Different Types of Watermarking Techniques

The types are spatial domain watermarking and frequency domain watermarking. In the spatial domain techniques, we embed the watermark by modifying the pixel values. On the other hand, in transform domain watermarking, the watermark is embedded into the coefficients of transform domain. Various types of transform domain techniques are DCT, DWT and DFT. From robustness and imperceptibility point of view, transform domain techniques are better than spatial domain techniques.

A. Spatial Domain Watermarking

We know that the image is made up of pixels. In this method of watermarking, we embed the watermark in some specific pixels of image. In the extraction phase, we extract the watermark from these specific pixels. This technique is very much easy to use, less complex and also takes less time. But on the other hand, it is not robust for various types of attacks.

B. Transform Domain Watermarking

The transform domain watermarking is better as compared to the spatial domain watermarking. The image is represented in the form of frequency in the transform domain watermarking. In the transform domain watermarking techniques, firstly conversion of the original image is done by a predefined transformation. Then we embed the watermark in the transform image or in the transformation coefficients. Finally, we take the inverse transform to get the watermarked image. Commonly used transform domain methods are Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), and Discrete Fourier Transform (DFT).

1) Discrete Cosine Transform

It is generally used for the signal processing. In this we transform the image into the frequency domain. It is applied in many areas like pattern recognition, data compression, and image processing. This technique is more robust than spatial domain watermarking techniques. The main steps used in DCT are:

- Firstly, take the image and divide it into nonoverlapping 8*8 blocks.
- Calculate forward DCT of each of the non-overlapping blocks.
- Use HVS blocks selection criteria.
- Now use highest coefficient selection criteria.
- Then embed watermark in the selected coefficient.
- Now take inverse DCT transform of each block.

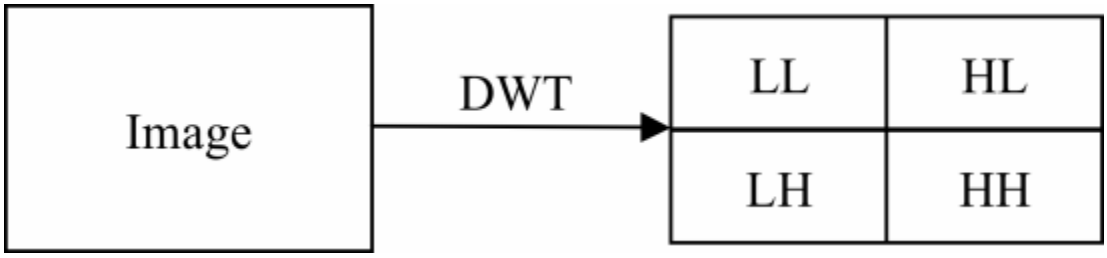
2) Discrete Wavelet Transform

Discrete Wavelet Transform (DWT) gives a multi resolution representation of the image. This representation provides a simple framework for interpreting the image formation. The DWT analyses the signal at multiple resolution. When we apply the DWT to an image, it divides the image into two quadrants, i.e. high frequency quadrant and low frequency quadrant. This process repeats until the signal

has been entirely decomposed. If we apply 1-level DWT on two-dimensional image, it divides it into four parts, i.e.

- LL: It consists the low frequency details of the original image. We can say that approximation of the image lies in this part.
- LH: It consists vertical details of the original image.
- HL: It consists the horizontal details of the original image.
- HH: It consists high frequency details of the original image.

Since we know that the detail of original image lies in low frequency coefficients, so we embed the watermark into low frequency coefficients. If we apply IDWT, we can reconstruct the original image from the decomposed image.



3) Discrete Fourier Transform

Discrete Fourier Transform (DFT) offers more robustness against geometric attacks like scaling, cropping, translation, rotation, etc. It decomposes an image in sine and cosine form. In this, embedding may be done in two ways: direct embedding and the template-based embedding.

In the direct embedding technique, we modifying DFT magnitude and phase coefficients and then the watermark is embedded. The template based embedding technique introduces the concept of templates. In DFT domain, during embedding process, we embed the template, which is used to find the transformation factor. When the image is transformed, firstly this template is searched and it is then used to resynchronize the image. After this, detector is used to extract the embedded spread spectrum watermark.

Reference:

https://ieeexplore.ieee.org/abstract/document/7581413