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RANDOM-VALUED IMPULSE NOISE REMOVAL USING FUZZY LOGIC

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Abstract. *In this paper, a fuzzy based random-valued impulse noise filtering technique is proposed. The proposed method is based on intelligent noise detection, intelligent image filtering and a detail preservation process. The noise detection method used in this paper is based on fuzzy gradients to detect the noisy pixels intelligently by differentiating them from the edge pixels. The detected noisy pixels are then processed by fuzzy based filtering process. Fuzzy based filtering process uses trapezoidal shaped fuzzy membership functions constructed through fuzzy set construction algorithm to remove random valued impulse noise from digital gray scale images. In order to preserve image details while filtering the noisy edge pixels, a fuzzy based detail preservation process has been introduced in the proposed method. The main contribution of the proposed technique includes 1) marvelous detail preservation at both noise detection and noise filtering level 2) removing the random-valued as well as mixed (salt & pepper and random-valued) impulse noise. Based on peak-signal-to-noise ratio and subjective quality measure, we have found experimentally that the proposed technique is superior to the state-of-the-art techniques for removing random-valued as well as mixed impulse noise.*

Keywords: Image restoration, Mixed impulse noise, Fuzzy filter, Fuzzy logic control, Random-valued impulse noise system control

1. **Introduction.** Image restoration has enormous applications in the last few decades. These applications range from space exploration to medical diagnosis. In this context, various efficient and sophisticated techniques for image restoration have been proposed in both spatial and transformed domains [1]. Image restoration is defined as a process to restore the original image from the degraded one with or without having prior knowledge about the degradation phenomena. Image degradation could occur due to any of the acquisition, pre-processing, compression, transmission, storage and/or reproduction phases of processing [2,24,25]. Removal of such degradation to restore the image is an important issue in image processing, for example, an important task is to remove the impulse noise without destroying the image details. Smoothing a region of the degraded image may lead to blurrier edges while sharpening edges can cause amplification of unnecessary noise. Standard impulse noise filtering techniques are mainly based on median and its modifications [3]. Most of the filters are applied on the whole image, apart from applying on the noisy pixels, noise free pixels are also changed which is the main contributing factor for destroying the image details. One of the most frequently used strategy for improving the impulse noise removal without destroying the image details is the switching scheme concept [4]. This switching scheme concept suggests that the noisy pixels should be detected first and then the noise removal process should be applied to the noisy pixels only. Noise free pixels should remain unchanged during the filtering process. Most of the newly