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A NEW ART-LMS NEURAL NETWORK FOR ADAPTIVE IMAGE RESTORATION

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Abstract. *A neural network design – the adaptive resonance theory least mean square (ART-LMS) neural network – is proposed for the restoration of images corrupted by impulse noise. The network design is based on the concept of a counterpropagation network (CPN). The ART network automatically uses a vigilance parameter to generate the cluster layer node for the Kohonen learning algorithm in CPN. In addition, the LMS learning algorithm is used to adjust the weight vectors between the cluster layer and the output layer for the Grossberg learning algorithm in CPN. The LMS algorithm is used to obtain the optimal weight for each cluster independently and minimizes the mean square error of the filter output. Experimental results show that the proposed filter based on proposed ART-LMS outperforms many well-accepted conventional filters in terms of noise suppression and detail preservation.*
Keywords: Neural network, Least mean square, Impulse noise, Median filter

1. **Introduction.** Digital images are often distorted by impulse noise during their acquisition and transmission. The impulse noise introduced into the images in the form of bit errors and outliers severely affects the perceptual quality of the image. The efficient removal of impulse noise from digital images is an important before the images are put through image processing operations such as image compression, image segmentation and image retrieval [1,2]. Thus, there is a strong need for image restoration. However, this is a difficult task because the developing such image restoration techniques is noise removal along with preserving the image details. Developing an effective image restoration technique has become increasingly important.

A large number of approaches have been developed for image restoration. The median filter has been extensively studied due to its ability to suppress impulse noise computationally efficiently. However, the median filter is prone to alter noise-free pixels, thereby causing a number of artifacts including streaking and edge jitter. Some modified median-based filters have been proposed to overcome these shortcomings. Among those are centered-weighted median (CWM) filter [3,4], rank-ordered mean filter, progressive switching median (PSM) filter [5] and decision-based filter [27]. Basically, the task of decision-based filter is to decide when to apply the median filter and when to keep pixels unchanged. Recently, impulse noise removal based on fuzzy logic has been attracting research effort [1,6-8]. Arakawa et al. proposed a fuzzy median (FM) filter. The output of the filter is obtained as a weighted sum of the input pixel and the output of the median filter, and the weight is set based on fuzzy rules concerning the states of the input pixel. In addition, Lin and Yu proposed the partition fuzzy median (PFM) filter [1]. Though