

Image Processing

Hough Transform

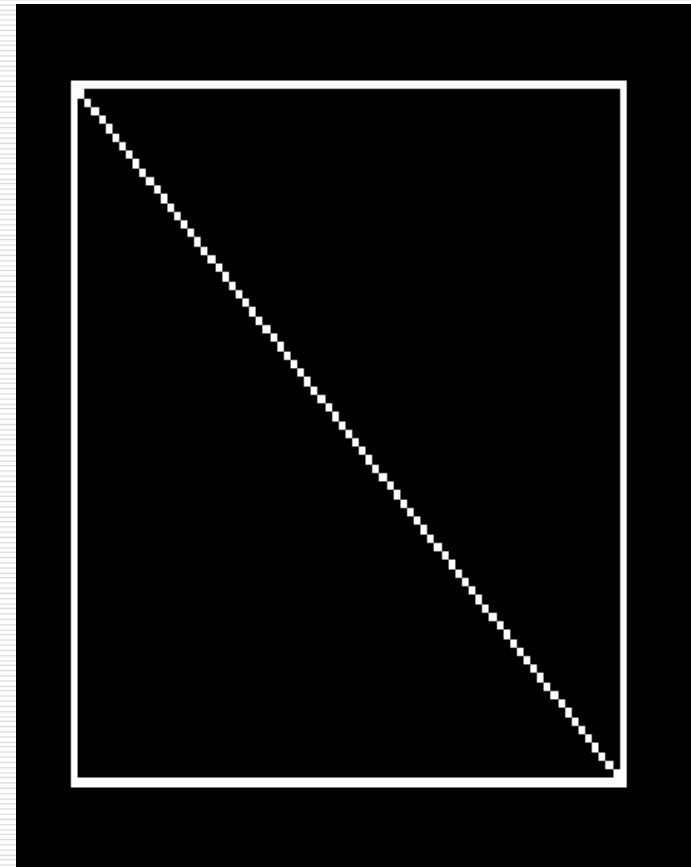
Hough Transform

- **The Hough transform is a technique which can be used to detect basic features of a particular shape within an image.**
 - **Eg: lines, circles, ellipse**
 - **The main advantage of the Hough transform technique is that it is tolerant of gaps in feature boundary descriptions and is relatively unaffected by image noise.**
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Hough Transform

- o Hough transform of a straight line:

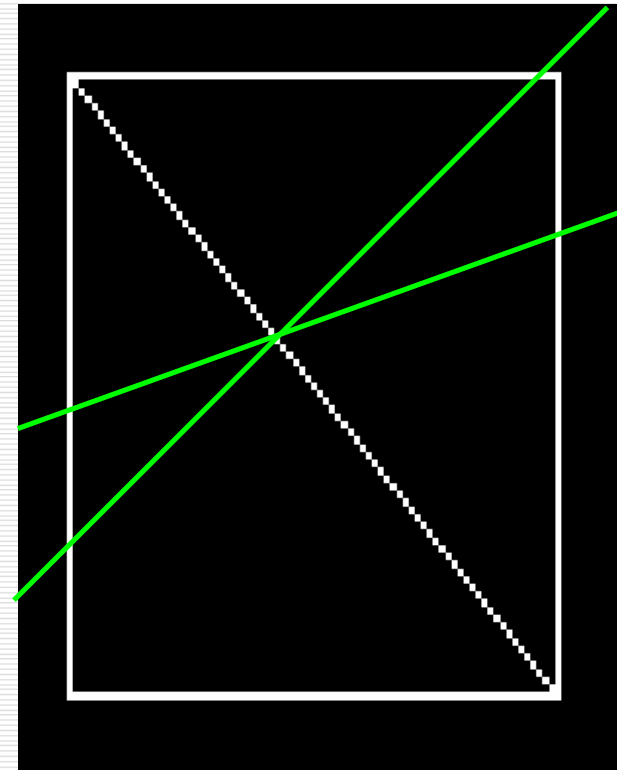
Each white point if considered in isolation could lie on an infinite number of straight lines



Hough Transform

- o Hough transform of a straight line:

Each white point if considered in isolation could lie on an infinite number of straight lines



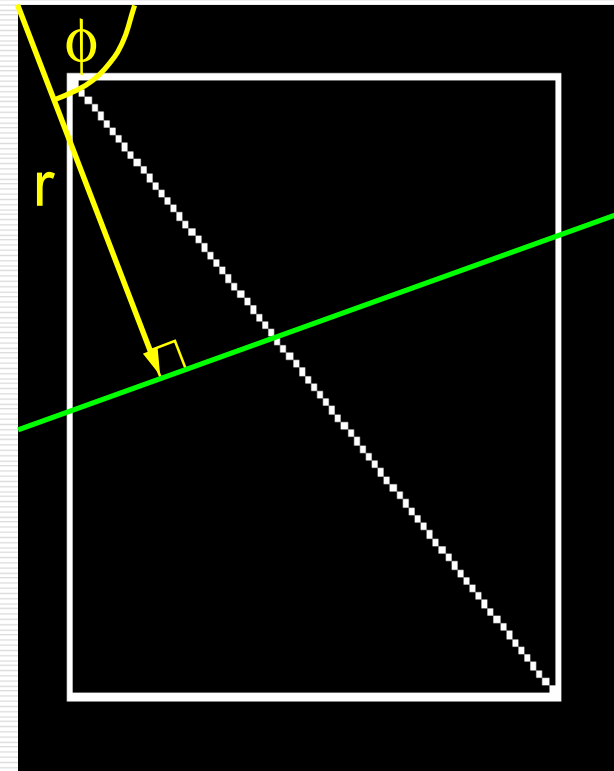
Hough Transform

Any line can be represented by two numbers

Here we will represent the yellow line by (r, ϕ)

In other words we define it using

- a line from an agreed origin
- of length r
- at angle ϕ to the horizontal



$$r = x \cos(\phi) + y \sin(\phi)$$

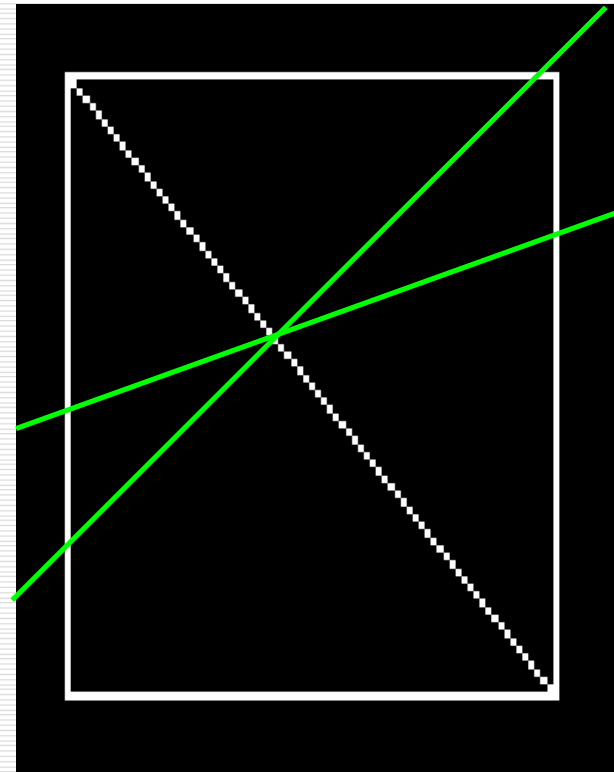
Hough Transform

Each straight line in this image can be described by an equation

Each white point if considered in isolation could lie on an infinite number of straight lines

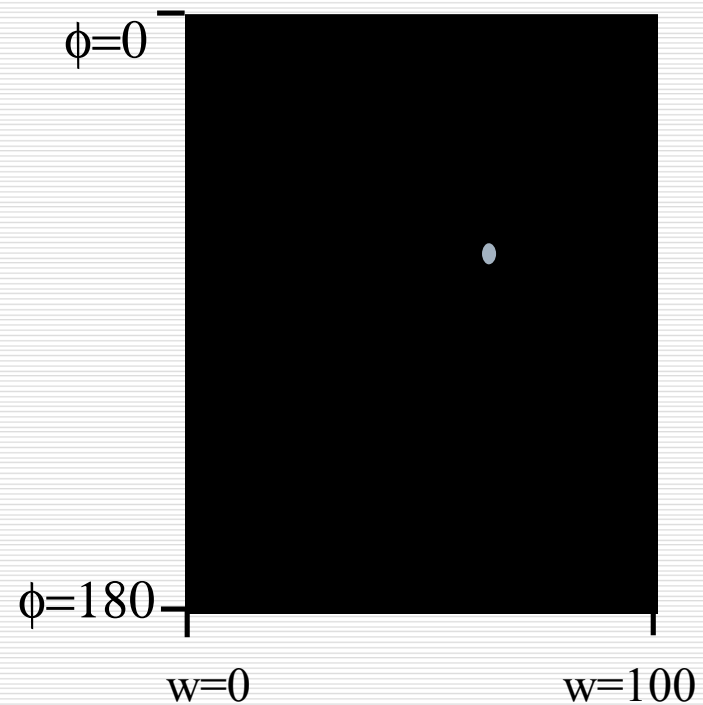
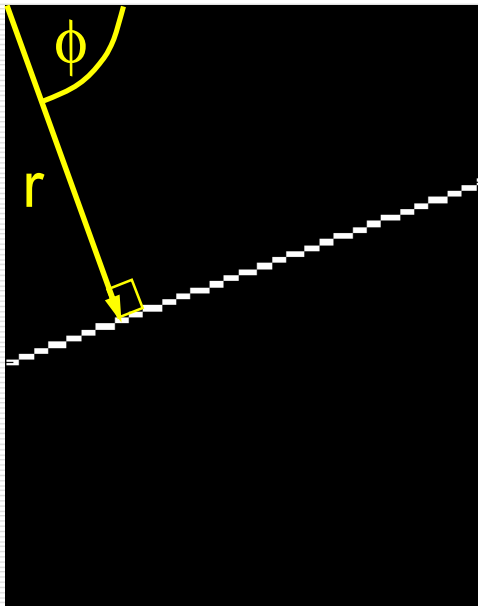
In the Hough transform each point votes for every line it could be on

The lines with the most votes win



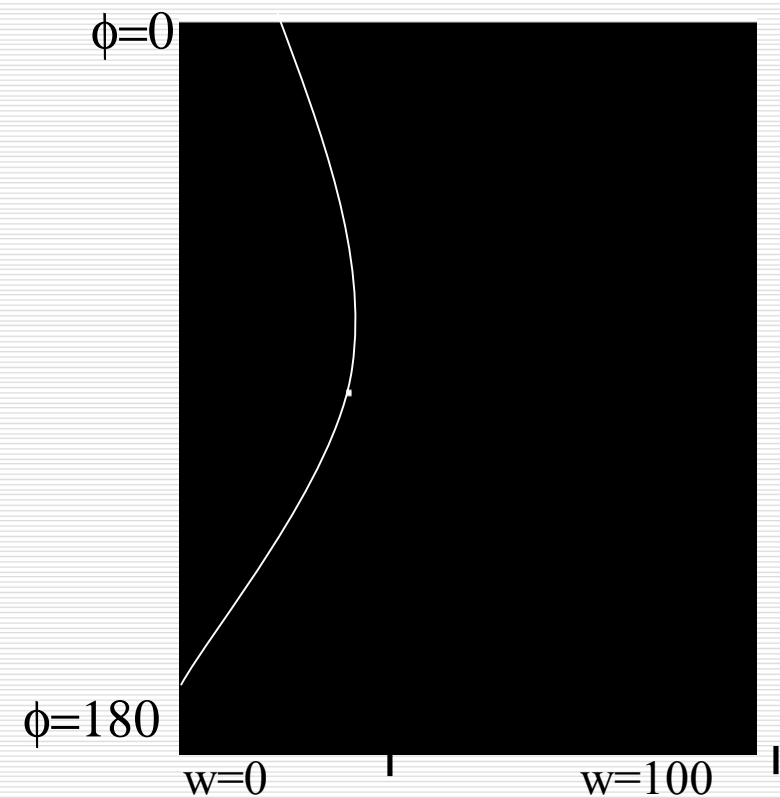
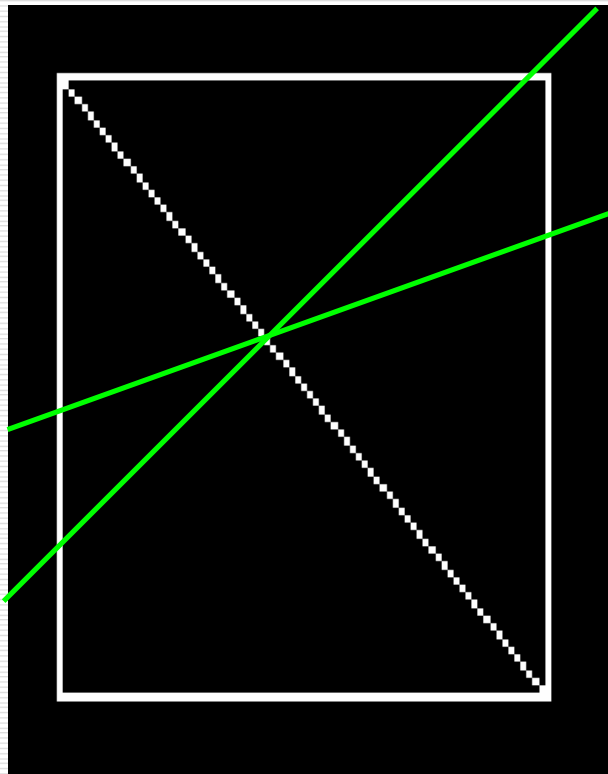
Hough Transform

Hough space

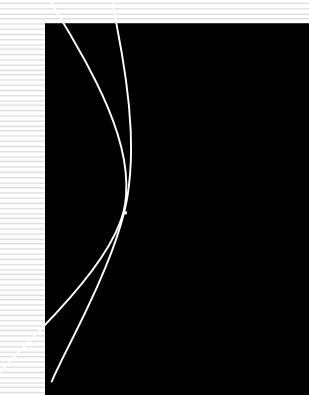
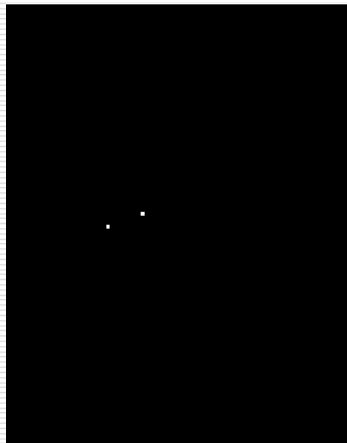
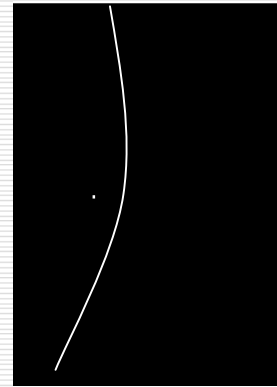
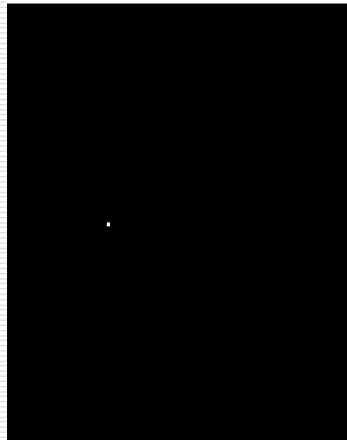


Hough Transform

Hough space

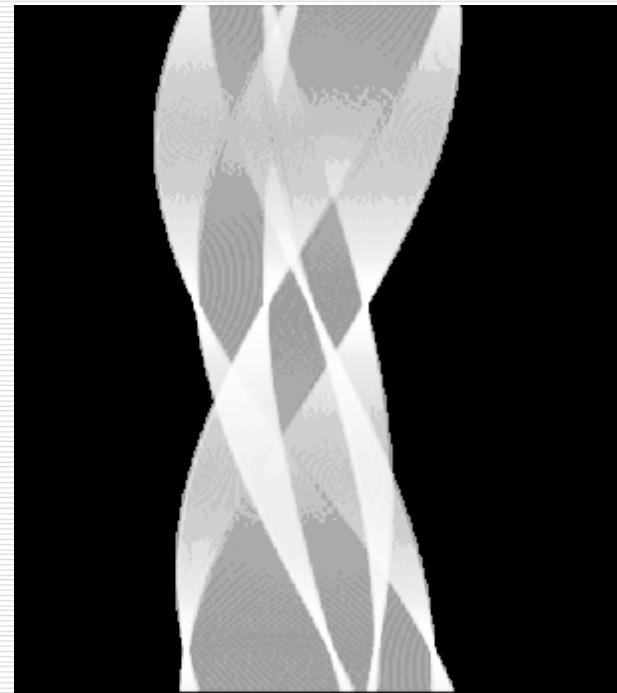
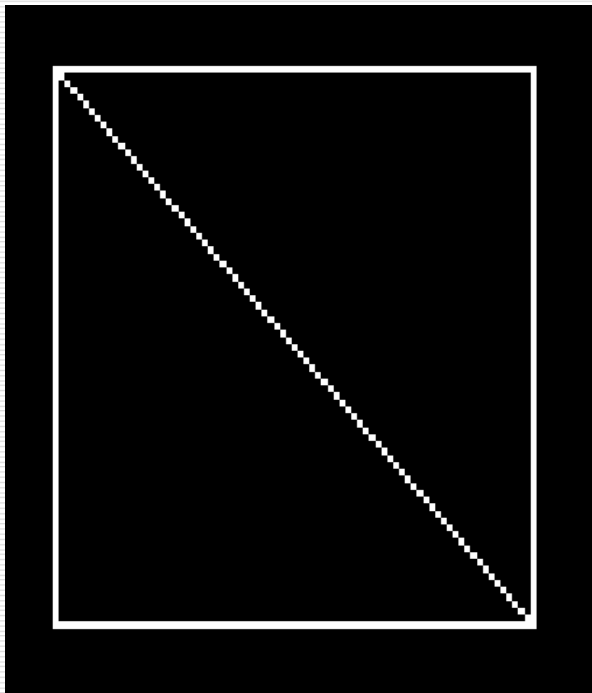


Hough Transform



Hough Transform

o Voting



Hough Transform

Create an array A indexed by f and r
for each point (x,y)

 for each angle f

$r = x \cdot \cos(f) + y \cdot \sin(f)$

$A[f,r] = A[f,r] + 1$

 end

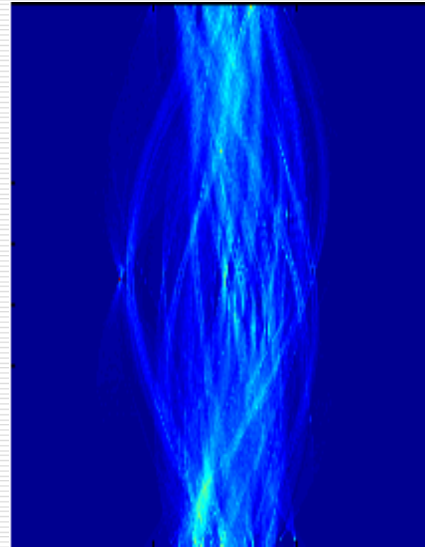
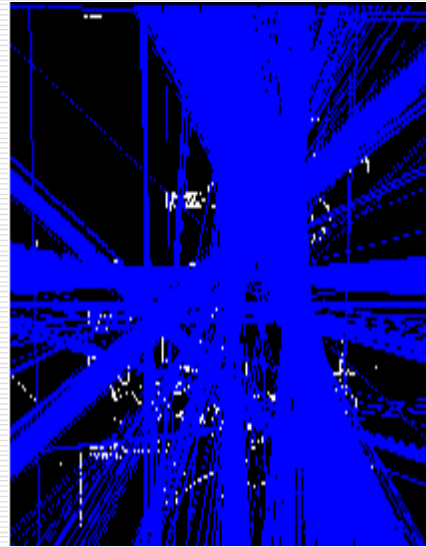
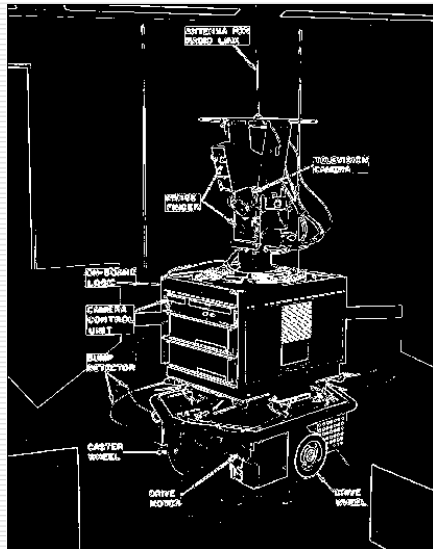
end

where $A > \text{Threshold}$ return a line

- A is called the accumulator
-

Hough Transform

o Example



Jeremy Wyatt

Hough Transform

- o **Questions:**

- n **What is the size of A ?**

- o **If A Too large then ??**
 - o **If A Too small then ??**

- n **How to define the threshold T ?**

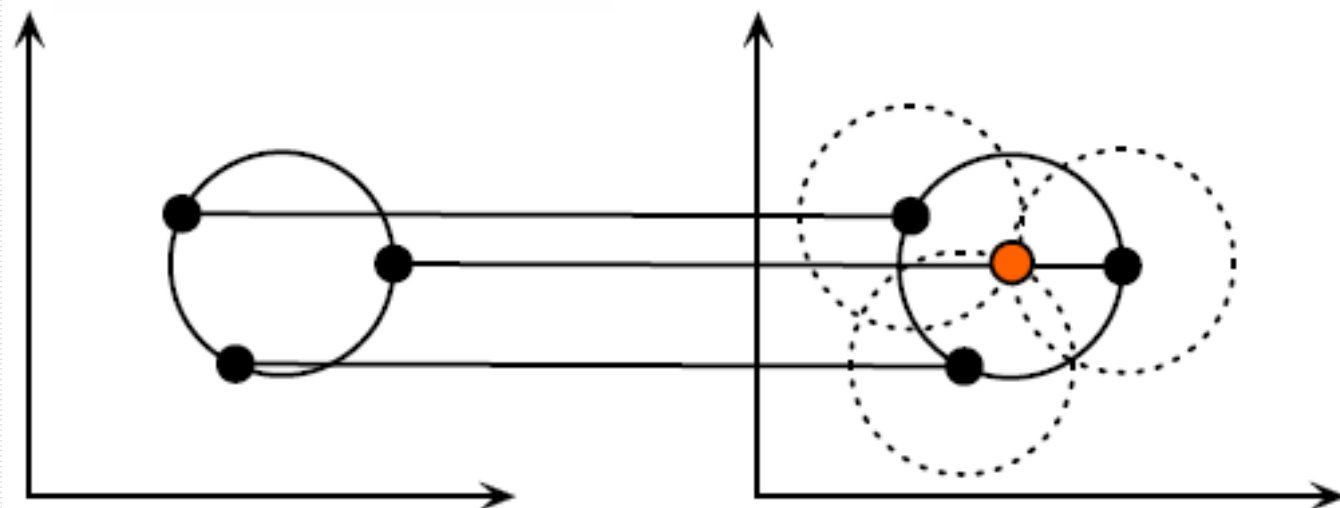
- o **If T Too large then ??**
 - o **If T Too small then ??**
-

Hough Transform

- Other primitives:

$$x = a + R \cos(\theta)$$

$$y = b + R \sin(\theta)$$



- What if R is known/unknown?