Q20. What is an adaptive median filter? Explain its use for noise reduction in an image.

Oct./Nov.-17, Set-2, Q4(a)

(or)

Write short notes on adaptive median filter.

Ans:

A filter which controls the excess spatial impulse noise and smoothens the non-impulse noise is referred to as adaptive median filter.

Adaptive median filter overcomes the limitation of median filters (which operates adequately for small impulse noise spatial densities). These type of median filters can deal with impulse noises with probabilities greater than 0.2. It offers an advantage of preserving image details during the smoothing operation of non-impulse noise. It operates in a rectangular area S_{xy}, whose size is increased depending on the conditions of filter operation.

The operation of adaptive median filtering algorithm is carried out in two levels namely level A and level B i.e.

Level A: $A1 = Z_{med} - Z_{min}$

$A2 = Z_{med} - Z_{max}$

If $A1 > 0$ AND $A2 < 0$, go to level B

Else increase the window size

If window size $\leq S_{max}$ repeat level A

Else output Z_{xy}

Level B: $B1 = Z_{xy} - z_{min}$

$B2 = Z_{med} - Z_{max}$

If $B1 > 0$ AND $B2 < 0$, output Z_{xy}

Else output Z_{med}

Where,

Maximum gray level value in $s_{xy} = Z_{max}$

Minimum gray level value in $s_{xy} = Z_{min}$

Gray level at coordinates $(x, y) = Z_{xy}$

Median of gray levels in $s_{xy} = Z_{med}$

Maximum allowed size of $s_{xy} = s_{max}$

The major objectives of adaptive median filtering algorithm are,

1. It has to eliminate the impulse or salt-and-pepper noise.
2. It is used for smoothing of other non-impulse noise.
3. It helps in the minimization of distortion by either thinning or thickening the object boundaries excessively.

The first step is to test level A, which estimates the impulse nature of median filter output, Z_{med}. If Z_{med} lies between Z_{min} and Z_{max}, then it is said to be non-impulse in nature.

If impulse is not found in this level, then the size of the window is increased and the level A is repeated until a median or maximum window size is reached. The algorithm outputs either changed or unchanged value of Z_{xy}, if maximum window Z_{xy} is checked for its impulse nature.

The next step is to test level B, where the centre point of window Z_{xy} is checked for its impulse nature. If the condition $B1 > 0$ and $B2 < 0$ is satisfied, Z_{xy} lies between Z_{min} and Z_{max} which yields non-impulsive characteristics of Z_{xy}. The algorithm outputs the unchanged value of Z_{xy}. If the condition $B1 > O$ and $B2 < O$ is not satisfied, then $Z_{xy} = Z_{min}$ or $Z_{xy} = Z_{max}$ Thereby, the algorithm outputs the Z_{med} value which is not an impulse noise.

The window size S_{xy} is moved to the next location in an image whenever the algorithm returns a value. The algorithm is initialized again and applied to pixels in the next location.

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