On-line Table: Formulas and description of GLCM texture parameters

Texture Parameter	Formula[a]	Description
Contrast	$\sum_{n=0}^{N_g-1} (i-j)^2 \left\{ \sum_{i=1}^{N_g} \sum_{j=1}^{N_g} p(i,j) \right\}$	Represents the amount of local gray level variation in an image; a high value of this parameter may indicate the presence of edges, noise, or wrinkled textures in the image
Homogeneity (inverse difference moment)	$\sum_{i=1}^{N_g} \sum_{j=1}^{N_g} \frac{p(i,j)}{1+(i-j)^2}$	Measures the smoothness (homogeneity) of the gray level distribution of the image; it is (approximately) inversely correlated with contrast—if contrast is small, usually homogeneity is large
Correlation	$\sum_{i=1}^{N_g} \sum_{j=1}^{N_g} \frac{ijp(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y}$	Measures the linear dependency of gray levels on those of neighboring pixels; it provides a measure similar to autocorrelation methods
Variance (sum of squares)	$\sum_{i=1}^{N_g} \sum_{j=1}^{N_g} (i-\mu)^2 p(i,j)$	Measures the dispersion (with regard to the mean) of the gray level distribution
Sum average[b]	$\sum_{i=2}^{2N_g} i p_{x+y}(i)$	Measures the mean of the gray level sum distribution of the image
Sum variance[b]	$\sum_{i=2}^{2N_g} \left(i - \left[\sum_{i=2}^{2N_g} i p_{x+y}(i) \right] \right)^2$	Measures the dispersion (with regard to the mean) of the gray level sum distribution of the image
Difference variance[c]	$\sum_{i=2}^{2N_g} \left(i - \left[\sum_{i=2}^{2N_g} i p_{x-y}(i) \right] \right)^2$	Measures the dispersion (with regard to the mean) of the gray level difference distribution of the image
Uniformity (angular second moment)	$\sum_{i=1}^{N_g} \sum_{j=1}^{N_g} p(i,j)^2$	Measures the uniformity (or orderliness) of the gray level distribution of the image; images with a smaller number of gray levels have larger uniformity
Entropy	$-\sum_{i=1}^{N_g} \sum_{j=1}^{N_g} p(i,j) \log[p(i,j)]$	Measures the degree of disorder among pixels in the image; it is (approximately) inversely correlated with uniformity; images with a larger number of gray levels have larger entropy
Sum entropy[b]	$-\sum_{i=2}^{2N_g} p_{x+y}(i) \log\{p_{x+y}(i)\}$	Measures the disorder related to the gray level-sum distribution of the image
Difference entropy[c]	$-\sum_{i=0}^{N_g-1} p_{x-y}(i) \log\{p_{x-y}(i)\}$	Measures the disorder related to the gray level difference distribution of the image

[a] In all equations, $p(i,j)$ is the (i,j)-th entry of the normalized GLCM, that is, $p(i,j) = P(i,j) / \Sigma_{ij} P(i,j)$, where $P(i,j)$ is the (i,j)-th entry of the computed GLCM; N_g is the total number of gray levels in the image; and μ_x, μ_y and σ_x, σ_y denote the mean and SDs of the row and column sums of the GLCM, respectively.

[b] The gray level sum distribution is given by $p_{x+y}(k) = \sum_{i=1}^{N_g} \sum_{i+j=k}^{N_g} p(i,j)$, $k = 2, 3\ldots, 2N_g$; it is related to the distribution of the sum of co-occurring pixels in the image.

[c] The gray level difference distribution is given by $p_{x-y}(k) = \sum_{i=1}^{N_g} \sum_{|i-j|=k}^{N_g} p(i,j)$, $k = 0, 1, 2\ldots, N_g - 1$; it is related to the distribution of the difference between co-occurring pixels in the image.