**Lab 2 Report**

Theoretical understanding

1. Median Filter

The median filter works by traversing the image pixel by pixel with a kernel of specified size, often square. At each position, the values of the pixels included in the kernel are sorted, and the median value is selected to be the value of the kernel's central pixel in the filter's output image.

2. Morphological Operations

Morphological operations are image processing operations that manipulate the shape or structure of objects in an image. They are commonly used in computer vision and image processing to perform operations such as dilation, erosion, opening and closing. Here are some of the basic morphological operations:

* Erosion: Erosion is an operation that reduces the size of objects in an image by "eating away" at the edges. It is often used to eliminate small protrusions or to separate connected objects.
* Dilation: Dilation is the opposite of erosion. It increases the size of objects in an image by adding pixels to the outer boundary of the objects. Dilation is often used to close holes in objects or to connect nearby objects.
* Opening: Opening is an operation that involves performing an erosion followed by a dilation. It is useful for removing noise and for separating objects that are very close to each other.
* Closing: Closing is the opposite of opening. It involves performing a dilation followed by an erosion. Closing is often used to fill holes in objects and to connect objects that are nearly touching.
* Morphological Gradient: The morphological gradient is an operation that calculates the difference between dilation and erosion of an image. This highlights the contours of objects in an image.
* Top-Hat: Morphological top-hat is an operation that extracts components that do not match the background of the image. It highlights objects that are brighter than the background.
* Black-Hat: Morphological black-hat is similar to top-hat, but it extracts components that are darker than the background of the image.

3. Watermarking

Results & discussion

1. Median Filter

As you can see from the image below, we have compared our own median filter (median\_blur) with that of OpenCV (cv2.medianBlur), as well as with Gaussian blur (cv2.GaussianBlur) and an mean filter (cv2.boxFilter). As you can see, for the same kernel size, our filter tends to blur much less than the functions implemented by OpenCV.

Une image contenant personne, skier, noir et blanc

Description générée automatiquement

2. Morphological Operations

As you can see in the image below, we are checking, using an example, that the dilation and erosion operators we have implemented appear to be working (comparing them to OpenCV functions). In the rest of the code, we generate random images and kernels to verify that dilation and erosion work correctly across a wide range of cases.

Une image contenant capture d’écran, Rectangle, diagramme, carré

Description générée automatiquement

On the other hand, we have checked the properties of morphological operators. As you can see in the image below, we can visualize that the closure is idempotent.

Une image contenant capture d’écran, texte, diagramme, cercle

Description générée automatiquement

3. Watermarking

Conclusion