Pixel manipulation and filtering are essential operations in image processing using OpenCV. They allow you to modify images at the most fundamental level for various applications such as enhancing images, detecting features, or applying artistic effects.

Pixel Manipulation in OpenCV

1. Accessing and Modifying Pixel Values:
   - In OpenCV, you can access or modify the value of specific pixels using array indexing.
   - For a grayscale image, `img[x, y]` gives the brightness of the pixel at (x, y).
   - For a color image, `img[x, y]` returns a BGR tuple (blue, green, red).

2. Iterating Over Pixels:
   - You can loop over all pixels in an image to apply a specific operation, like thresholding or custom filtering.
   - However, direct pixel manipulation using loops in Python can be slow and is generally not recommended for large-scale processing.

3. Efficient Pixel Operations with Numpy:
   - Since OpenCV images are Numpy arrays, you can perform efficient array operations which are much faster than looping over pixels.

Image Filtering in OpenCV

1. Blurring (Smoothing) Images:
   - Techniques like Gaussian Blur, Median Blur, and Bilateral Filtering are used to reduce noise and details.
   - Syntax: `cv2.GaussianBlur(src, ksize, sigmaX)`, `cv2.medianBlur(src, ksize)`, etc.

2. Applying Filters for Edge Detection:
   - Sobel and Laplacian filters are common for edge detection.
   - `cv2.Sobel(src, ddepth, dx, dy)` or `cv2.Laplacian(src, ddepth)` are used to find edges.

3. Custom Filters with Convolution:
   - You can create custom filters using convolution: `cv2.filter2D(src, ddepth, kernel)`.
   - This allows you to apply custom effects, like sharpening, embossing, or other kernel-based transformations.

4. Morphological Operations:
   - Operations like Erosion, Dilation, Opening, and Closing are used for shape-based transformations and noise removal.
   - Functions like `cv2.erode()`, `cv2.dilate()`, `cv2.morphologyEx()` are used with specific structuring elements.

5. Frequency Domain Filtering:

- For more advanced applications, filtering in the frequency domain (using Fourier Transform) is used for high-pass and low-pass filtering.

In conclusion, pixel manipulation and filtering in OpenCV enable a wide range of image processing capabilities, from basic operations like blurring and sharpening to advanced techniques for feature extraction and noise reduction.