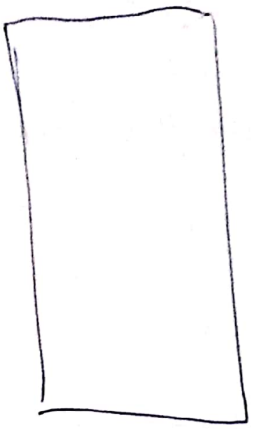
Quality of image



Parameter of Quality of image:-

1. format of image → .png file
   → .jpeg file
2. whitning of image
3. Contrast of image
4. Noise of image
5. Colorspace of image (distribution of color)

Image Quality Parameters

MTF - Modulation Transfer Function
CTF - Constrast Threshold "
} → Radiography

Noise - Noise Equivalent Irradiation (NEI)
Noise Equivalent Quanta
Noise Equivalent Temperature Difference (NEDT)

SNR - Signal to noise Ratio

JND - Just noticeable difference } 2 image

comparison
→ meta properties

Whitening of image :- (Increase the whitening of image)

By do whitening, the network will converge faster

→ To get rid of correlation among data.

Whitening transform (ZCA)

Image Processing :-

• A general image processing operator is a fn that take one or more image as input image and produce an output image.

• Image transform can be seen as;
  • Point operators (pixel transform)
  • Neighbourhood (area-based) operator

Pixel transformation :-

• In this kind, each output pixel's value depends on only the corresponding input pixel value

• Brightness and contrast adjustment :-

$$g(x) = \alpha f(x) + \beta$$

$\alpha > 0$ and β are often called the gain and bias parameter.

alpha value [1.0 - 3.0] , beta value → [1-100]

Gamma correction :

$$O = \left(\frac{I}{255}\right)^{\gamma} \times 255$$

when $\gamma < 1$, the original dark region will be brighter and the Histogram will be shifted to right

Prewhitening with zero-phase component analysis (ZCA) :-

ZCA, a whitening technique that increase spatial selectivity (precision) of the spatial filter maps.

* whitening remove covariance structure.

$$Y = VD^{-1/2}V^T X$$

$X = VDV^T$

$X VD^{-1/2}U^T = Y$

what does it do?

- shrink large data directions and expend small data directions.
- Large data directions in a channel covariance matrix tend to reflect low spatial frequencies
- ZCA whitening increases the spatial precision.
- whitening only some dimension to focus on shrinking only the largest component.

```
r = d > .5
Y = V(:, r) * D(r, r) ^ (-1/2) * V(:, r)' * X;
```

pre_whiten :

```
mean = np.mean(x)
std = np.std(x)
std_adj = np.maximum(std, 1.0/np.sqrt(x.size))
y = np.multiply(np.subtract(x, mean), 1/std_adj)
return(y)
```

Histogram Equalization :-

- Histogram Equalization is a technique for adjusting image intensities to enhance contrast.

$$P_n = \frac{\text{number of pixel with intensity } n}{\text{total number of pixels}} \quad n = 0, 1, \ldots, L-1$$

$$g_{i,j} = \text{floor}\left((L-1)\sum_{n=0}^{f_{i,j}} P_n\right)$$

Histogram Equalization on ~~image~~ 3-D image :-

- Separate out the image in all three component respectively.

$r, g, b =$

- Apply histogram in each component respectively
- finally merge them.

OR

- Conversion bgr image into gray & white image.

DHE and gamma correlation

Tan & Triggs :-

→ Illumination & Reflectance :- (Suitable for)

- Illumination is amount of light falling on the scence and depend on external condition.

Reflectance is the amount of light reflected by obj & is affected by objects property.

Tan Triggs

- Increasing the gamma, increase dynamic range in darker regions while compresses it in the brighter region further.

Steps:

Gamma correction → difference of gaussian filtering → masking

Contrast Equalization ←

Difference of gaussian filtering

- Shading effects are consider to be predominantly low frequency phenomena
- It is not possible to distinguish b/w a illumination gradient and one caused by shading effects of surface structure since ~~modelling~~ illumination is also modelled as low frequency phenomena.
- DoG filter is a way to perform bandpass filtering operations which remove shading & illumination component in the image and also reduce the noise.
- The output of DoG filter is edge intensity image.
- The second gaussian has large sigma, which remove high frequency details in the image and retain only low frequency component of the image
- Now from we subtract this low frequency image from the original low pass filtered image thereby obtain a high frequency edge image.
- $\sigma_1 = 3$ & $\sigma_2 = 7$

Contrast equalization:

- The final step of our processing chain is contrast equalization which globally rescales the image intensity to standardize a robust measure of overall contrast or intensity variation.

- Since DoG approximate gradient, there are bound to be extreme value produced by highlights, shadow & noise etc.

$$I = \frac{I}{(\text{mean}(I^{\alpha}))^{1/\alpha}}, \quad I = \frac{I}{(\text{mean}(\min(\tau, I^{\alpha})))^{1/\alpha}}$$

$$I = \tau * \tanh\left(\frac{I}{\tau}\right)$$

→ output rang $(-\tau, \tau)$

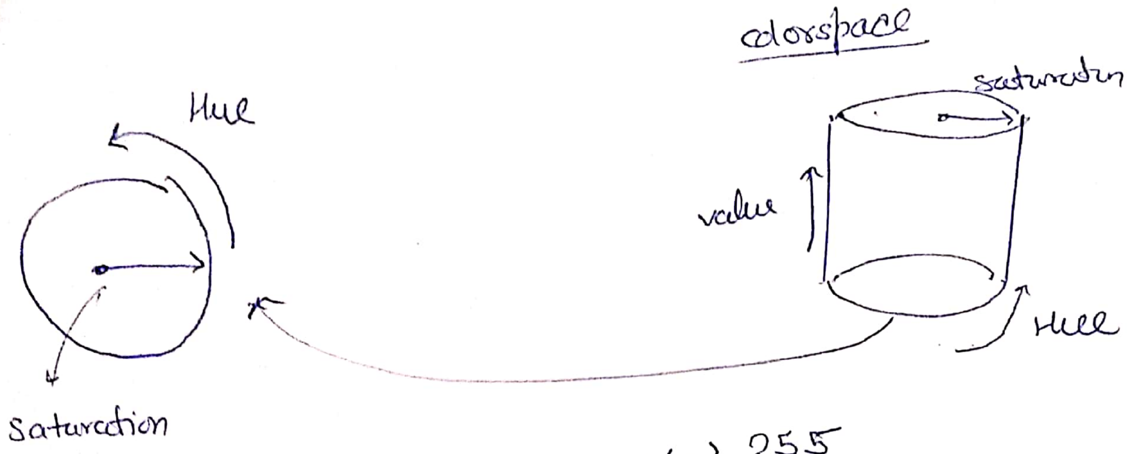
Colorspace of image :-

← Image Quality parameter →

MTF :- (modulation transfer function) :-

- It is spatial frequency response of an imaging system or a component
- It is the contrast at a given spatial frequency relative to low frequency.
- MTF is responsible for converting contrast value of different-sized objects into contrast intensity level in image.

HSV



V → 255

0 → black 100 → 40 k

→ 40 – 220

Hue: 0-180

Saturation! 0-255

value ; 0-255

value is the direction of lightness/darkness. In term of a spectral definition of color.

→ **Noise** :-

Salt and paper noise :-

SNR (Signal to noise ratio) = signal power/Noise Power

→ Image alignment :-

Enhanced correlation coefficient (ECC)

→ ECC is invariant to photometric distortions in contrast and brightness.

→ The objective fun is non-linear fun of the parameters,