

TTK4255: Robotic Vision

Homework 2: Feature detection

Jens Erik Kveen

1 Part 1 - Theory

Task 1.1

The standard Cartesian form is problematic because the slope is not defined for vertical lines.

Task 1.2

$$\rho = x \cos(\theta) + y \sin(\theta) \quad (1)$$

this gives:

$$\begin{aligned} \theta = 0^\circ &\implies \rho = x \in [0, L] \\ \theta = 180^\circ &\implies \rho = -x \implies \rho \in [-L, 0] \\ \theta = 45^\circ &\implies \rho = \frac{\sqrt{2}}{2}(x + y) \implies \rho \in [0, L\sqrt{2}] \\ \theta = -45^\circ &\implies \rho = \frac{\sqrt{2}}{2}(x - y) \implies \rho \in \left[-\frac{L}{\sqrt{2}}, \frac{L}{\sqrt{2}}\right] \end{aligned}$$

Task 1.3

The measure is invariant to intensity shifts since the derivatives are not affected by it, so \mathbf{A} remains the same. For rotation it's invariant since the uncertainty ellipse generated by \mathbf{A} does not change shape when being rotated.

If w not radially symmetric, the it's still invariant under intensity shifts for the same reason, but not under rotation. since rotating now will change how w affects the derivatives.

Task 1.4

No, the none-invariance comes due to the fixed maxima threshold. Making this threshold be $\frac{\text{maxima}}{\text{constant}}$ will remove the problem. Since the threshold is scaled along with the rest of the image no new local maxima will show up.

2 Part 2 - Hough transform

Task 2.1

For normalized coordinates we have $\rho \in [-\sqrt{2}, \sqrt{2}]$ and $\theta \in [-180^\circ, 180^\circ]$. So for the un-normalized rho should not be bigger than the image diagonal:

$$\begin{aligned} \text{diag} &= \sqrt{350^2 + 800^2} = 873.2 \\ \rho &\in [-873.2, 873.2] \quad \theta \in [-\pi, \pi] \end{aligned}$$

Task 2.2

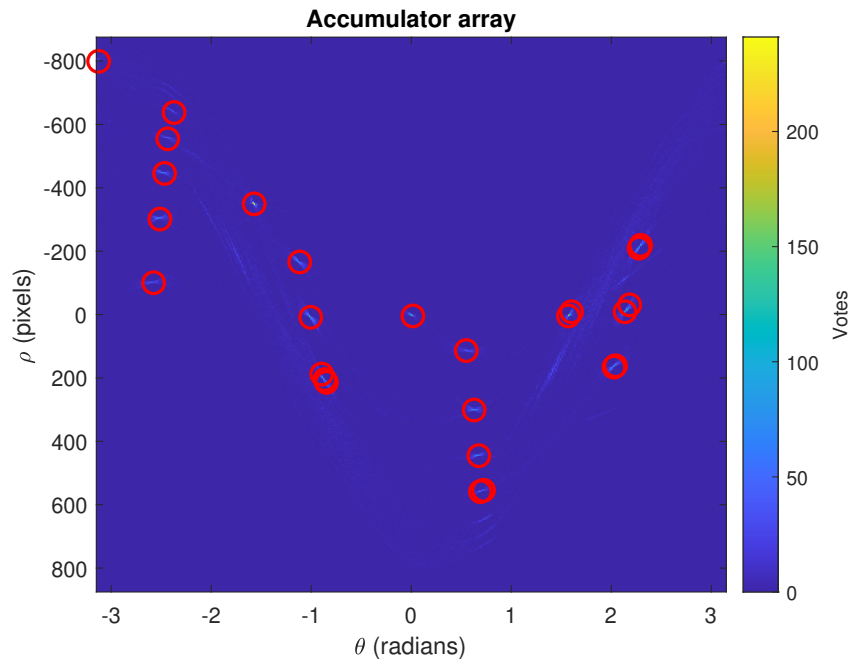


Figure 1: Accumulator array

Task 2.3

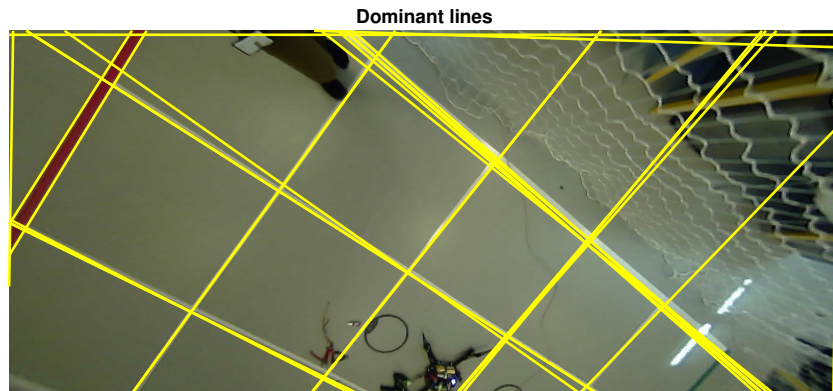


Figure 2: Detected lines overlaid image

3 Part3 - Edge detection

Task 3.1



Figure 3: Corners strength of image

Task 3.2

negative corner strength indicates strong edge like features. This is clearly visible in the lines around the doors in the strength image: Figure 3.

Task 3.3

Some of the checkerboards are "brighter" than the rest and also the contrast between the black and white squares is bigger. This gives a stronger response than the others.

Task 3.4

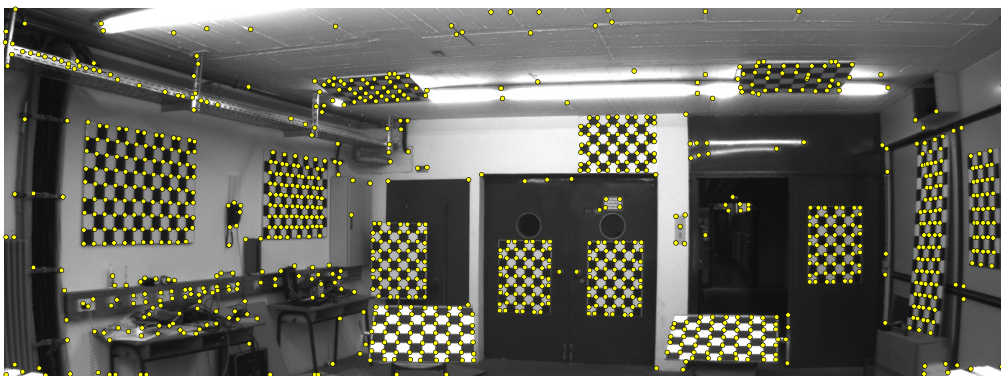


Figure 4: Scatter plot of detected corners over image