Texture

Texture is a feature used to partition images into regions of interest and to classify those regions.

Introduction:

1. Texture analysis.
2. Defining texture.
3. Techniques of texture.

1. Texture analysis.

1. Texture segmentation is concerned with automatically determining the boundaries between various texture regions in an image.
2. Texture classification is concerned with identifying a given textured region from a given set of texture classes.

2. Defining texture.

1. Structural: texture is a set of primitive texels in some regular or repeated relationship.
2. Statistical: texture is a quantitative measure of the arrangement of intensities in a region. This set of measurements is called a feature vector.
3. Modelling: texture modelling techniques involve constructing models to specify textures.

3. Techniques of texture.

1. Co-Occurrence Matrix:
   for a given image I of size n × m, the elements of a gray-level Co-occurrence matrix Mco for a displacement vector d (= Δx, Δy):

$$\text{Mco} = \sum_{x-1}^{n} \sum_{y-1}^{m} \{1,\ if\ I(x,\ y) = i\ and\ I(x + \Delta x,\ y + \Delta y = j)\ ||\ 0,\ otherwise\}$$

   In Haralick Features: Haralick had 14 statistical features. These features are generated by calculating the features for each one of the co-occurrence matrices obtained by using the directions

0◦, 45◦, 90◦, and 135◦, then averaging these four values. The distance parameter can be selected as one or higher. A vector of these 14 statistical features is used for characterizing the co-occurrence matrix contents , only four of them:

The Contrast: Measures the local contrast of an image.

$$\text{Contrast} = \sum_{i}^{n} \sum_{j}^{n} (i-j)^2 P\,[i,j]$$

The Correlation: Provides a correlation between the two pixels in the pixel pair:

$$\text{Correlation} = \sum_{i}^{n} \sum_{j}^{m} \frac{(i-\mu)(j-\mu)P\,[i,j]}{\sigma^2}$$

The Homogeneity: Measures the local homogeneity of a pixel pair:

$$\text{Homogeneity} = \sum_{i}^{n} \sum_{j}^{m} \frac{P\,[i,j]}{1+|i-j|}$$

4. Local binary patterns.

Local Binary Pattern (LBP) method has been used in various applications. LBP is an operator for texture description that based on the signs of differences between neighbour pixels and central pixels
The basic version of LBP operator uses the centre pixel value as threshold to the 3 × 3 neighbour pixels.
The equation basic of LBP:

$$\text{LBP}(x_c, y_c) = \sum_{n=0}^{7} 2^n g\,(I_n - I\,(x_c, y_c))$$

The function g(x) will be zero if x <0 and g(x) = 1 if x ≥ 0.

For example: