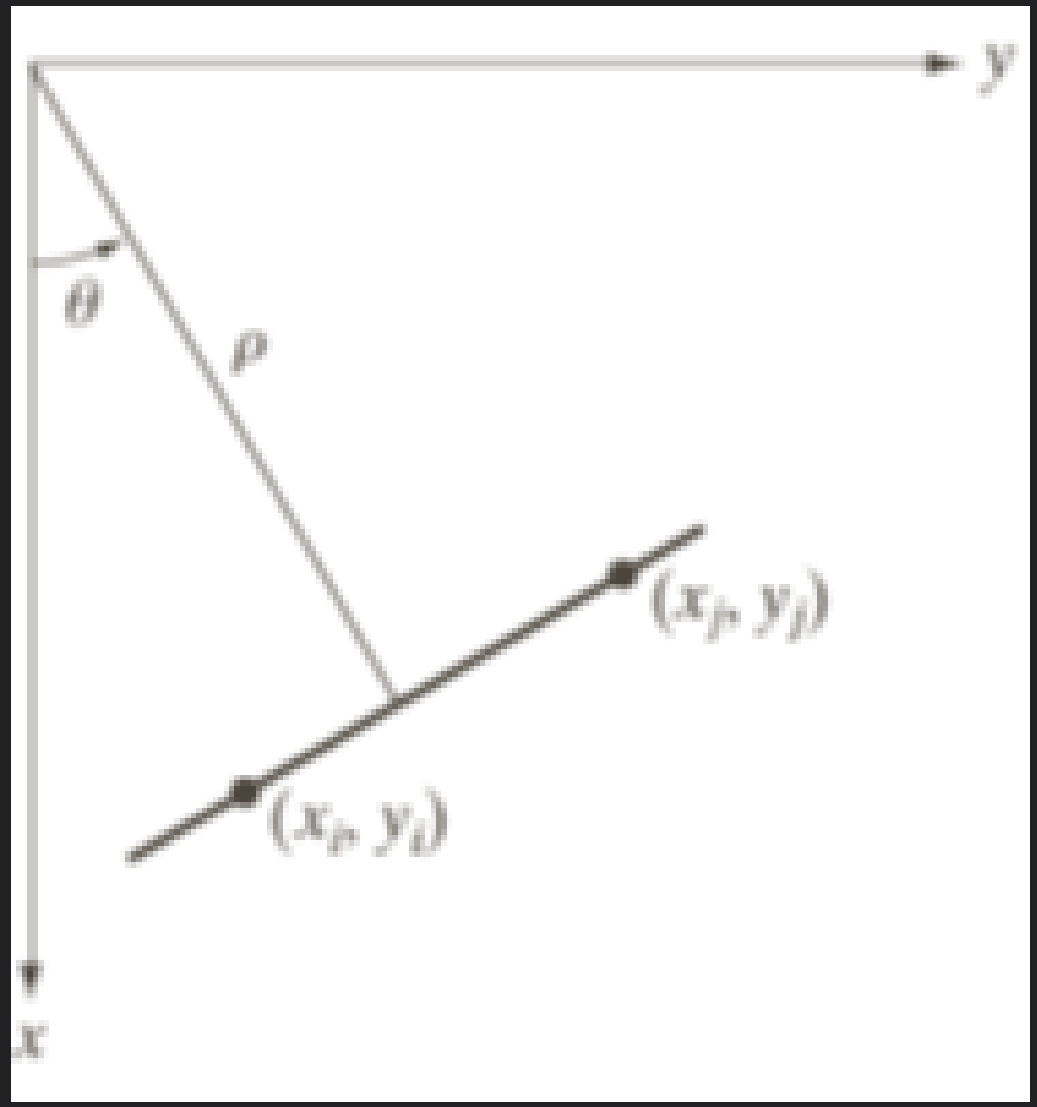
$x \cos \theta + y \sin \theta = \rho$

$-D \leq \rho \leq D$

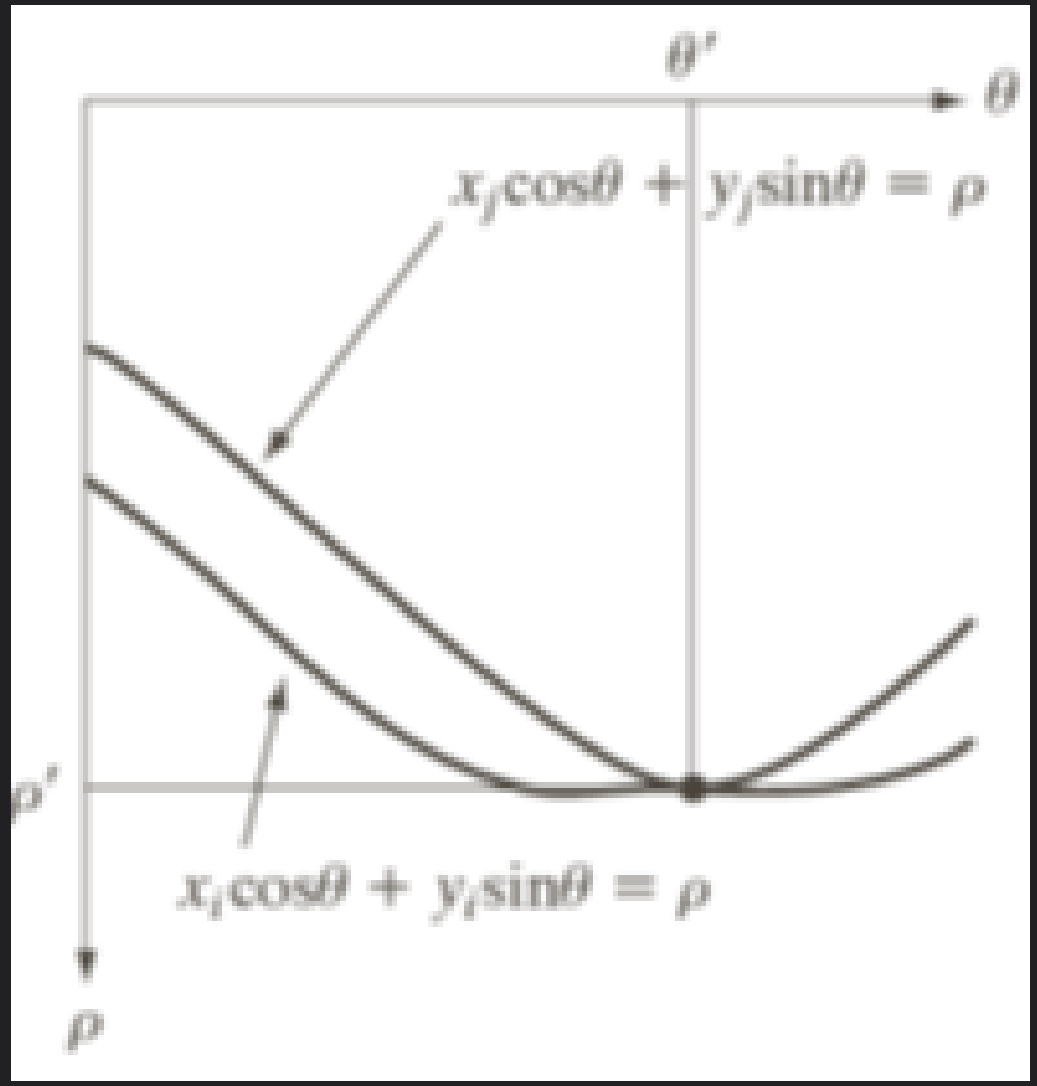
D is maximum distance between opposite corners in an image

$\theta = \tan^{-1} (g_y / g_x)$

$+90^0 \leq \theta \leq -90^0$

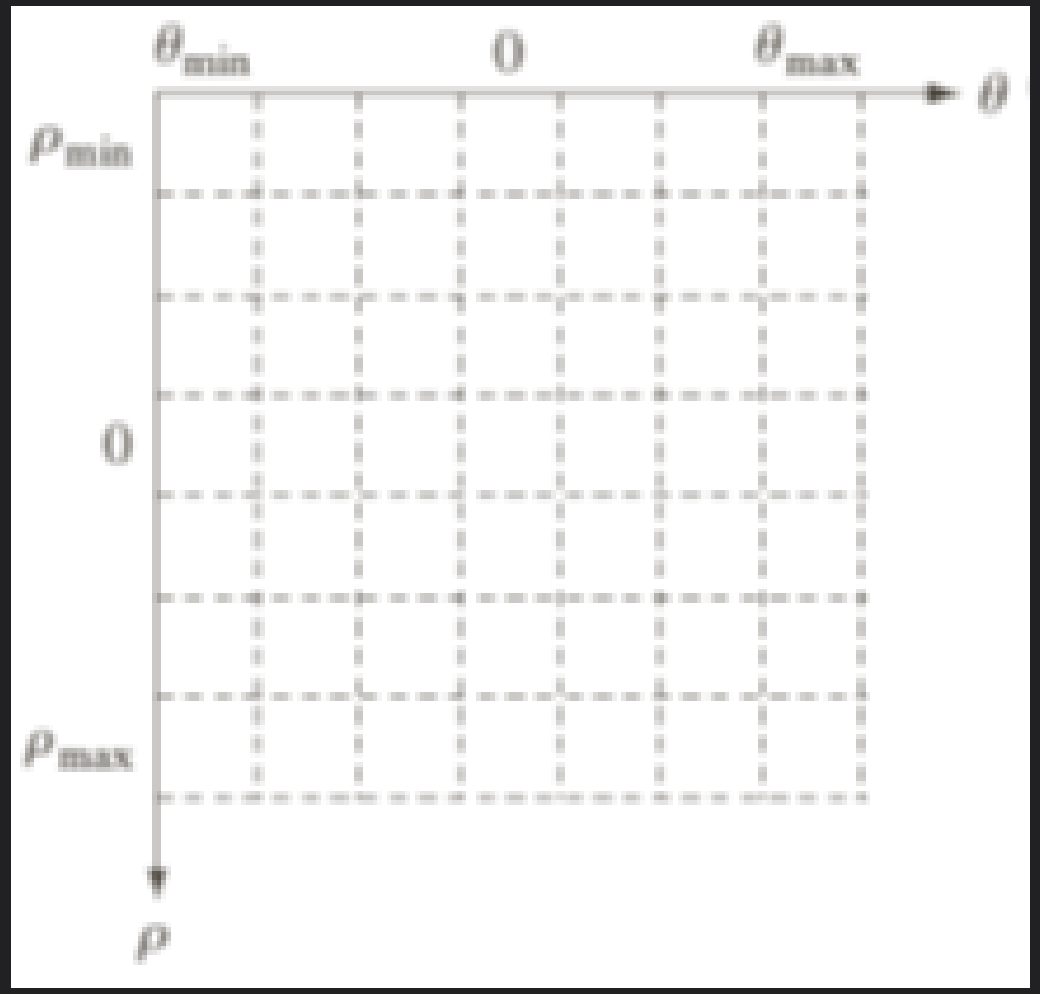


ρ and θ parameter space



Accumulator array

- A(p,q)
- A(p,q) = A(p,q) + 1



Hough Transform Algo for fitting Straight line

1. Quantize the parameter space $P[\theta_{min}, \ldots\ldots, \theta_{max}, p_{min}, \ldots\ldots, p_{max}]$.

2. For each edge point (x, y) do
   $p = x \cos\theta + y \sin\theta,$
   $P[\theta, p] = P[\theta, p] + 1.$

3. Find the local maxima in the parameter space.