Point Operation

Arithmetic Operation & Grayscale Transformation

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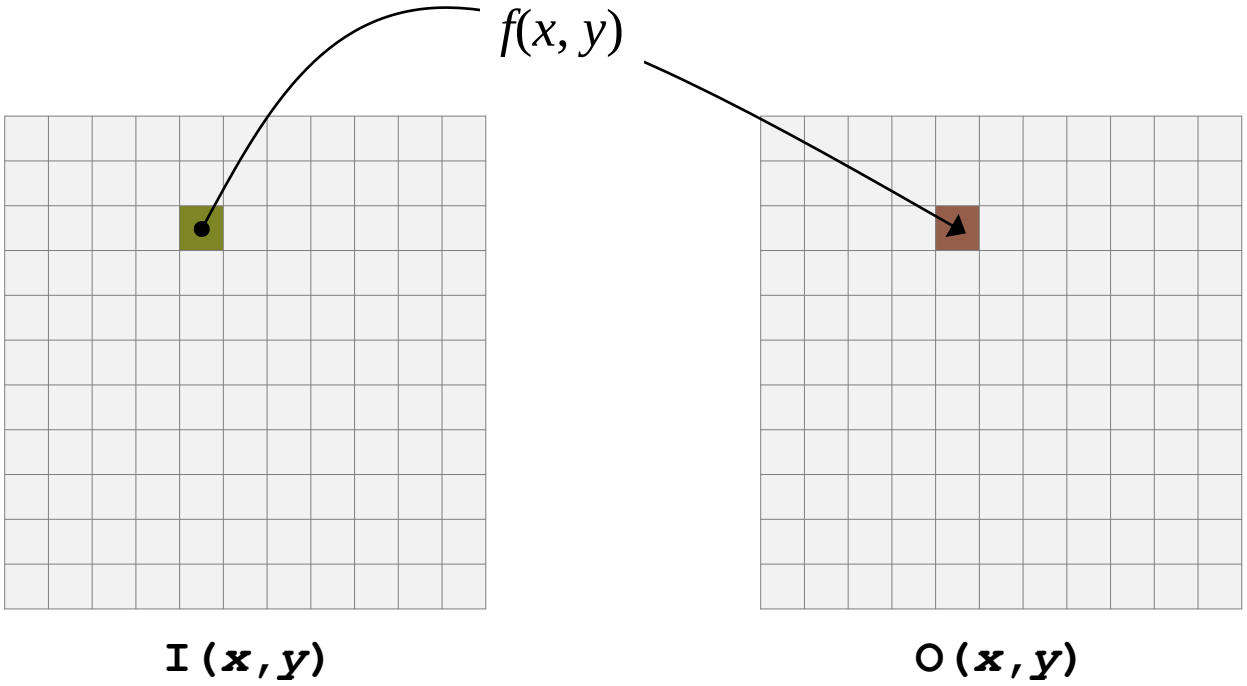
학습 내용

- Point Operation 개요
- Arithmetic Operation
- Grayscale Transformations
- Processing for Color Images

POINT OPERATION 개요

- Each pixel value is replaced with a new value obtained from the old one



I = O: in-place transformation

TECHNIQUES

ARITHMETIC OPERATION

GRAYSCALE TRANSFORMATION

HISTOGRAM MODIFICATION

OBJECTIVE

Improving image ***contrast*** and ***brightness***

Image contrast: a measure of the distribution and range of the gray levels

the difference between the brightness and darkest pixel values, and
how the intermediate values are arranged

Image brightness: the overall average or mean pixel value in the image

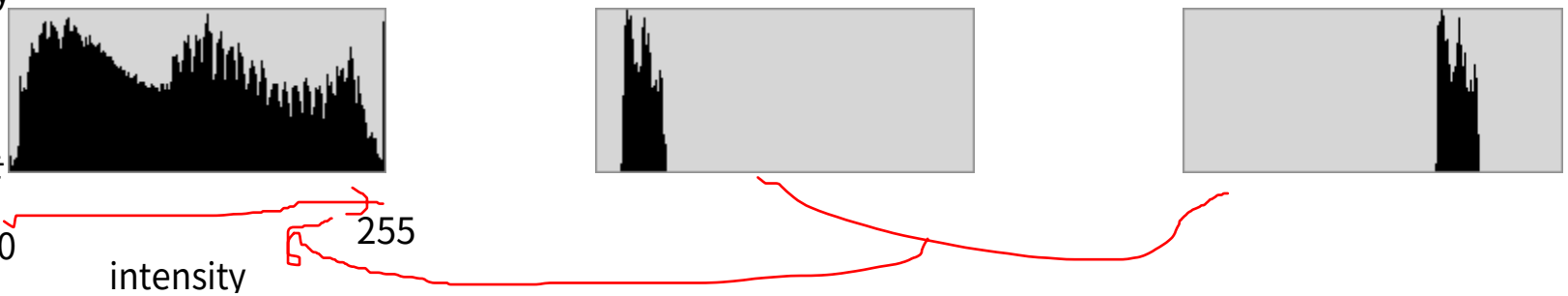
CONTRAST & BRIGHTNESS

intensity가 기준
contrast가 기준

intensity가 낮다
contrast가 낮다

intensity가 높다
contrast가 낮다

frequency
빈도수
얼마나
intensity
가 나오는
지



SCALAR ARITHMETIC OPERATION

모든 픽셀에 대해서 산술연산 시행

k = 2
l = -1

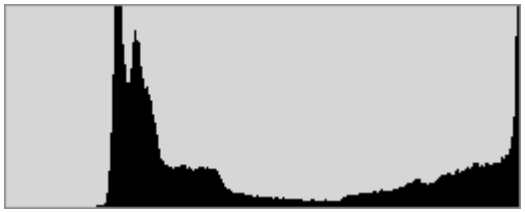
$$\mathbf{O}(x,y) = k \times \mathbf{I}(x,y) + l$$

l: level, k: gain

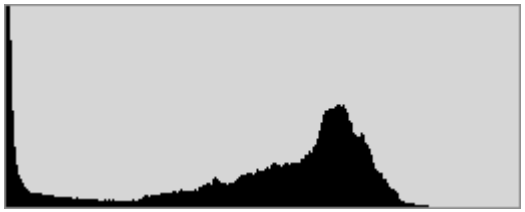
❖ **클리핑(clipping) 처리**

```
if( O(x,y) > 255 ) O(x,y) = 255;
if( O(x,y) < 0 )   O(x,y) = 0;
```

$l = 50, k = 1$

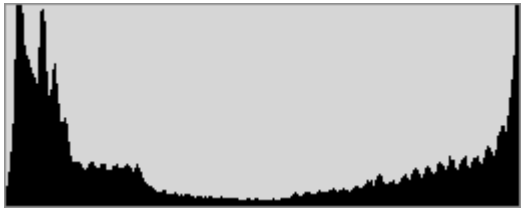


$l = -50, k = 1$



$l = 0, k = 1.2$

$l = 0, k = 0.83$



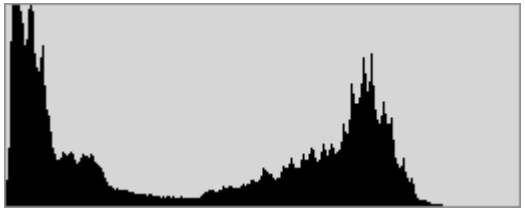
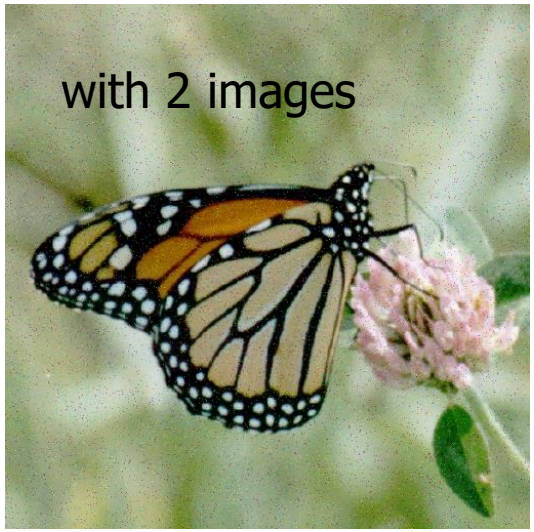


IMAGE ARITHMETIC OPERATION

흰색, 검은색 작은점 노이즈가 생성 -> 하드웨어의 문제, 현재는 문제가 안됨
median filter를 주로 사용해서 제거
보통 Gaussian noise, White noise가 많이 생김 -> averaging을 통해 개선



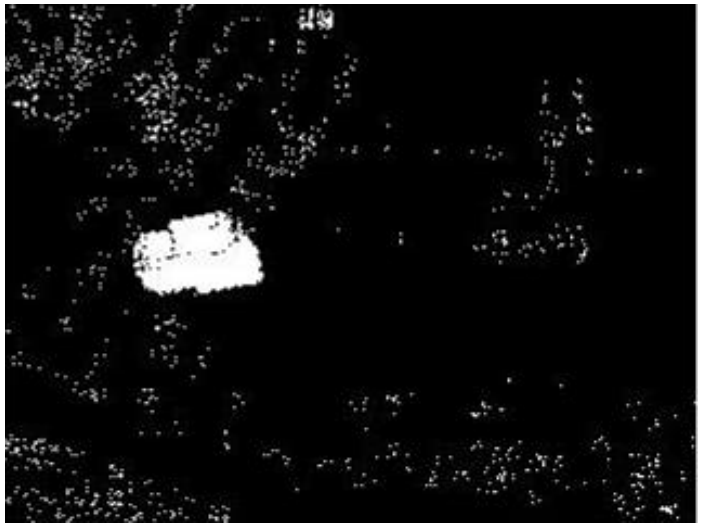
averaging

영상은 CVIPTools로 부터 가져옴

픽셀끼리 빼면 차이점이 발생해서 다른영상이란것을 확인 가능

difference

after thresholding



GRAYSCALE TRANSFORMATION

Improving image contrast and brightness by using **mapping function**

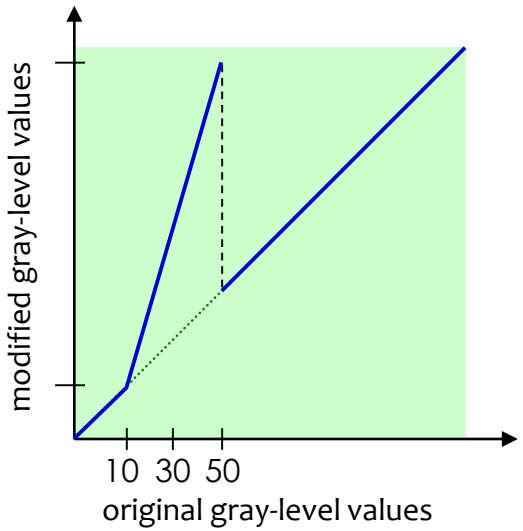
$$\mathbf{O}(x, y) = \mathbf{M}[\mathbf{I}(x, y)]$$

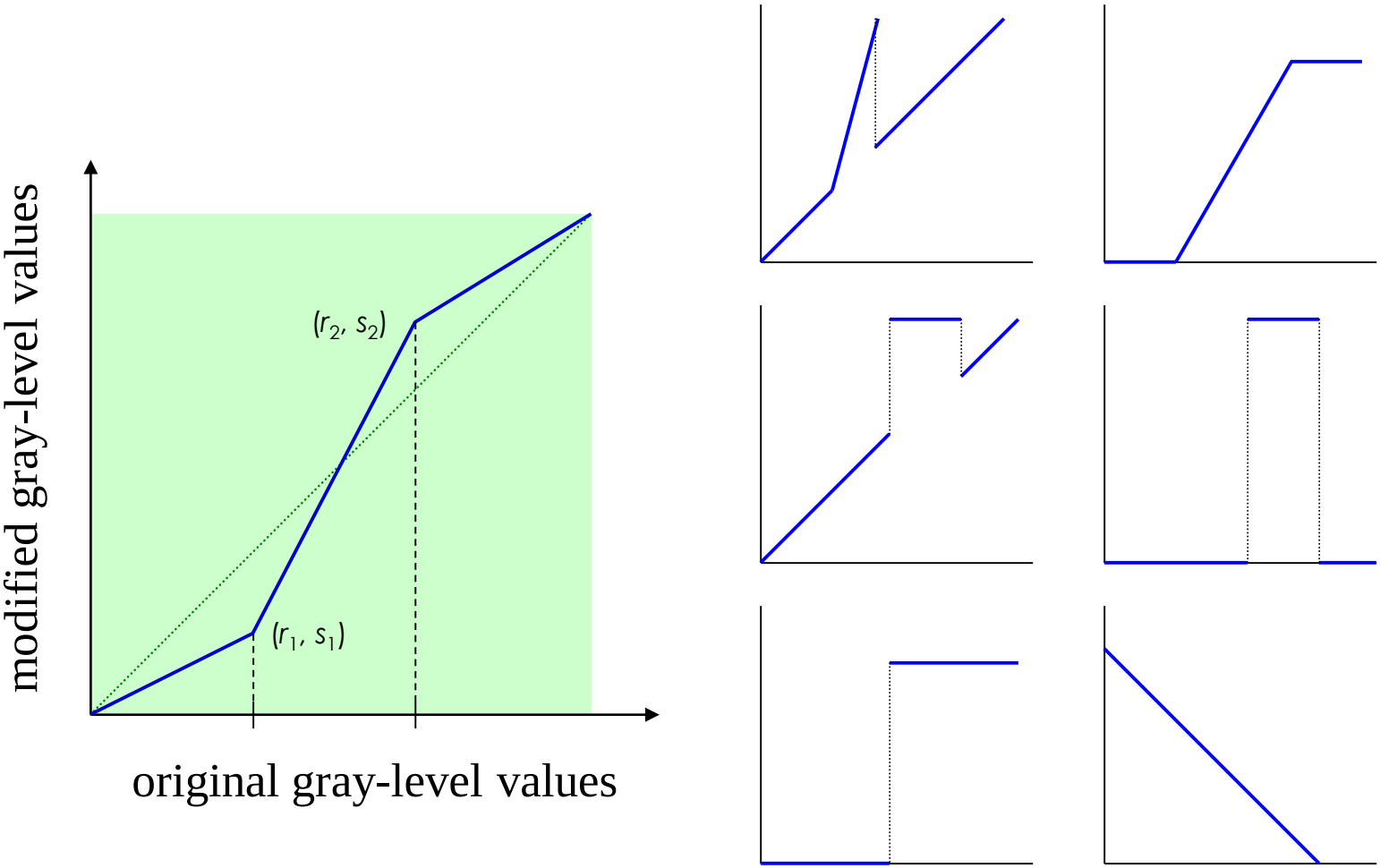
= K_x I(x,y) + l

example

(10,50) 범위의 gray level을 (10,250) 범위로 변경

$$\mathbf{M}[\mathbf{I}(x,y)] = \begin{cases} \mathbf{I}(x,y) & 0 \le \mathbf{I}(x,y) < 10 \\ 6[\mathbf{I}(x,y)] - 50 & 10 \le \mathbf{I}(x,y) \le 50 \\ \mathbf{I}(x,y) & 50 < \mathbf{I}(x,y) \le 255 \end{cases}$$

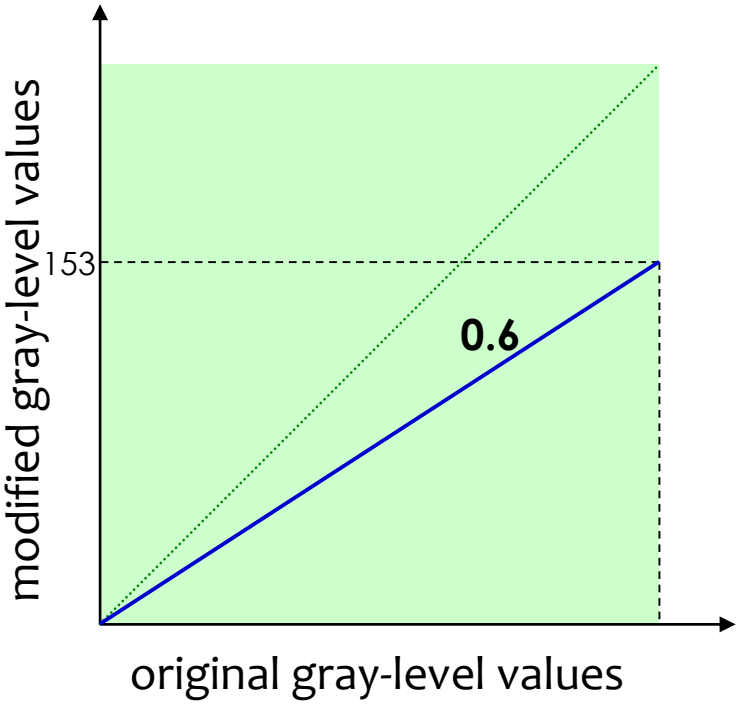




General Form of Gray-Scale Modification

Brightness scaling by multiplication

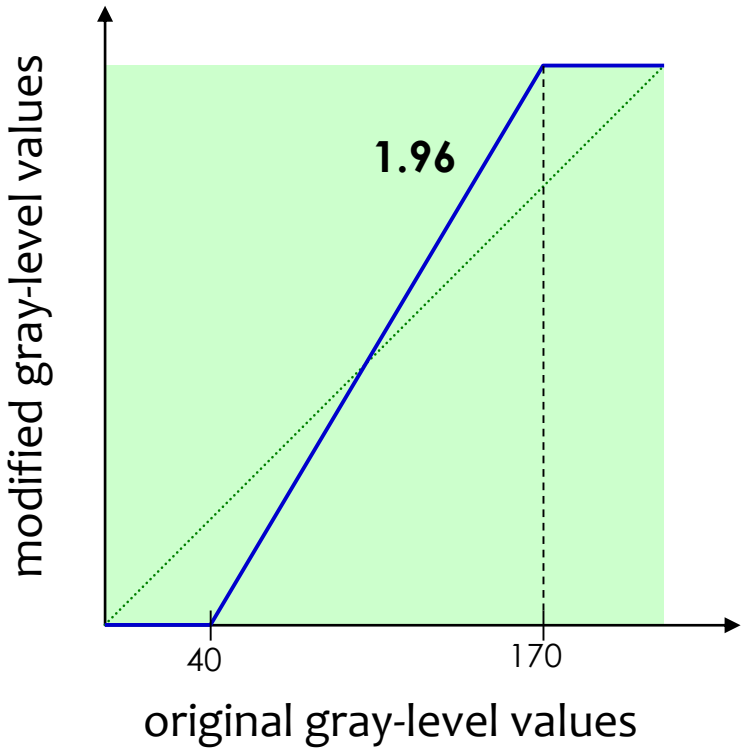
Grayscale Compression



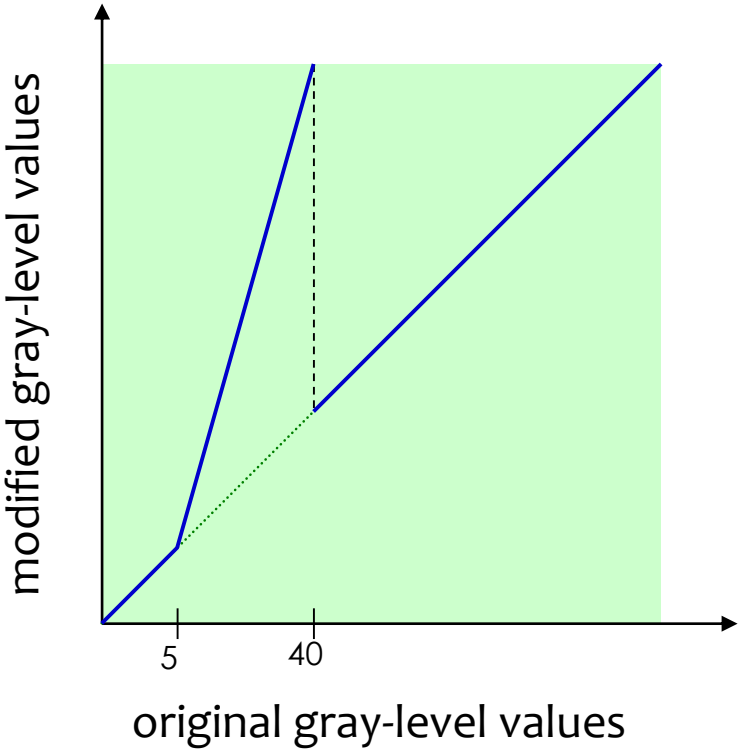
$$\mathbf{O}(x, y) = \mathbf{0.6}[\mathbf{I}(x, y)]$$

Brightness scaling by multiplication

Grayscale Stretching

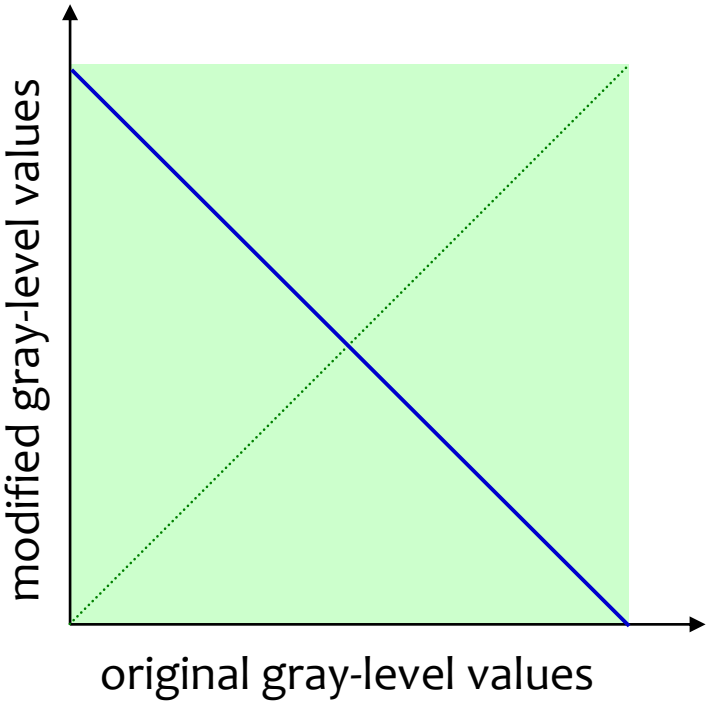


$$\mathbf{M}[\mathbf{I}(x,y)] = \begin{cases} 0 & 0 \le \mathbf{I}(x,y) < 40 \\ 1.96[\mathbf{I}(x,y)] - 78.5 & 40 \le \mathbf{I}(x,y) \le 170 \\ 255 & 170 < \mathbf{I}(x,y) \le 255 \end{cases}$$

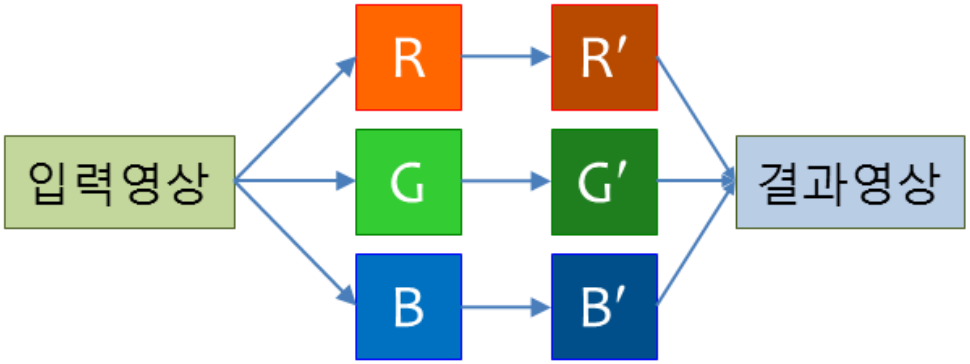


$$\mathbf{M}[\mathbf{I}(x,y)] = \begin{cases} \mathbf{I}(x,y) & 0 \le \mathbf{I}(x,y) < 5 \\ 7.14[\mathbf{I}(x,y)] - 30.7 & 5 \le \mathbf{I}(x,y) \le 40 \\ \mathbf{I}(x,y) & 40 < \mathbf{I}(x,y) \le 255 \end{cases}$$

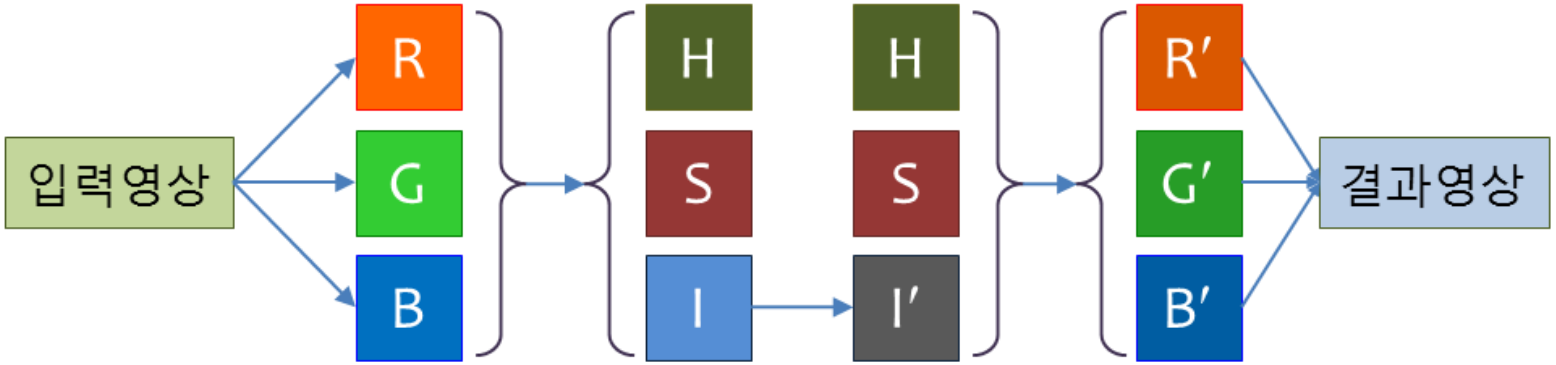
Gray-level Negative



Processing for Color Images



RGB 처리



HSI 처리

요약

- point operations
  - 이웃 픽셀과는 독립적으로 입력 영상의 각 픽셀 값을 변환한 후 결과 영상의 동일한 위치에 출력하는 연산
  - Improving image contrast and brightness
- Arithmetic operation
  - Scalar operation 및 Image operation
- Grayscale transformation
  - Improving image contrast and brightness by using mapping function
  - Brightness scaling by multiplication, Gray-level Thresholding, Gray-level Negative 등

Reference

- 오일석, **Computer Vision**, 한빛 아카데미, 2014
- Scott E Umbaugh, **Computer Imaging**, CRC, 2005
- Mark Nixon and Alberto Aguado, **Feature Extraction & Image Processing**, ELSEVIER, 2008
- Frank SHIH, **Image Processing and Pattern Recognition**, IEEE Press, 2010