DATA.ML.300 Computer Vision Exercise 4

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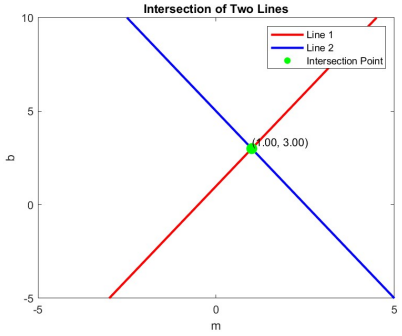
30 Jan 2024

1 Task 1

(a) Lines in parameter space are:

$$1 = -2m_0 + b_0$$
$$5 = 2m_1 + b_1$$

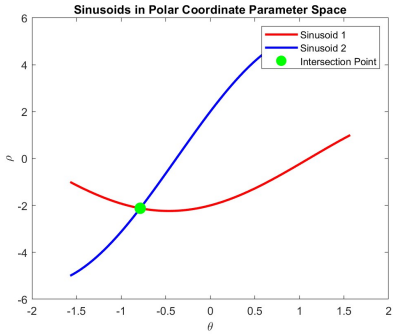


Intersection at m = 1, b = 3

(b) Sinusoids in Polar coordinate parameter space are:

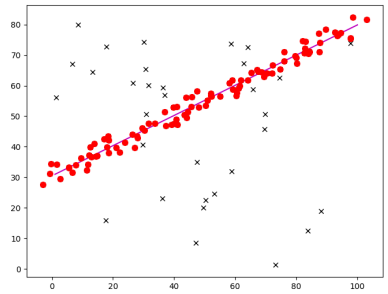
$$\rho_0 = x_0 cos(\theta) + y_0 sin(\theta)$$
$$\rho_1 = x_1 cos(\theta) + y_1 sin(\theta)$$

Intersection at $\theta_i = \arctan(-1)$, ρ = -2 $\cos(\theta_i)$ + $\sin(\theta_i)$

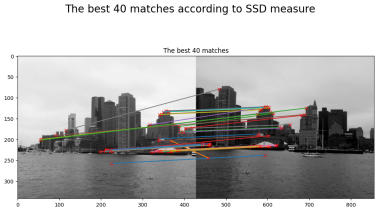


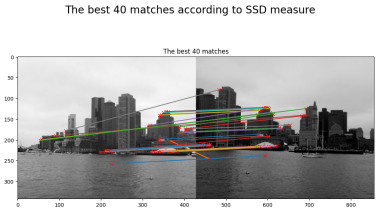
(c) Polar coordinates form simplifies the computation of vertical lines which have undefined slope in Cartesian coordinates form as they can be represented as horizontal sinusoidal curve in polar coordinates form. Additionally, polar coordinates can also represent lines that pass through origin easily unlike in Cartesian coordinates form as the y-intercept of such lines are undefined.

2 Task 2



3 Task 3





Comparing the two plots, we can clearly see that NCC performed better in this image. The reason is that it normalizes by the product of the standard deviations of two patches, making it more robust to brightness, contrast and scale variance. Since the image on the right is darker and translated compared to the image on the left, NCC would perform better in this case.

4 Task 4

(a) Among the top 5 matches for NNDR, only 1 of them is correct while 2 of them are correct for where ordering is based on nearest neighbor distance.

(b) SURF has a few advantages over Harris Corners. Firstly, SURF is scale and rotation invariant, making it more robust compared to Harris Corners in which the corners detected in one image might not necessarily match the scaled or rotated version of the same image. Secondly, SURF is more versatile than Harris Corners as it can detect different types of features unlike Harris Corners which specifically identify corners in an image. This is crucial for many computer vision task such as object recognition. In some cases, however, Harris Corners may still be better than SURF. For example, in scenarios where computational resources are limited, Harris Corners may be preferred due to their simplicity and lower computational cost. Additionally, for some specific applications where the primary goal is to detect corner-based features, Harris Corners might still be a good choice because SURF has many additional features beyond corner detection which can increase the computational cost.