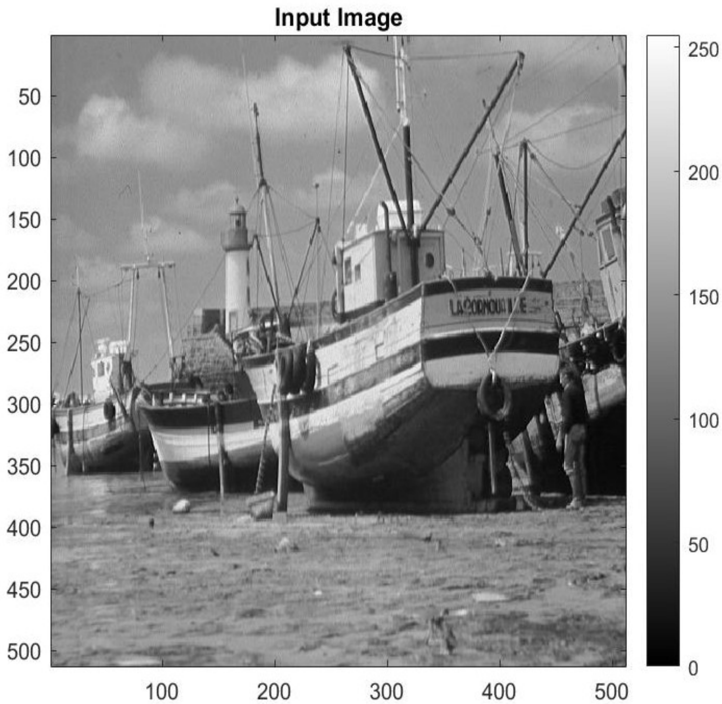
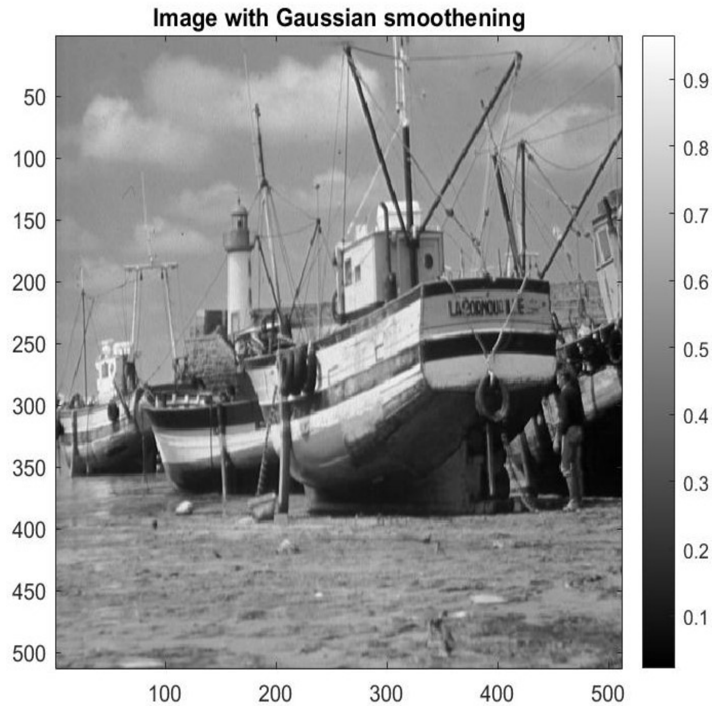
REPORT -Q1

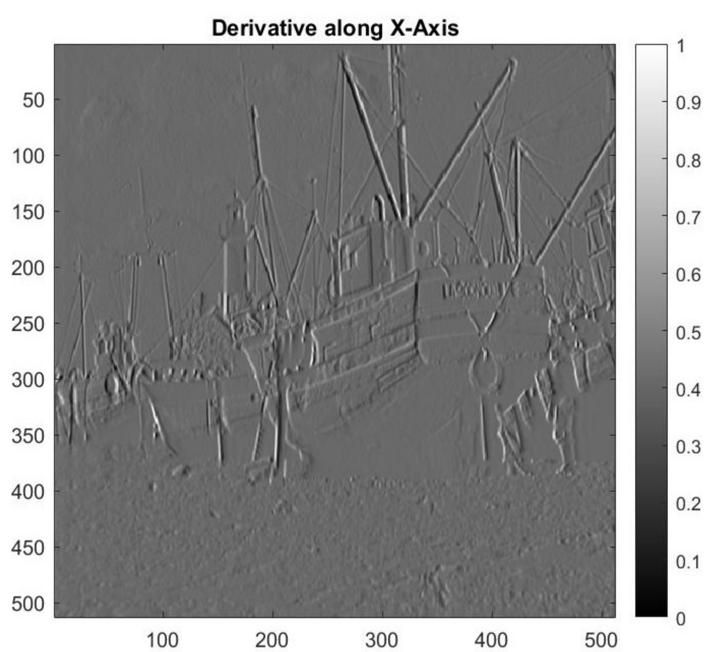
Harris Corner Detection Algorithm

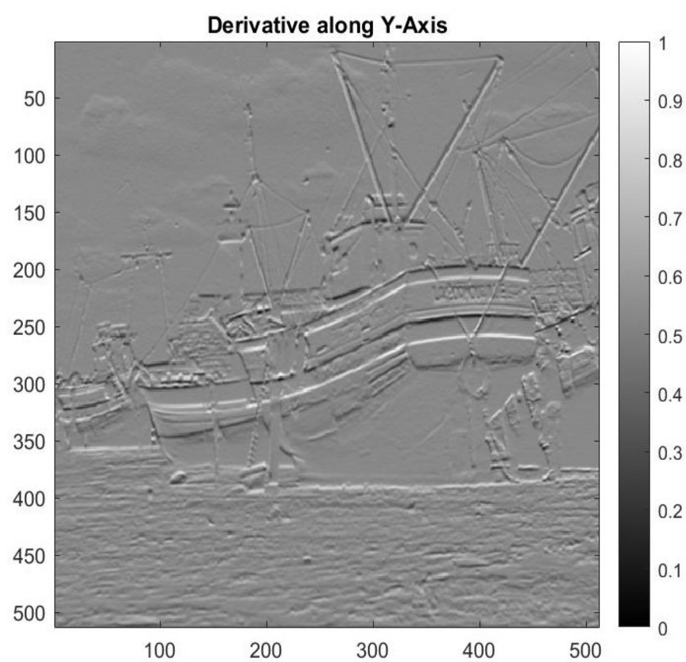
I. Boat.mat





The intensities in the original image *boat.mat* were rescaled to [0,1] and gaussian smoothening filter applied, with sigma1 = 0.5.



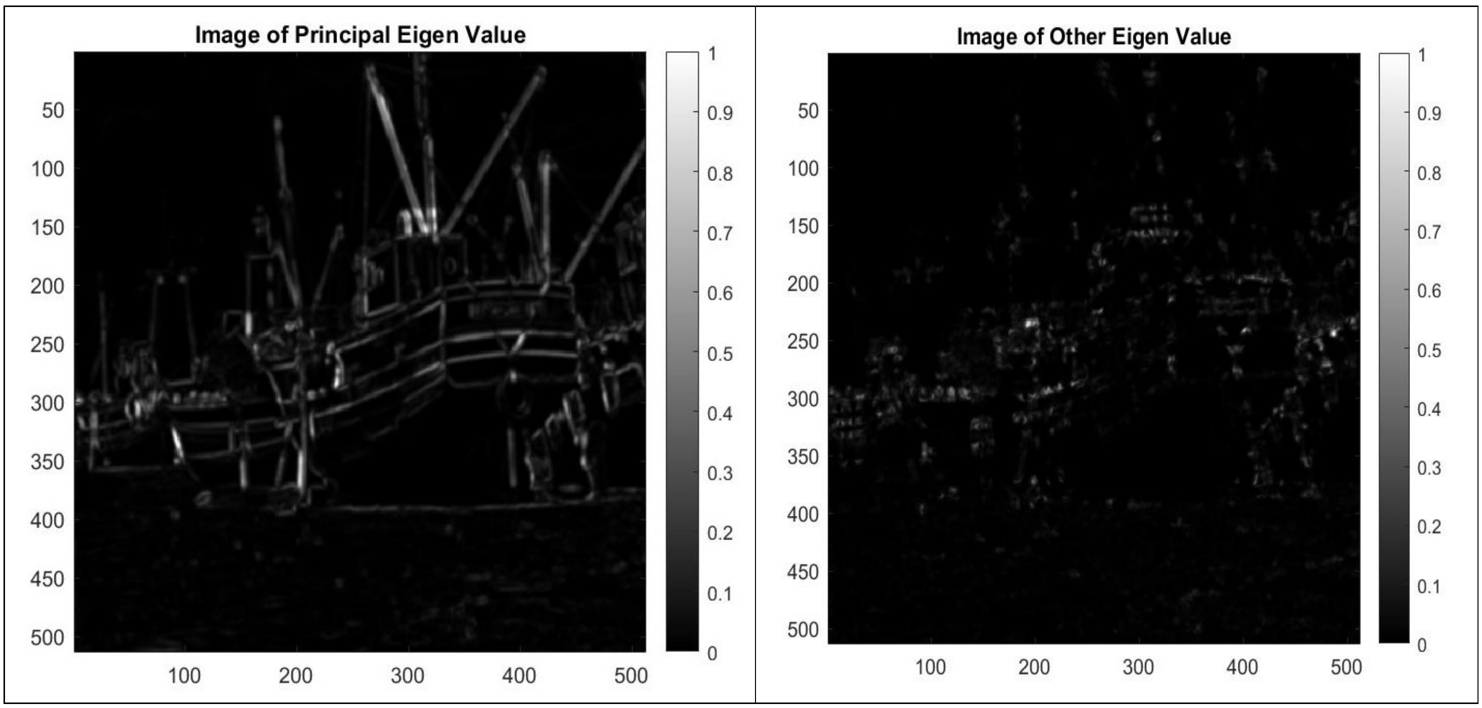


The partial derivatives of the smoothened image along the vertical and horizontal directions. These partial derivatives *(I_x, I_y)* are then used to calculate structure tensor components, along with gaussian smoothening(sigma2 = 1.4), given by the formula:

$$A = \sum_u \sum_v w(u,v) \begin{bmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix}_{(u,v)}$$

Also, the patch dissimilarity at any shift (x,y) is given by:

$$S(x,y) \approx \begin{pmatrix} x & y \end{pmatrix} A \begin{pmatrix} x \\ y \end{pmatrix}$$



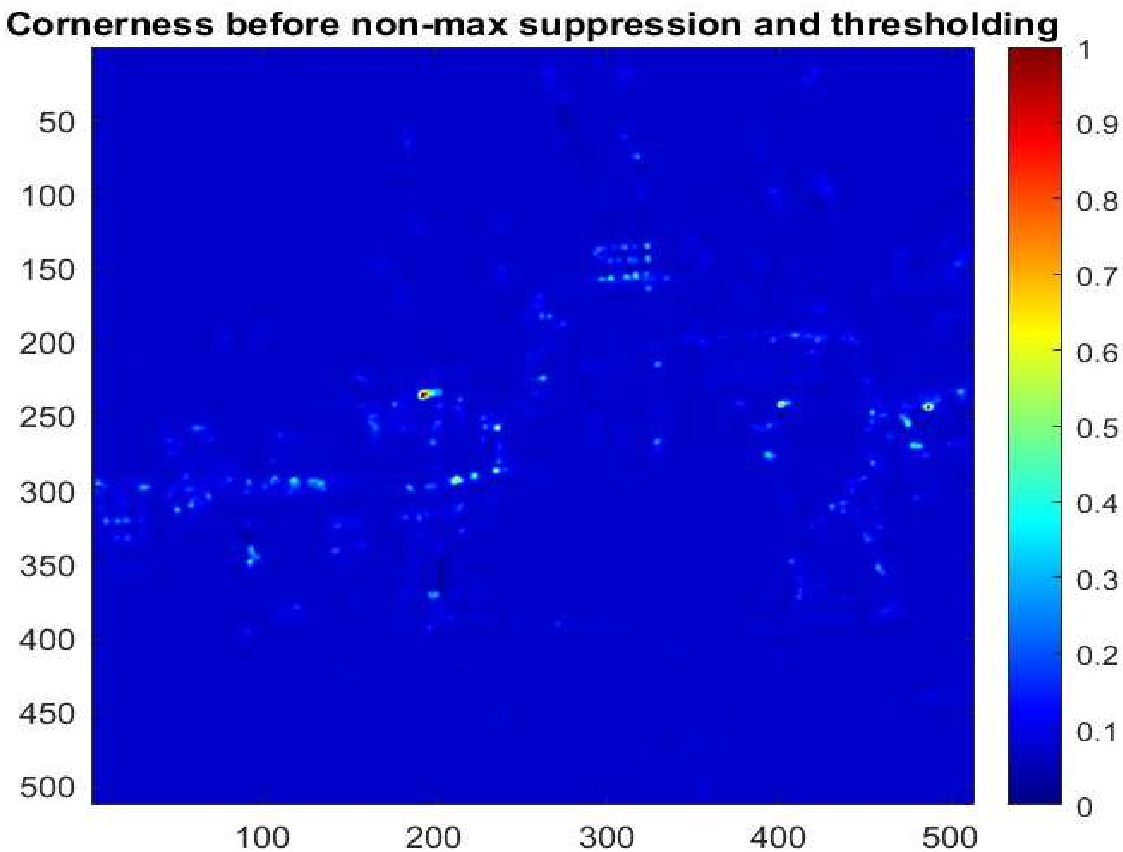
The images obtained for principal eigen value and the other eigen value

The corners are detected where **both** the principal and other eigen value are **large**

Structure tensor components are then used to calculate the Corner-ness measure at each pixel, where:

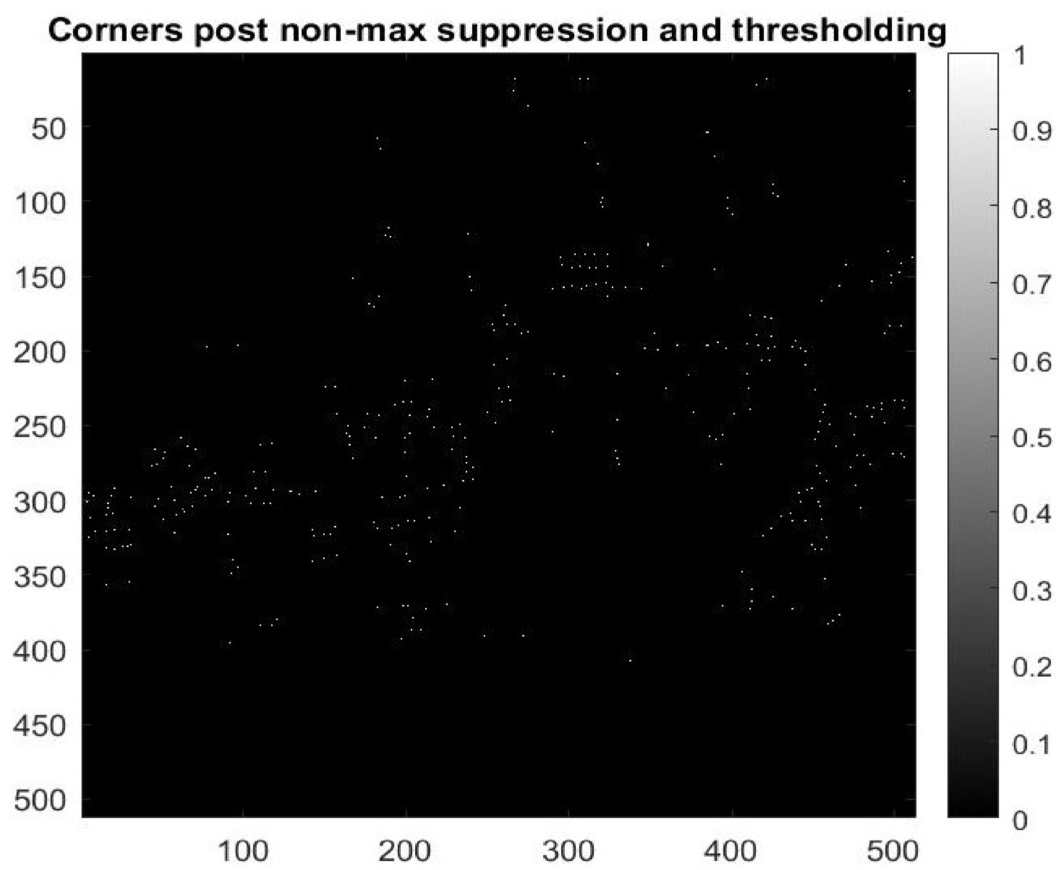
$$\text{Corner-ness } C := \text{Determinant } (A) - k \,(\text{ Trace } (A)\,)^2$$

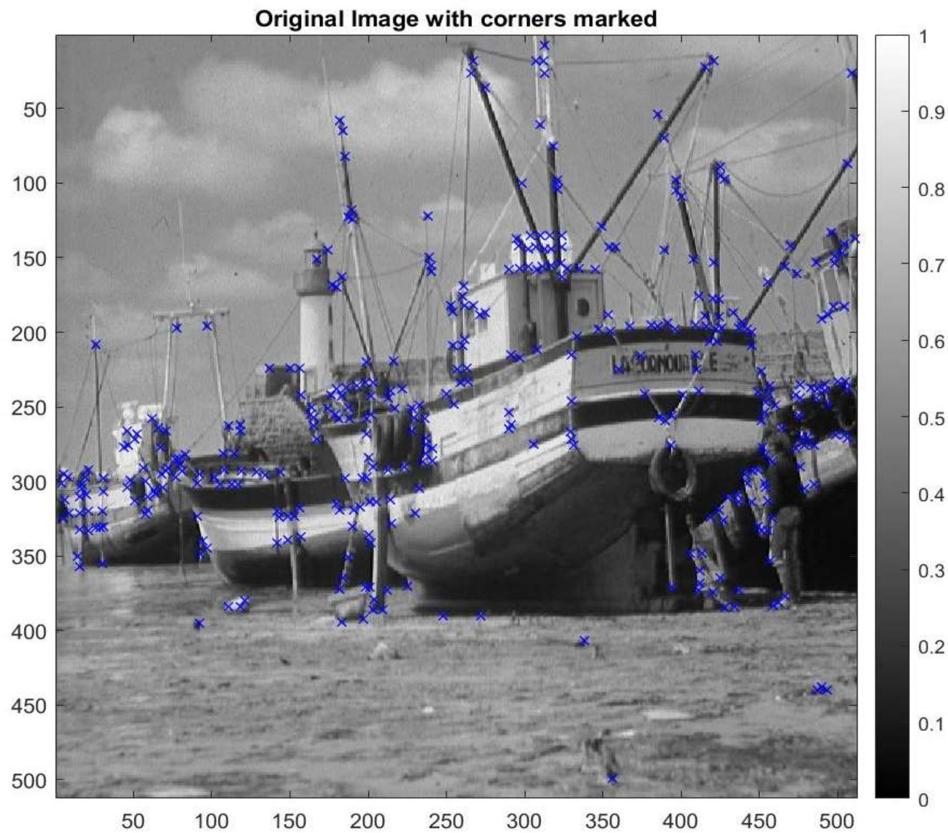
The constant k in the corner-ness measure is empirically tuned to lie between 0 and 0.25. The tuned value of scaling parameter k = 0.01.



Here, corners are detected when both eigen values of the structure tensor are large.

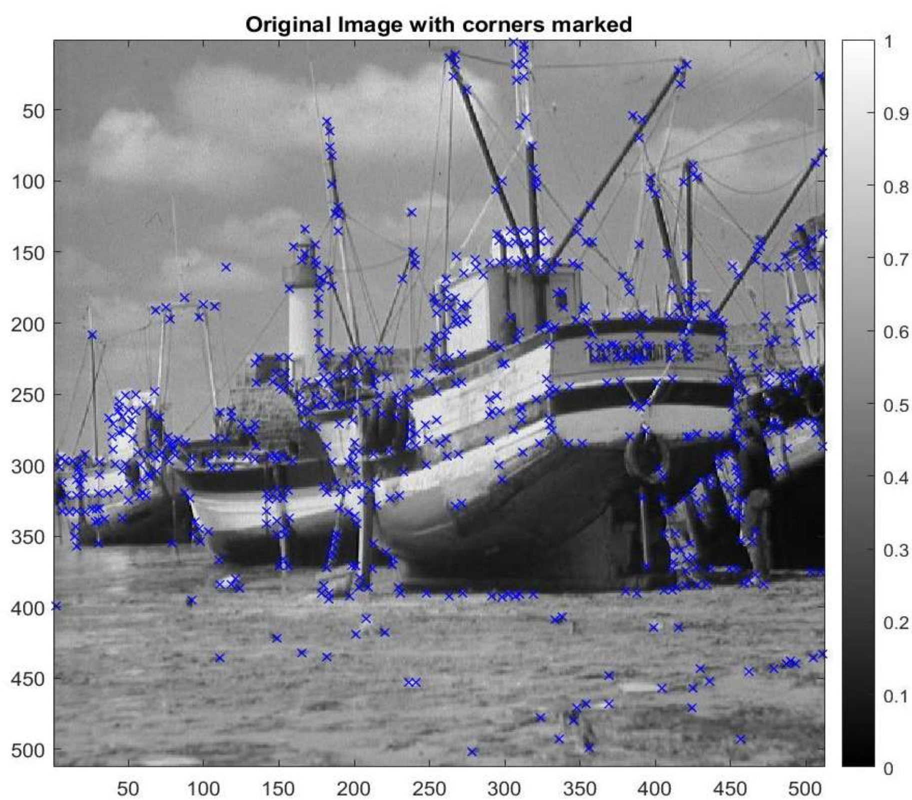
Finally, after non-maximum suppression, using a window of size 3X3 and thresholding at 0.04, the corners are marked in the original image





Hence, the corners in the image are accurately detected. The tuned parameter values are:

Sigma1	0.5
Sigma2	1.4
k	0.01
Threshold	0.04



Here, decreasing the threshold(=0.01) gives some irrelevant corner points