Adaptive Filters for Image Processing based on Artificial Neural Networks

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Abstract. This paper presents our research in image processing (filters used for edges detection, color transformation, and distortion correction) using Artificial Neural Networks. We have developed a tool, Neuron Color, in order to do this kind of experiments and improving our adaptive methods.

1 Introduction

Traditional image processing methodology consists in transforming an original image in a processed image, using a well-known transformation function[1]. This function is coded into the application. Our goal is to make a system able to perform image processing tasks without knowing the transformation function. Instead of traditional methods, we are able to learn this function from practical examples.

We have used Artificial Neural Networks – ANN (Back-propagation)[2] in order to achieve this goal. The main advantage of this approach is that we haven't used predefined algorithmic functions, but image visual features learning. Learning is achieved using image original's samples and target images' samples, which allows the system to automatically carry out a certain transformation.

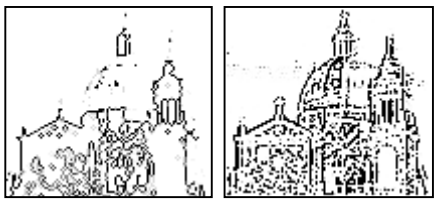
This paper's goal is to show the viability and usability of Neural Network training, in creating "adaptive intelligent filters", using Back-propagation. These filters are responsible for making image processing as previously stated.

2 Neuron Color

Neuron Color is a multiplatform application, implemented in Java language, to enable image processing experiments using ANN, focused in Back-propagation. Its main functions are: application of trained Neural Networks for image transformation (neural filter), and creation of example sets with both formatted inputs and outputs, which will be used in neural learning applications.

3 Experiments

To demonstrate our approach's efficiency the following experiments have been carried out: (a) edge detection (Fig.1); (b) colored image transformation to grayscale, with or without context (group of neighboring pixels) (Fig.2); (c) pseudo colors attribution in grayscale images; (d) correction of image distortions.



(A) (B)

Figure 1 Edge detection (from fig.2).
(A) using algorithmic functions;
(B) using a trained Neural Network

(A) (B)

Figure 2 Grayscale images.
(A) neural without context;
(B) neural with context

4 Final Considerations

As we can see in Fig.1b, we obtained interesting visual results. Several studies have been carried out by us in order to: (i) select the best attribute set (network inputs), which has the best capability for describing image's features; (ii) improve learning performance of Neural Networks. So, in that way, we are able to achieve even better visual results.

5 References

[1] R.Gonzales; R. Woods. *Digital Image Processing*. Addison-Wesley (1993).

[2] D. Rumelhart, G. Hinton and R. Williams. *Learning Internal Representations by Error Propagation. In: Parallel Distributed Processing: Explorations in the Microstructure of Cognition* - Vol. 1. MIT Press, Cambridge (1986).