Image Filtering

16-385 Computer Vision (Kris Kitani)

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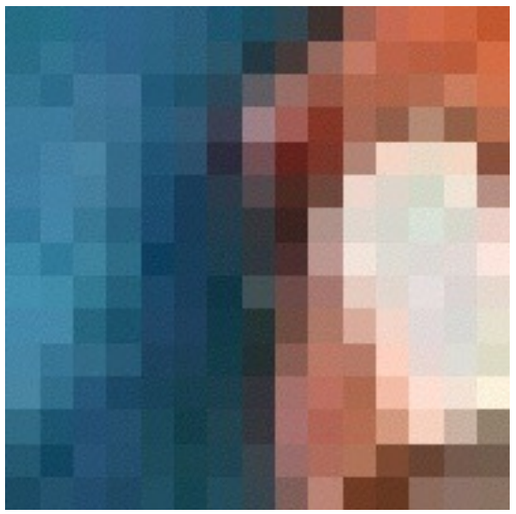
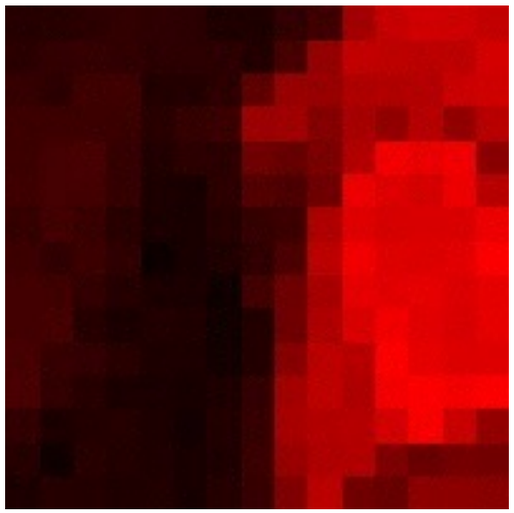
What is an image?

An image is an array of numbers

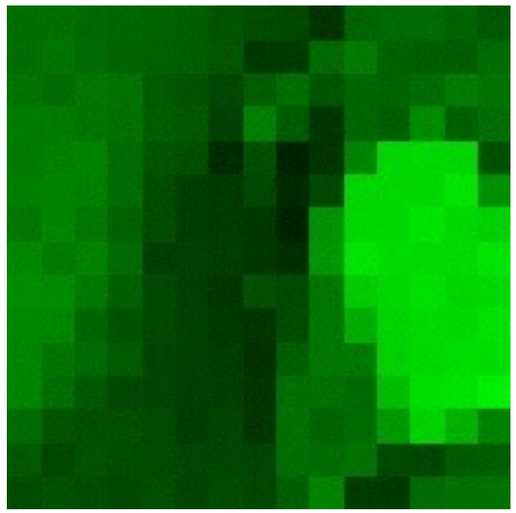


color image patch

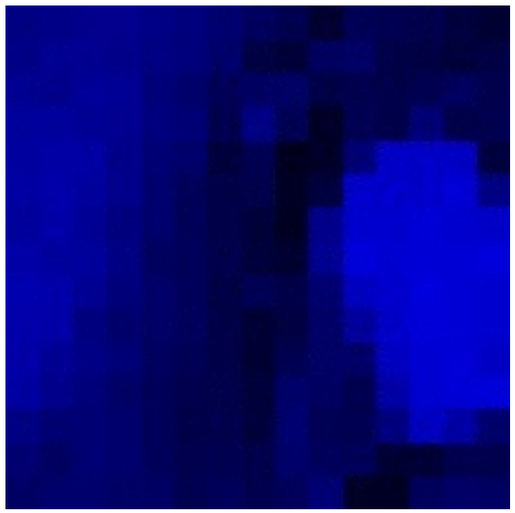
Red



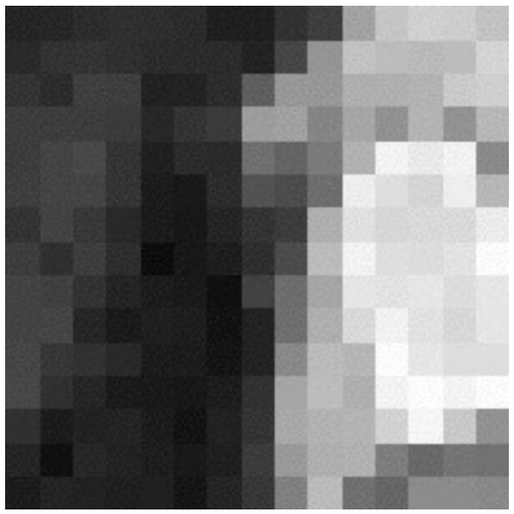
Green

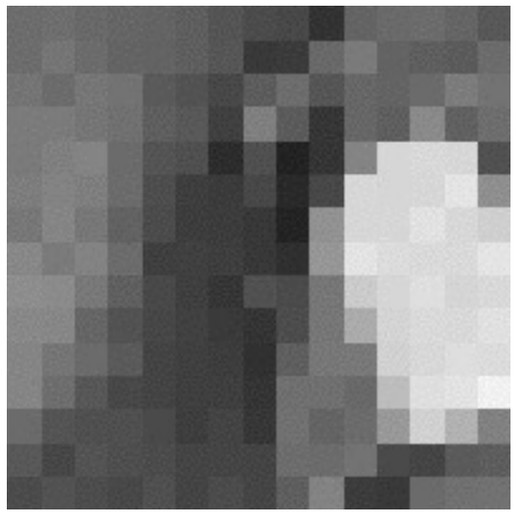


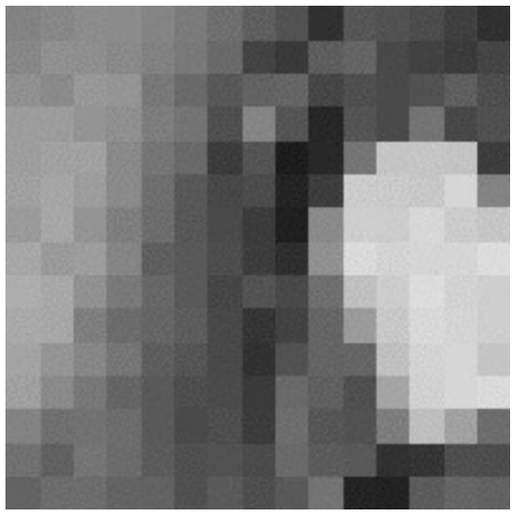
Blue



colorized for visualization







actual intensity values per channel (quantized to 256 values)

how many bits?

What kind of image transformations can we perform?

Filtering

changes the pixel values

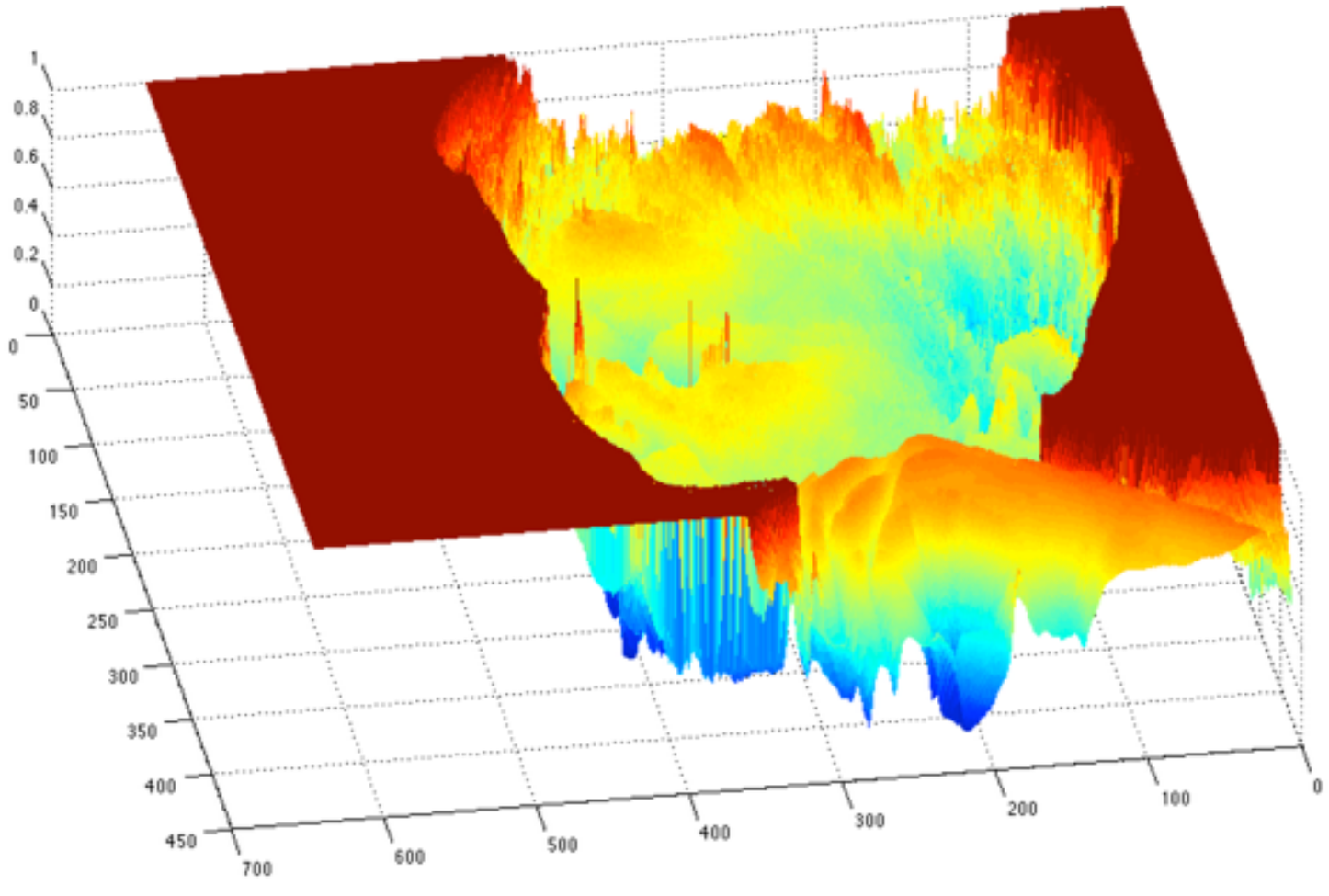
Warping

changes the pixel location

An image as a 2D function

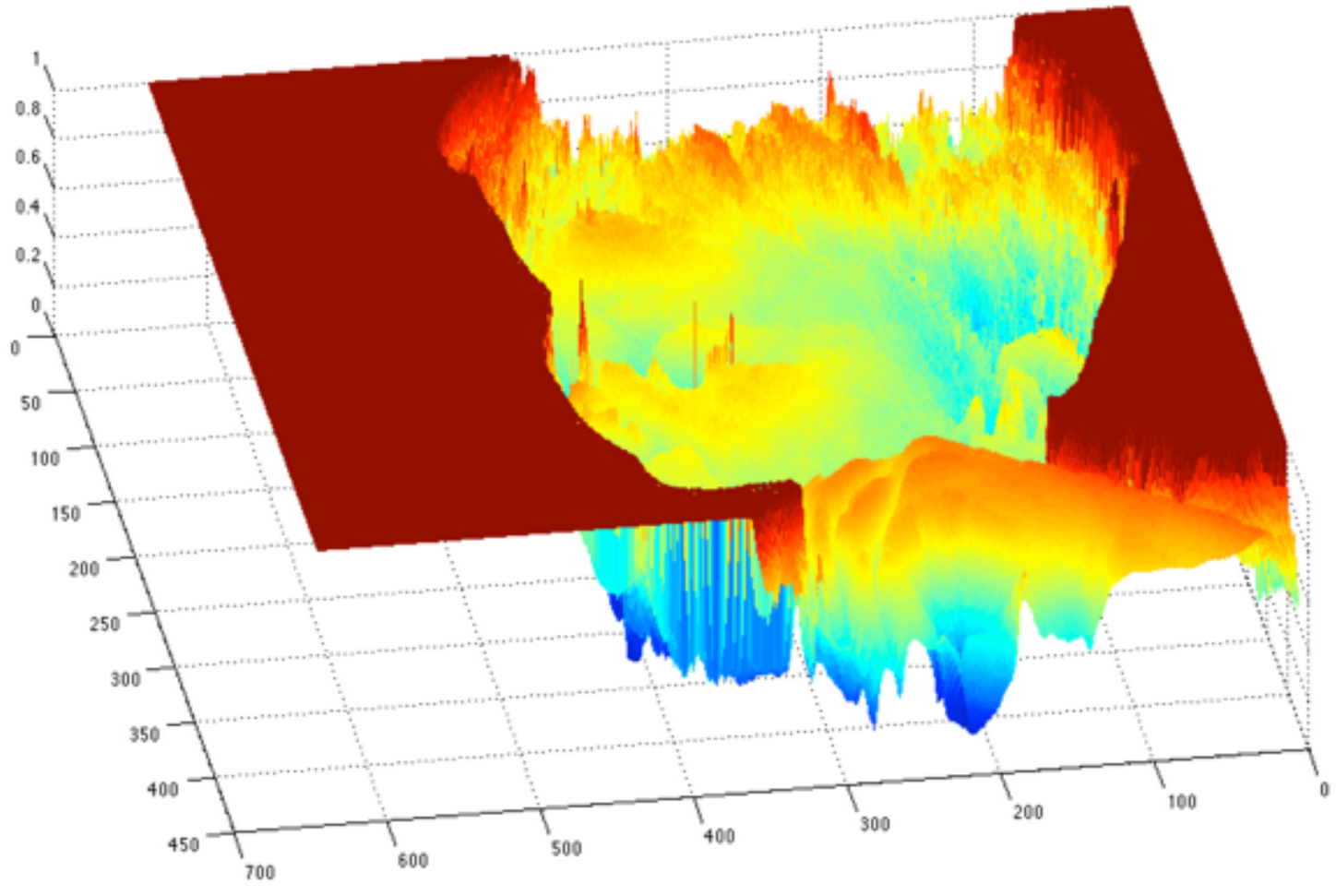
$$f(\boldsymbol{x})$$

$$\boldsymbol{x} = \begin{bmatrix} x \\ y \end{bmatrix}$$



An image as a 2D function

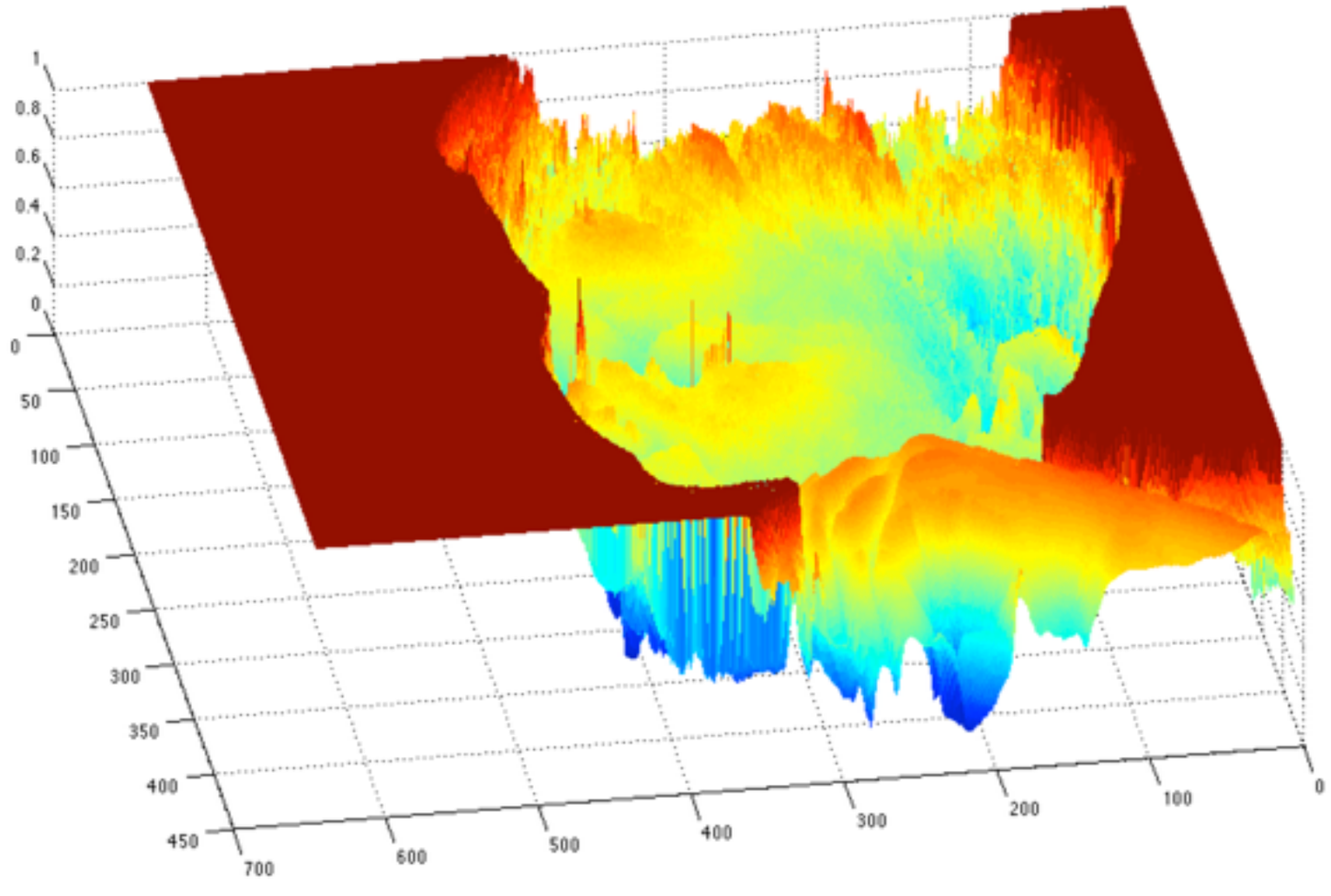
$$f(\boldsymbol{x}) \qquad \boldsymbol{x} = \begin{bmatrix} x \\ y \end{bmatrix}$$



What is the range of $f(\boldsymbol{x})$?

An image as a 2D function

$$f(\boldsymbol{x}) \qquad \boldsymbol{x} = \begin{bmatrix} x \\ y \end{bmatrix}$$



What is the range of $f(\boldsymbol{x})$?

8-bit image: 256 values

What kind of image transformations can we perform?

Filtering

F

$$G(\boldsymbol{x}) = h\{F(\boldsymbol{x})\}$$

G

changes the **range** of image

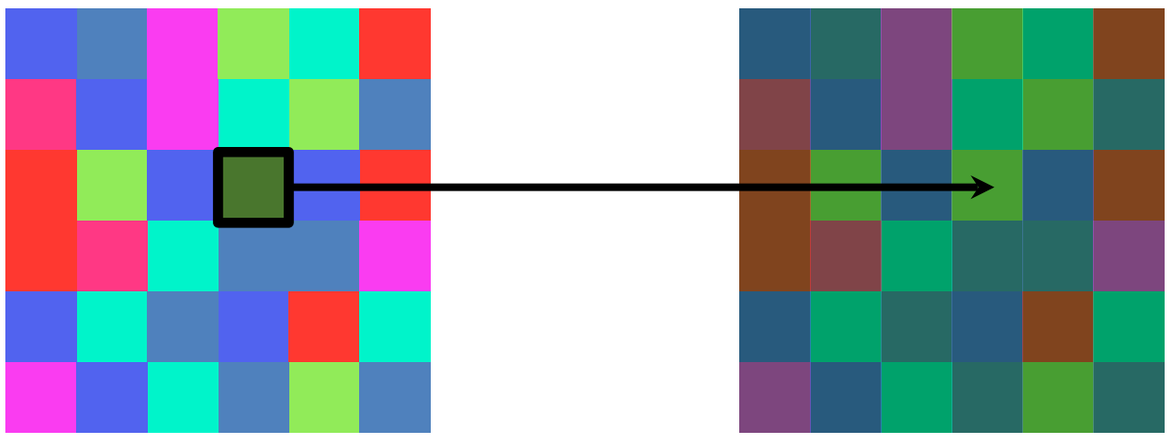
Warping

$$G(\boldsymbol{x}) = F(h\{\boldsymbol{x}\})$$

changes the **domain** of image

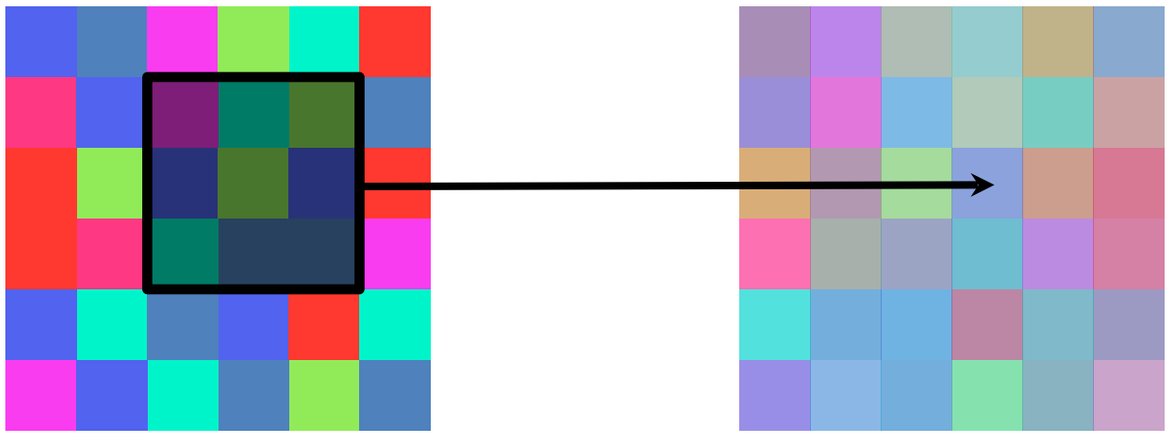
What kind of image filtering can we perform?

Point Operation



point processing

Neighborhood Operation

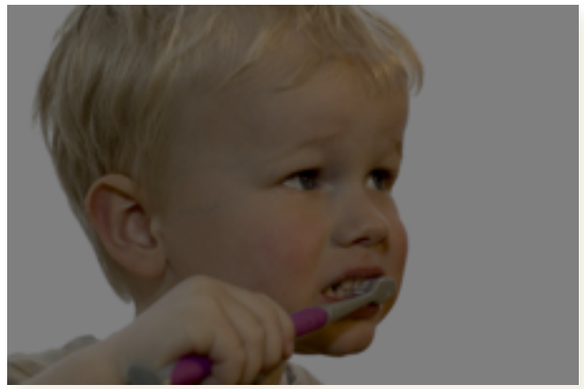


filtering

Examples of Point Processing

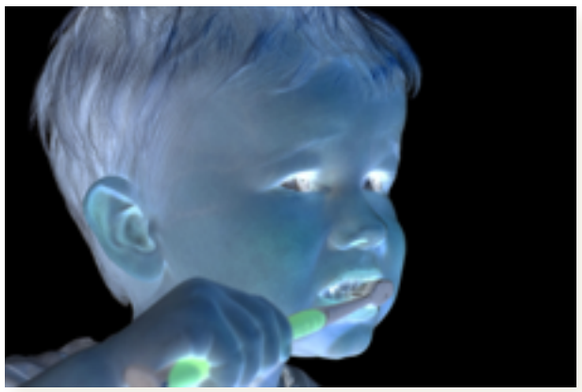
Original

Darken



Lower Contrast

Nonlinear Lower Contrast



Invert

Lighten

Raise Contrast

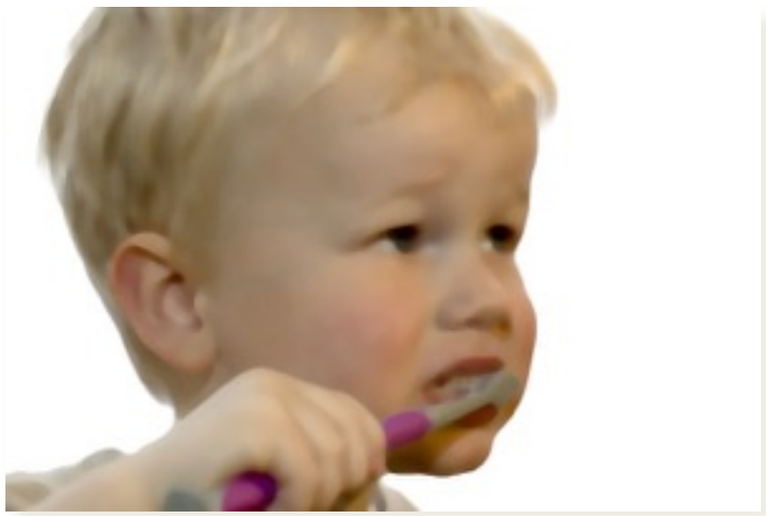
Nonlinear Raise Contrast

Examples of filtering

Original

Gradient Magnitude

Gaussian Blur



Median

Adaptive Thresholding

Bilateral