

# Lecture 4 - IP - Neighbourhood Processing

Jannick Drews

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# 1 Pre-lecture

Preparation: Chapter 5 (not 5.2.2 and 5.2.3) + chapter 12

# 2 Lecture

Ranked filters: Ranking the values in the neighbourhood(sort)

## 2.1 Correlation - EXAM

Fundamentals for machine-learning (Neural networks)

### 2.1.1 1 Dimension

**Filter coefficients; Values inside the filter.**

$$g(x) = h(x)f(x) = \sum_{i=-n}^n h(i)f(x+i)$$

where  $n$  is the distance to the middle of the filter, a filter with a width of 3, has  $3 \geq n = 1$ , and since filters start from -1,  $n$  is equal to 1, since  $-1, 0, 1$ .

This is also because of the position of the anchorpoint, since 0 is in the middle it goes from -1 to 0 to 1, whereas an anchorpoint in the first cell would go from 0 to 1 to 2.

If the filter response is out of range(255), we typically normalize the response by adding the filter values together  $1 + 2 + 1 = 4$  so if the response was 285 it would be  $\frac{285}{4}$

## 2.2 Convolution vs. Correlation

Convolution is nearly the same, although the filter is mirrored, the last filter cell would modify the first cell in the filter response or output cell.

## 2.3 Applications of both

- Object detection
- Blur image
- Remove noise
- Edge detection
- Morphology(Later)

## 2.4 2 Dimensions

Correlation:

$$g(x, y) = \sum_{j=-R}^R \sum_{i=-R}^R h(i, j) f(x + i, y + j)$$

Convolution:

$$g(x, y) = \sum_{j=-R}^R \sum_{i=-R}^R h(i, j) f(x - i, y - j)$$

## 2.5 Boundary problem

Solutions can be:

- Zero-padding.
- Replication: Copy the cell value besides the padding

## 2.6 Template matching

Using another image as a correlation/convolution kernel filter, to receive a filter response, where the highest response value is the best possible match for the template.

Features, is for finding generalized objects.

## 2.7 Blurring

Image blurring, also called smoothing kernels, mean filter or low-pass filter. A spatial low-pass filter is a filter with the same values. A gaussian filter is like a sombrero hat, so the closer to the kernel center the bigger the values (there could also be potential big values on the edges of the kernel).

## 3 Exercises

Exercise 1  
3 Homogenous blur, gaussian blur, bilateral filter, median filter, discuss/show the effects of different sizes.

Improve quality of enhancement.

Exercise 2  
3

Exercise 3  
3

## 4 Knowledge

- Convolution  
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- Correlation  
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- template matching  
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- smoothing filter  
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- median filter  
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## 5 Important notes

When the filter is symmetric, then correlation is equal to convolution