

# Computer Vision

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# 1 Miscellaneous

## 1.1 Low Pass vs Median

Low pass filtering can reduce noise in an image, but it also spreads the noise over the image. In some cases this may be undesirable. The common approach would be to threshold the filtered image, but finding the threshold value can be cumbersome.

One other filter to de-noise is the **median filter**. It's not *isotropic* and it doesn't work with a normal convolution, but it requires a *sorting* operator.

Gaussian and averaging filters introduce in the image values that were not in the original image. The median filter, instead, only "selects" values from the image, not inventing new ones.

## 1.2 Morphology

A form of non linear filtering that refers to the shape of a region.

Goals:

- check whether a certain shape fits into another
- check whether a picture has holes of a certain size
- remove areas smaller than a threshold

## Binary morphology

We need a **binary image**<sup>1</sup> and **structuring elements** and implement four main operations:

- erosion
- dilation
- opening
- closing

Erosion and dilation are intuitive, enlarging or reducing the size of a region. Opening and closing are combinations of erosion and dilation in sequence.

Structuring elements can be squares, circles, other primitives, or custom shapes. For every structuring element we need to define a "center". It is usually the geometric center of the image but it doesn't have to be.

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<sup>1</sup>A binary image is not grayscale but an image composed only of true and false

### 1.2.1 Dilation

Dilation performs an  $\oplus$  (or) operation between the image and the element. More specifically:

- sweep the element over the image
- if the origin of the element touches the image (a 1 in the image).
  - perform the or, "stamping" the element onto the image

It is important to note that the output of the filter has to be stored in a separate image, to avoid it recursively dilating a pixel across the whole image.

### 1.2.2 Erosion

Erosion works in a similar way by scanning the element over the image: We don't check with the center of the element anymore but we "activate" the filter when every 1 in the filter overlaps a 1 in the image.

Question: In the output image, do we only put the center of the element or the whole element?

### 1.2.3 Closing and Opening

Closing: dilate and then erode

Opening: erode and then dilate.

Closing fills the holes in the image with the dilation, and then removes the excess added by the first operation with erosion.

Similar but inverse result is gotten by opening. The holes are enlarged, eating away at the shape. Then the remaining bits are consolidated.