**Lecture 3: Pixel-wise Operation**

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Arithmetic operation is expressed like O = f(I), O means output intensity and I means input intensity. For example, f(I)=I+128, f(I)=I-128. They make images bright or dark. And there are also Complements operation. For example, 1-m or 255-m.

- Image histogram

Image histogram counts how many times each intensity value occurs in an image. Eventually, this shows an intensity distribution. Thanks to that, we can know how the image is dark or bright and Image contrast. Histogram and PDF are same except that histogram’s region sum is the number of all pixels in an image, but PDF’s region sum is 1.

- Histogram stretching

For a better visibility, the image has low contrast can be stretched using Histogram Stretching. And there are many types of stretching functions depending on an image content like linear or curve stretching function. Gramma correction is used to curve stretching function. And it can make image more detailed.

- Histogram equalization

Histogram equalization is a fully automatic procedure for enhancing the contrast. It means that makes intensity values have a uniform probability. There are two constraints for histogram equalization. At first, a final histogram should be as uniform as possible. Second, the input pixels with the same intensity should be changed with the same intensity. The formula is s= T(r) = (L-1)CDF(r). But it has the problem like washed-out appearance. It can solved using histogram matching.

- Histogram matching

It generates a processed image that has a specified histogram. The formula is z=G^-1(s) = G^-1(T(r)). We have to apply equalization twice. Histogram equalization try to be as similar as possible to uniform distribution. Otherwise, Histogram matching try to be as similar as possible reference.