

# Report 22th June

## Detection of Ellipse

WU Zihan

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# Project Target

To detect ellipses in the images/videos.



Figure: Input



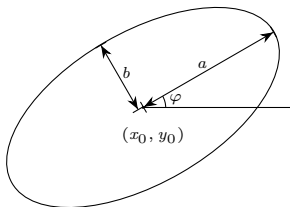
Figure: Output

# Ellipse

To describe an ellipse we need 5 parameters:

$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0, \text{ where } B^2 - 4AC < 0.$$

Or in another way, we need the coordinates of ellipse's center  $(x_0, y_0)$ , semi-major/semi-minor axes  $(a, b)$ , and a rotation angle  $(\varphi)$ .



# Two major ways

## Hough Transform

- Slow
- Sacrifice accuracy for efficiency

## Edge Following

- Derived from Arc-support LS
- use greyscale image (gradient)
- Greedy for efficiency

# Methods

- To detect the arc segments;
- (To form arcs;)
- To predict the 5 parameters for ellipses;
- Co-clustering;
- Validation.

# LSD: A Fast Line Segment Detector with a False Detection Control

IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE

- Finding line-support region (region growing algorithm)
- Rectangular Approximation of Regions
- Validation

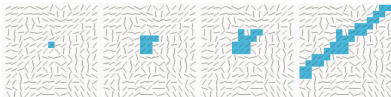


Figure: Region generation

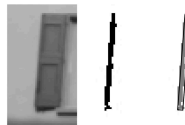


Figure: Rectangular Approximation

# Arc segments' result



Figure: Source Images

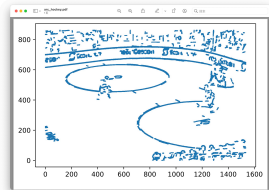
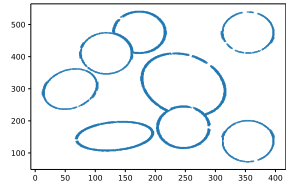


Figure: Arc Detection Results

# Arc Segments' Result



Figure: Arc Segment Example

$$x^2 + bxy + cy^2 + dx + ey + f = 0;$$

$$\begin{pmatrix} x & y & 1 \end{pmatrix} \begin{pmatrix} 1 & \frac{b}{2} & \frac{d}{2} \\ \frac{b}{2} & c & \frac{e}{2} \\ \frac{d}{2} & \frac{e}{2} & f \end{pmatrix} \begin{pmatrix} x \\ y \\ 1 \end{pmatrix} = O_{3 \times 3};$$

$$\begin{pmatrix} x_1 & y_1 & 1 \\ \vdots & \vdots & \vdots \\ x_n & y_n & 1 \end{pmatrix} \begin{pmatrix} 1 & \frac{b}{2} & \frac{d}{2} \\ \frac{b}{2} & c & \frac{e}{2} \\ \frac{d}{2} & \frac{e}{2} & f \end{pmatrix} \begin{pmatrix} x_1 & \dots & x_n \\ y_1 & \dots & y_n \\ 1 & \dots & 1 \end{pmatrix} = O_{3 \times 3}.$$