

Readings

- [Moeslund](#) Chapter 4 Point Processing
- [Moeslund](#) Chpt 5 Neighbourhood Processing
- [Klette](#) 2.1.2, 2.3 Local Operators, Classes of Local Operators

Summary

Point Processing

- Brightness and contrast are additive and multiplicative factors applied to intensity
 - Normalization (whitening) scales and offsets by image mean and variance
- Gamma mapping is a non-linear mapping
- Represent all pixels in an image via a histogram; make operations based on the histogram
 - stretching: mapping min/max to 0/255
 - equalization: forcing cumulative distribution to be linear
- Histogram thresholding for e.g. segmenting objects (foreground) from background
- Otsu's method is an automated way of determining the threshold by minimizing the weighted variance between foreground and background.

Motivation

- point processing vs. filtering is distinguished by the input
 - point processing relies on only a single (corresponding) pixel
 - filtering uses a local window of data from input, centered on corresponding pixel
- filtering can be used for a variety of tasks:
 - enhancement, denoising, etc.
 - extracting information: texture, edges, etc.
 - finding patterns via template matching

Denoising

- common types of image noise include impulse, salt & pepper noise and Gaussian noise
- a simple way to remove Gaussian noise is via a moving average

Correlation

- correlation filtering applies cross-correlation: a weighted summation of the input window, where the set of weights are also known as the filter or kernel
- boundary handling is needed to ensure that output size is same as input size
- common weights for denoising are uniform (i.e. averaging or box filter) or a Gaussian
- extent of Gaussian smoothing determined by σ , or the scale parameter
- sharpening filter accentuates the differences by subtracting the local average
- normalized cross-correlation turns any image patch into a filter kernel which can be applied to find matching regions or patterns in an image

Convolution

- the convolution operation first flips the kernel before applying cross-correlation
- cross-correlation and convolution are equivalent if kernels are symmetric

Image Pyramids

- Naïve downsampling (by decimating rows and columns) results in strong pixellation effects; a better way is to apply smoothing before downsampling

- A Gaussian image pyramid is constructed by repeatedly filtering with a Gaussian kernel and subsampling
- Laplacian of Gaussian pyramid is constructed by storing the residuals between the Gaussian pyramid

Non-Linear Filtering

- Non-linear operations (median, min/max) cannot be expressed as correlation nor convolution since these are linear operations
- Median filtering is commonly applied for smoothing impulse and salt & pepper noise