

Information Statistics II

Lecture 1. Introduction to digital image processing and mathematical morphology

What is "digital image?"

An image expressed by a set of numbers handled by computers.

What is "pixel?"

A digital image consists a set of points (Fig.1). Each point has its own brightness. These points are called "**pixels**," and the number of pixels within a unit length / area is called "**resolution**."

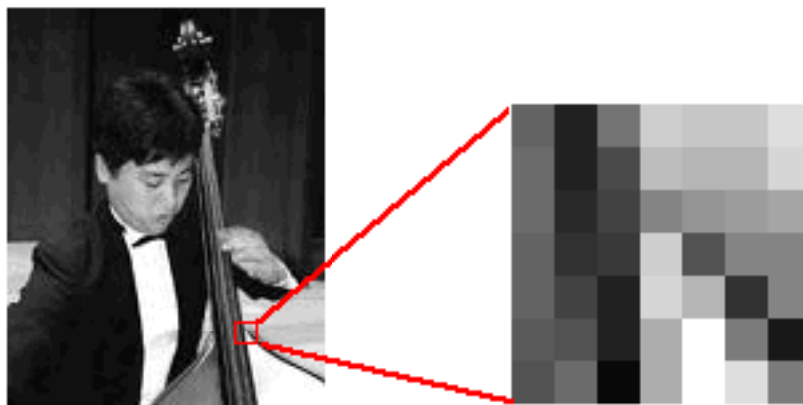


Fig. 1. Pixels.

Expressing brightness by numbers

Brightness of each pixel is expressed by a number in a range (0 to 255 here). This number is called "**pixel value**." Once the brightness of each pixel of an image is expressed by a pixel value, the image can be transmitted with little error, and is processable by computers.

Processing by computers

A new image can be created by calculation using pixel values of other images. Addition, subtraction, binarization, etc. are performed by this operation.

Filtering

Filtering is one of the most basic digital image processing. This operation places a **window**, which indicates the neighborhood, on each pixel of the original image. A certain calculation is carried out with the pixel values in the window, and the new image is organized by the results of the calculation (Fig. 2).

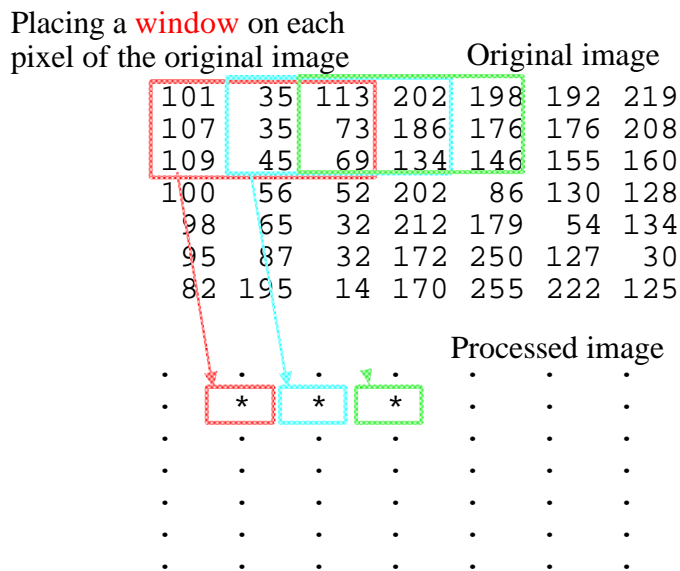


Fig. 2. Filtering.

Mathematical morphology

Mathematical morphology is a concept for handling "shapes" of objects in images quantitatively. All morphological methods are reduced to only two basic operations called "**erosion**" and "**dilation**," and logical operations.

Erosion and dilation are defined by similar operations to filtering, and here a small figure similar to the window is called a **structuring element**. **Opening** removes portions smaller than the structuring element only. **Closing** removes spots smaller than the structuring element only (Fig. 3). Thus the size of structuring element is the quantitative measure of these operations. The quantitiveness of morphological operations is utilized for size distribution analysis, or **granulometry**, for example (Fig. 4).

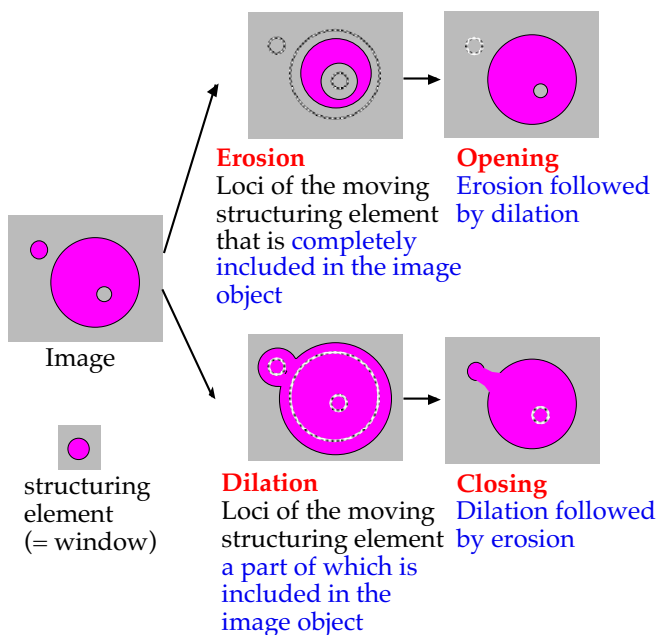


Fig. 3. Mathematical morphological operations.

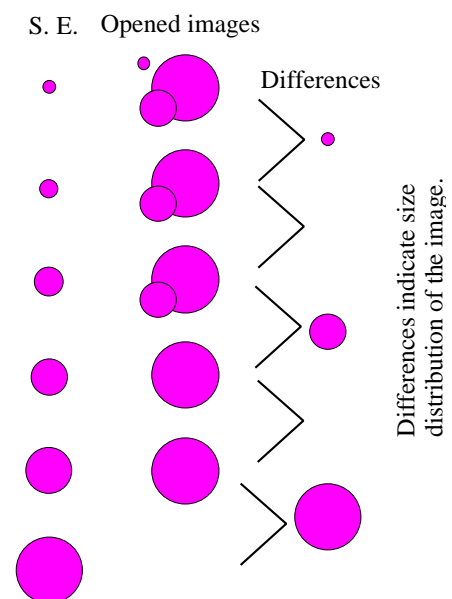


Fig. 4. Granulometry.