EE5176: Computational Photography

Programming Assignment 1

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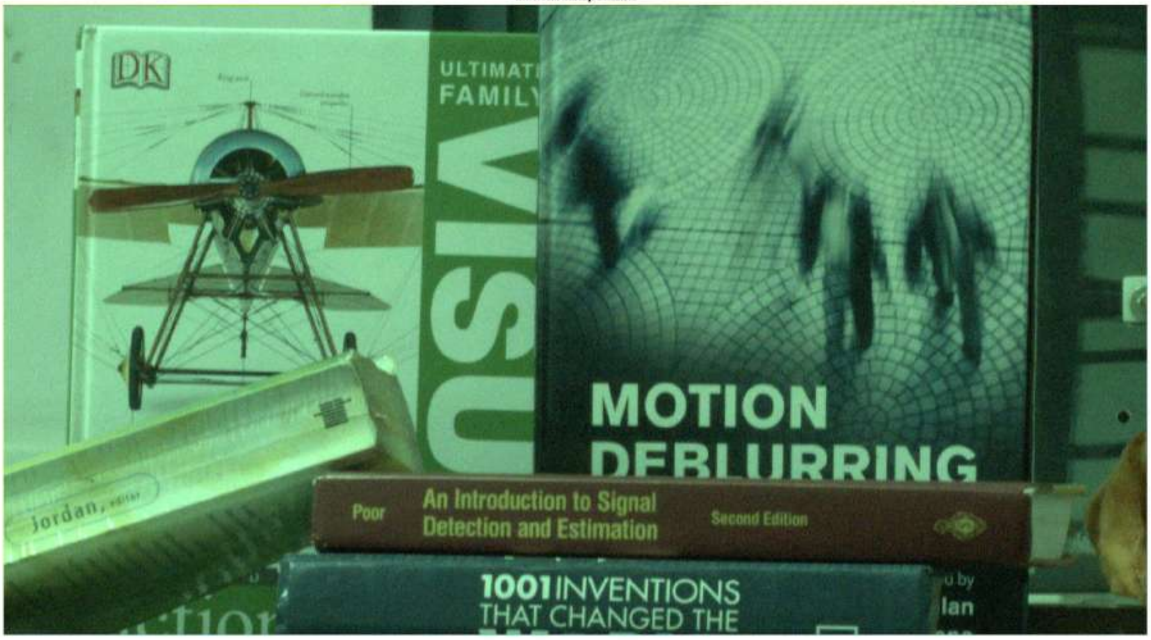
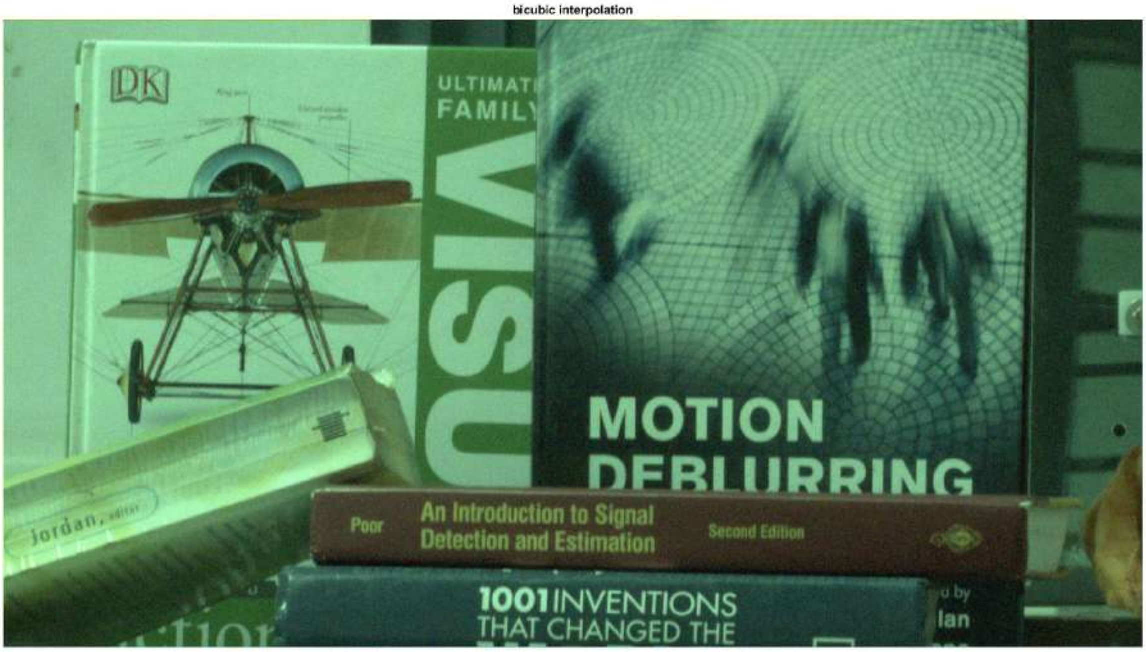
1. **Demosaicing**
   a) Bilinear Interpolation

bilinear interpolation

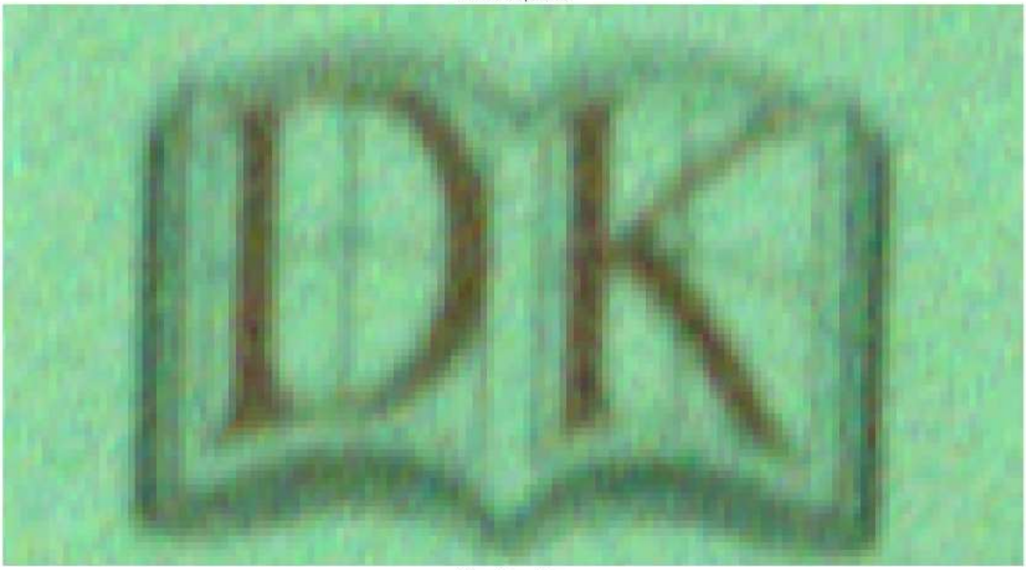


   b) Bicubic Interpolation

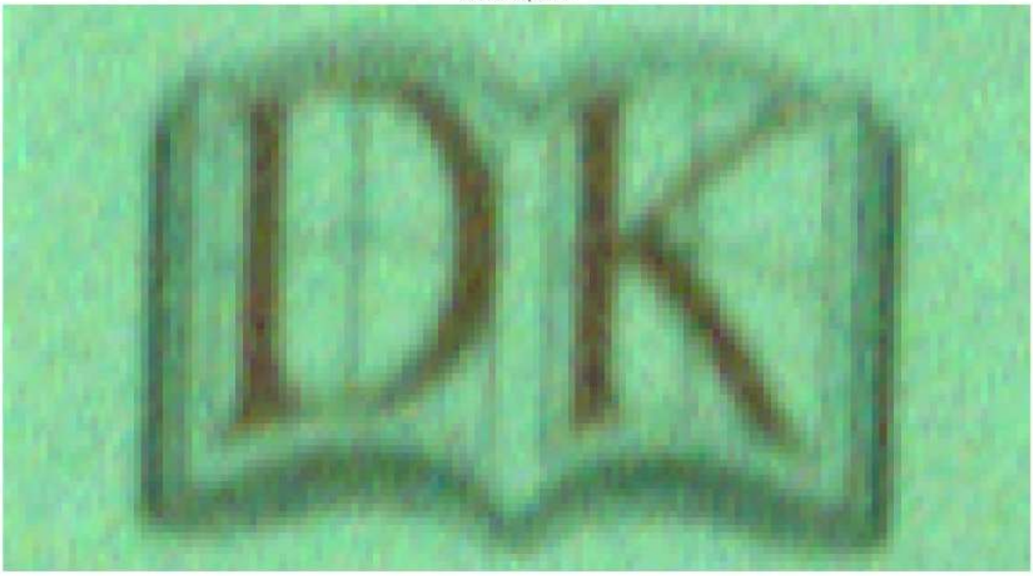
bicubic interpolation



bicubic interpolation

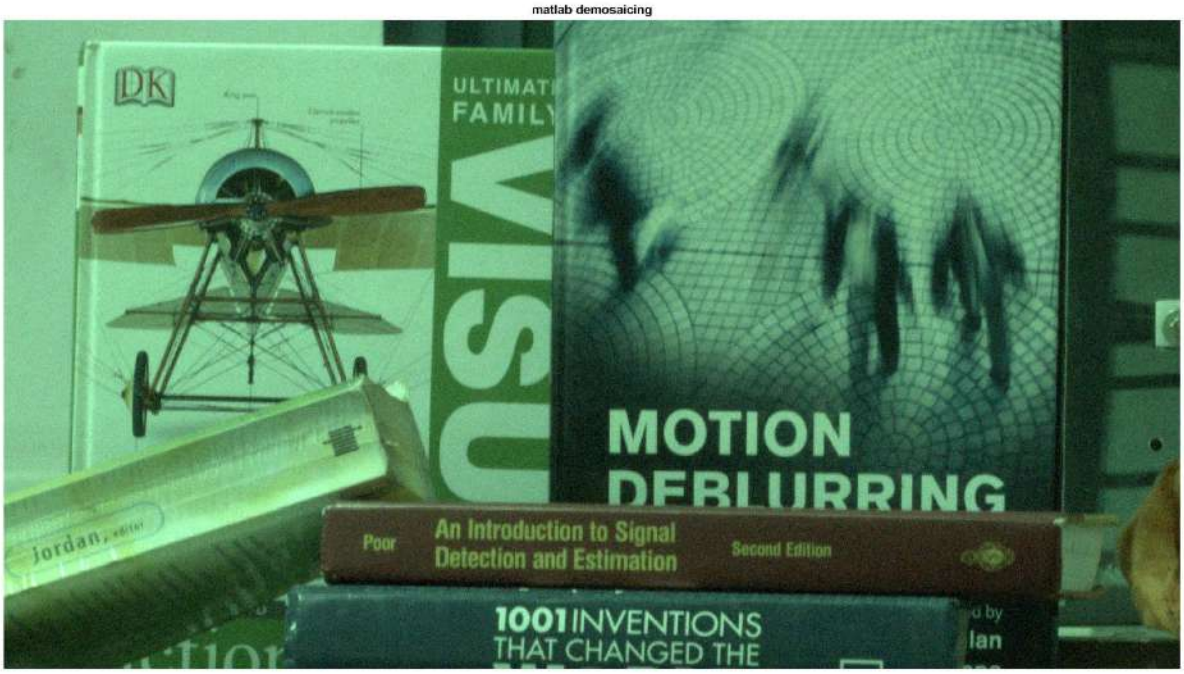


bilinear interpolation

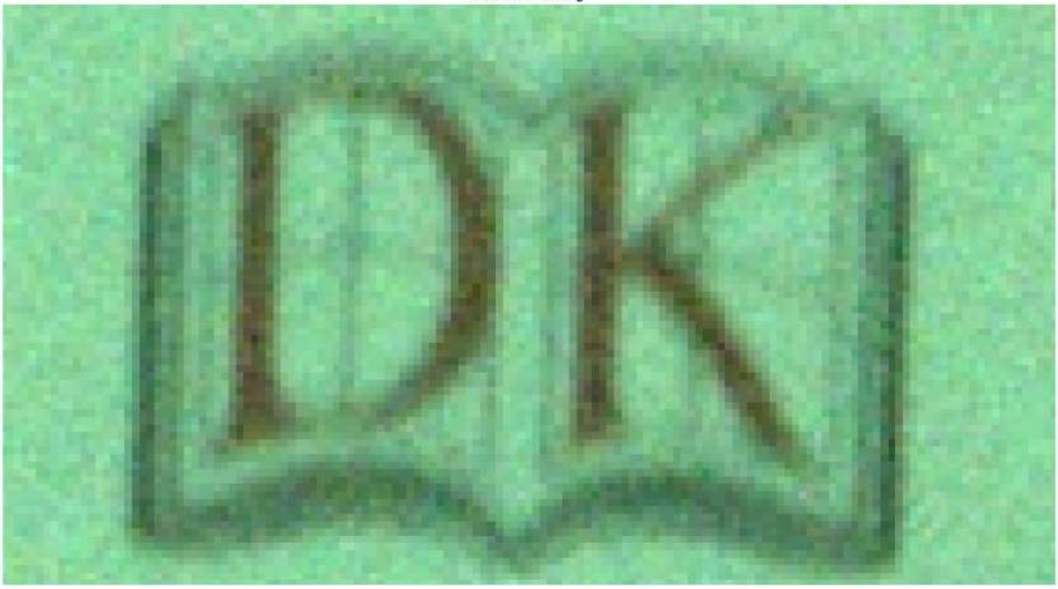


c) Matlab Demosaicing

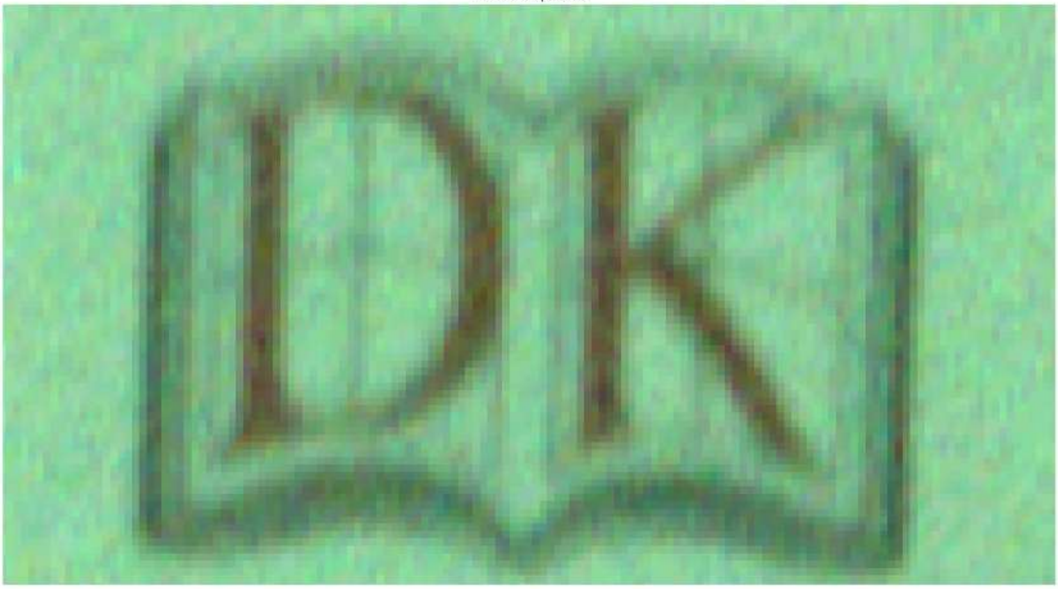
matlab demosaicing



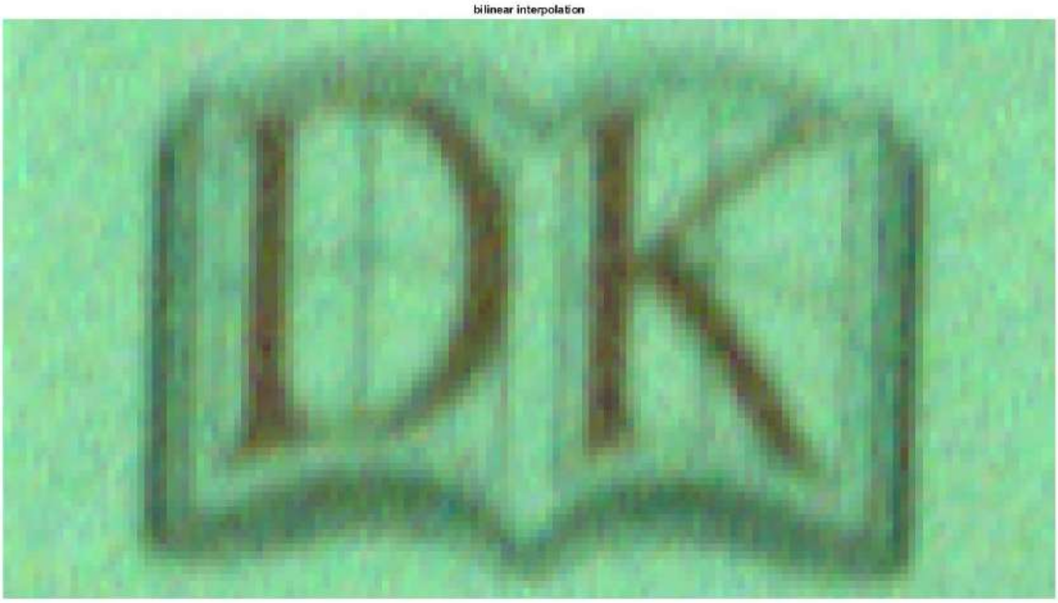
matlab demosaicing



bicubic interpolation



bilinear interpolation



d) The assumptions that are made is that the NaN values in the border of the colour channels are set to 0. If this assumption is not taken to consideration, then the image cannot be generated.

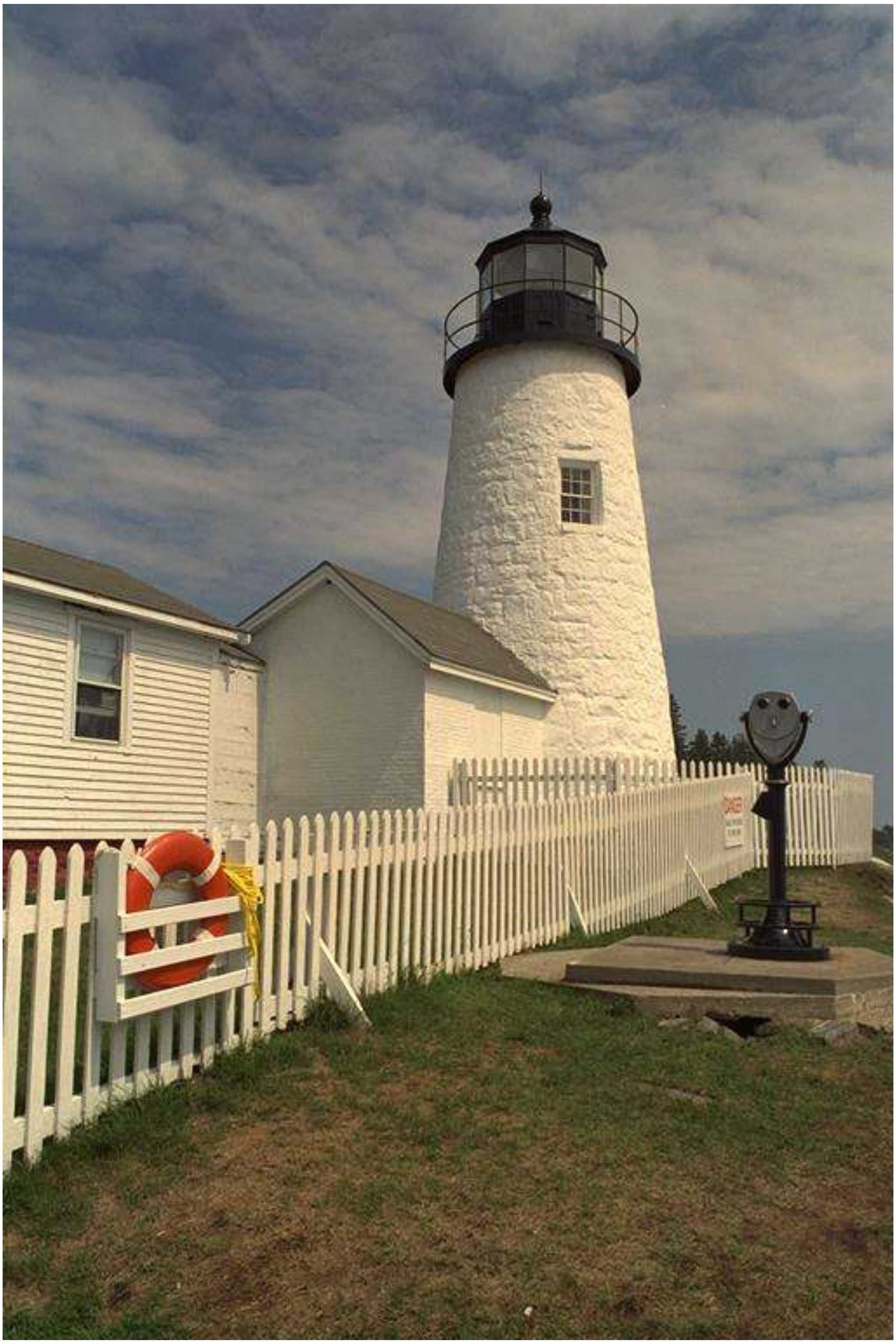
e)

kodim demosaicing

f)

kodim median filtered ycbcr

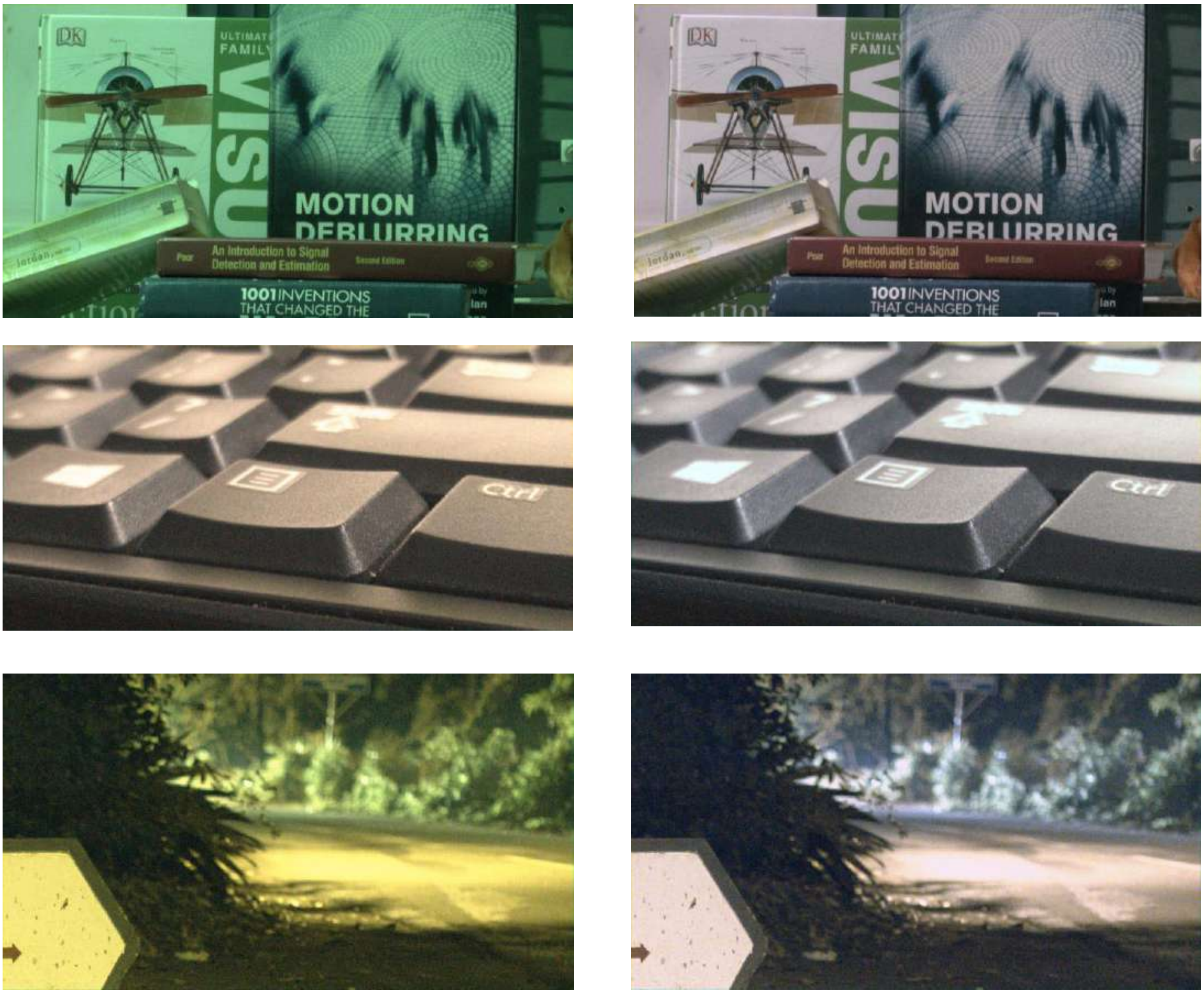
g)



In the demosaiced image, there are color fringe patterns visible mostly on all the edges. They are highly visible in the horizontal edges of the leftmost house, in the watchtower's window and in the fence. The median filtered image has mostly removed all the color fringe patterns of the demosaiced image, except for the slightly visible fringe pattern on the fence. The original image does not have any fringe patterns, although it needs to undergo white-balancing.

2. White Balancing and Tone Mapping

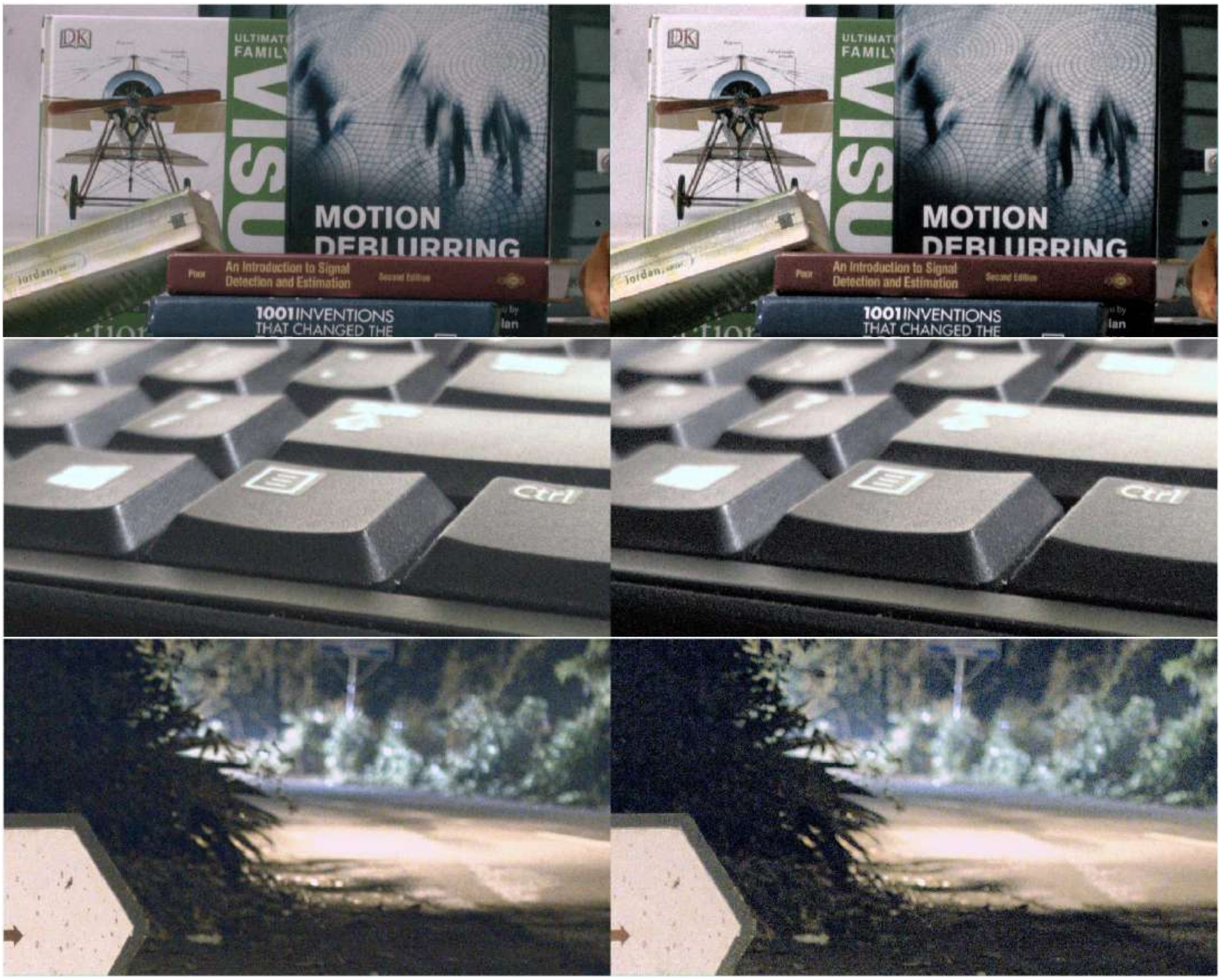
a)



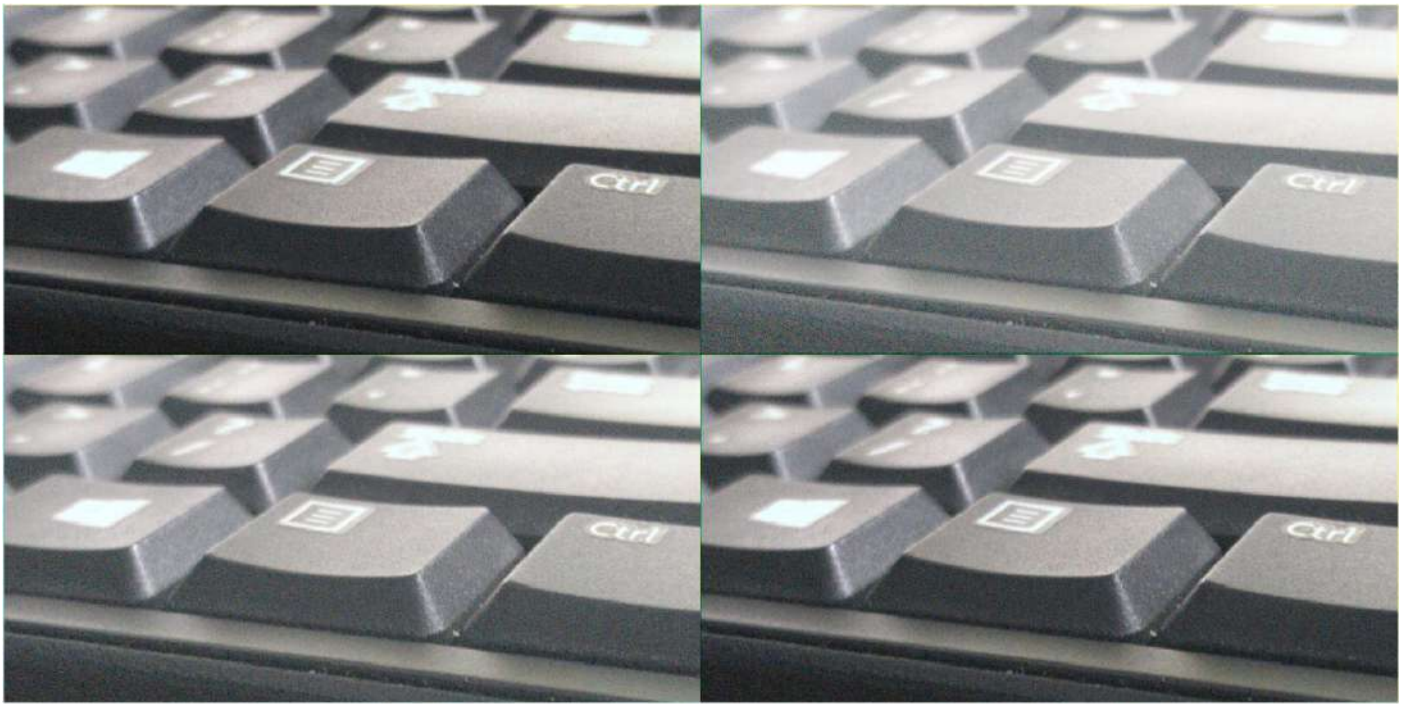
b)

c)

d) (left – Original image, right – Histogram Equalization)



e) (top left – Original Image, top right – 0.5 gamma, bottom left – 0.7 gamma, bottom right – 0.9 gamma)



3. Image Denoising

a) (1060:1128,1:100)

b) (705:765,924:984)

c) (1:200,1:200)

1. If k is the size of kernel than sigma = (k-1)/6. This is because the length for 99% of gaussian pdf is 6*sigma.

2. If sigma_r <= sigma_n, there would be less performance of noise filtering, i.e. there would be more noise. If sigma_r >> sigma_n, the noise filtering would be so much that even the edges would get smoothened.

[From Stanford lectures]

4. Given

Pixel width = 3.45 μm circle of confusion = 3 pixels

$f = 16mm$ $W = 3.45\mu m \times 3 = 10.35 \mu m$

a) Aperture $D = \frac{f}{N} = \frac{f}{2.2}$ $v = 3m$

$DOF_{+} = \frac{NWv^2}{f^2 + NWv}$ $DOF_{-} = \frac{NWv^2}{f^2 - NWv}$

i) $DOF_{+} = 0.6319m$ $DOF_{-} = 1.091m$

$DOF = 1.723m$ $DOF = DOF_{+} + DOF_{-}$

ii) Aperture $D = \frac{f}{4}$ $v = 3m$

$DOF_{+} = 0.98m$, $DOF_{-} = \cancel{2.821m}$ $2.827m$

$DOF = 3.807m$

iii) Aperture $D = \frac{f}{4}$ $v = 1m$

$DOF_{+} = \cancel{0.139m}$ $0.139m$ $DOF_{-} = 0.1929m$

$DOF = 0.332m$

b) From (i) → (ii), the aperture was reduced and hence, the depth of field increased. $DOF \propto \frac{N}{f}$

From (ii) → (iii), the object ~~red~~ distance reduced and hence, the depth of field reduced. $DOF \propto v^2$