ALTERNATIVE WAY OF IMAGE COMPRESSION WITH NEURAL NETWORK

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ABSTRACT

This paper presents an alternative way of image compression via approximation of "image" function with small neural network. By using smaller network or single neuron this method has lower computing requirements than standard neural method with compression in hidden layer. .

1. INTRODUCTION

Typical way of compression with neural network is using hidden layer with lower dimension then input or output layer. In our case, network input and output is an image. The input and hidden layers perform the compression, it transforms the input vector of dimension *d(IN)* to hidden layer space of dimension *d(HI).* The dimension of hidden layer is lower than of input layer $d(HI)<d(IN)$. Output layer with the help of hidden layers performs decompression. It transforms the vector from hidden layer with lower dimension to output vector space with higher dimension $d(HI)<d(OUT)$. The dimension of input and output layer is the same $d(IN)=d(OUT)$. The disadvantage of this solution is highly time-consuming computing for network learning.

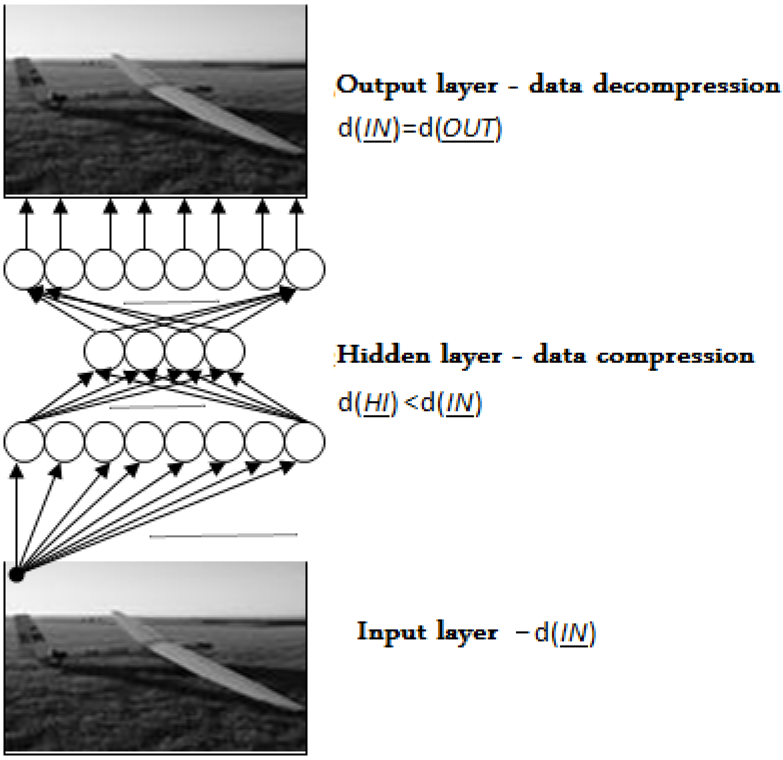


Figure 1. Using of hidden layer in neural network for image compression

2. ALTERNATIVE WAY OF COMPRESSION

A different view on the image gives us an alternative way of compression. Any image is a single matrix (for grayscale bitmap) or triple matrix (for color image). You can imagine this matrix as a vector, then put together rows or columns. After that, an image can be viewed as a numeric sequence or function. Pixel intensity Y is a function of pixel position X in sequence, Y=f(X).

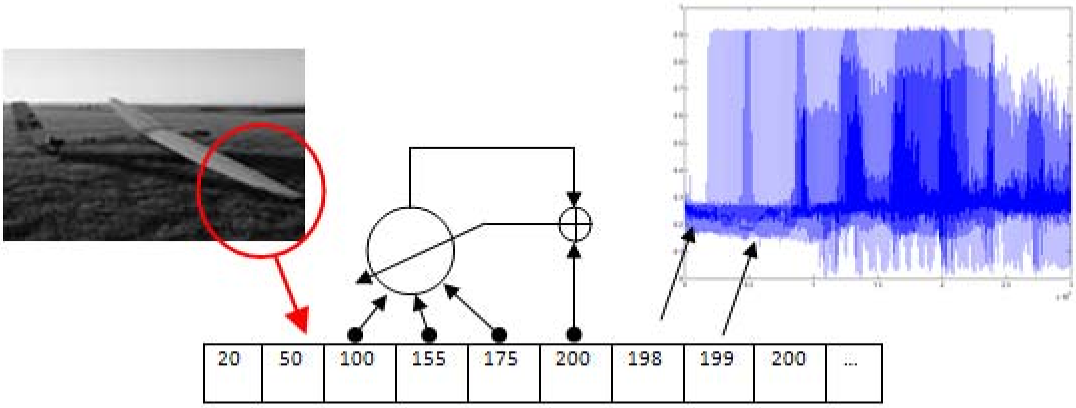


Figure 2. Alternative way of compression

2.1. TOPOLOGY

Neural network is useful for function approximation. Neural network with single neuron was tested for approximation of “image” function. Number of inputs was chosen between 5 and 150 pixels. Higher number of inputs gives better quality of decompressed image with higher time requirements for computing. Linear and sigmoid transfer function were tested and linear transfer function was chosen for future testing because it has better results for grayscale picture.

2.2. LEARNING ALGORITHM

Levenberg-Marquardt algorithm was chosen for network training.

$$w_k = w_{k-1} - \left(J^T J + \lambda I\right)^{-1} J^T \varepsilon_{k-1} \tag{1}$$

2.3. TESTING IMAGE

The original bitmap image can be seen on fig.3. The resolution of the image is 200 x 150 pixels in grayscale.

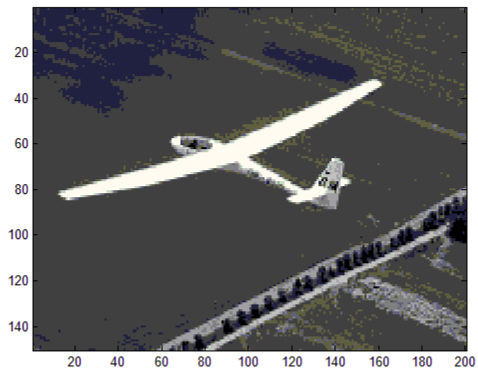
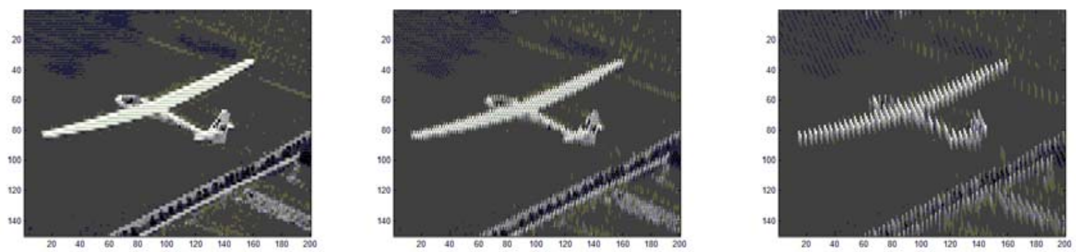


Figure 3. Original image

2.4. RESULTS

For image decompression it is necessary to use a part of original image. If more data is used for decompression then the decompressed image is of higher quality but the compression level is lower on the other hand. Parameter *proklad* involves additional information from original image, e.g. *proklad=2* means every second pixel from original image is used for image restoration. *Proklad* values 2, 4 and 8 were tested. The number of network inputs (5, 20, 60 and 150) was the next tested parameter.



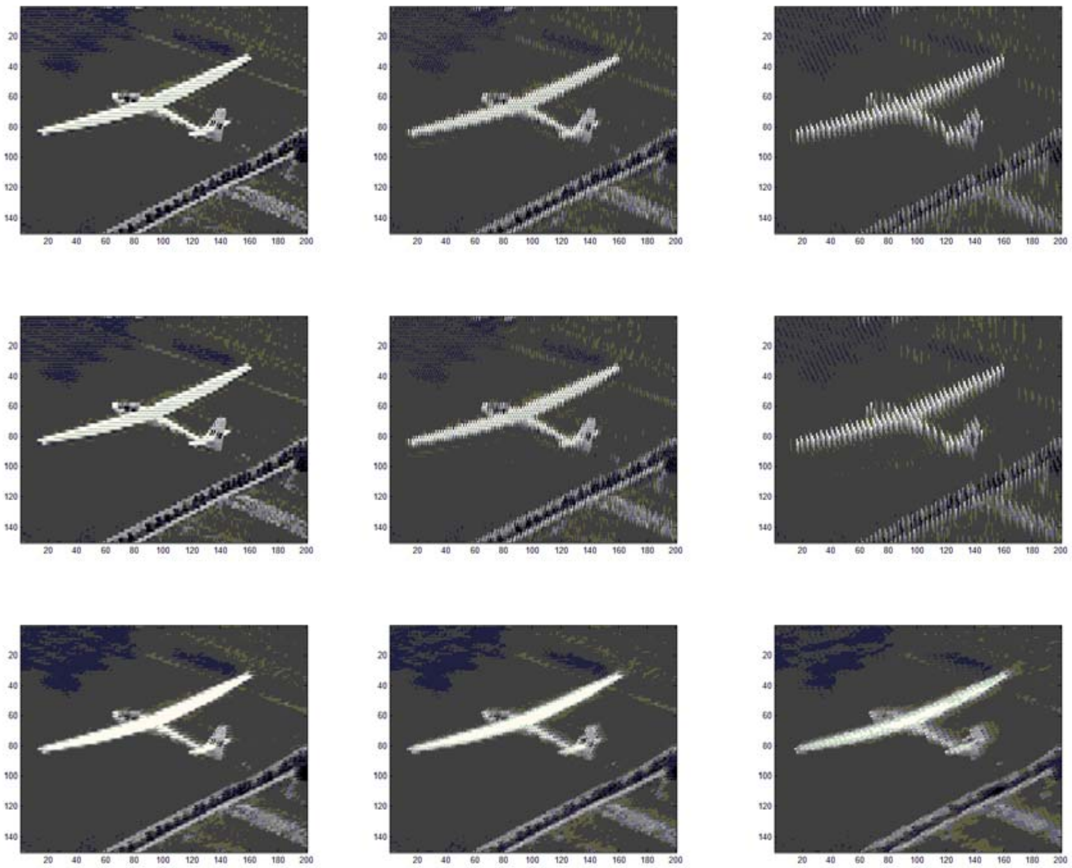


Figure 4. Compressed images proklad=2, 4, 8 (columns), number of network inputs 5, 20, 60 a 150 (rows).

3. CONCLUSION

Different approach to an image i.e. description by brightness intensity function of pixel position gives us alternative way for image compression with the usage of neural network. The main advantage of this method is lower time requirement for compression and decompression as compared to multilayer network. Subjective comparing of compression methods is on Table 1. Using of the small network for better compression ration and faster algorithms for lower time of compression is part of future works.

	Time of compression	Time of decompression	Compression ratio	Image quality
Single neuron	**Medium**	**Low**	**Low(1:2-1:4)**	**Low-Medium**
Multi layer	**High**	**Medium**	**Medium(1:4-1:10)**	**Medium**
JPG	**Low**	**Medium**	**High (1:10-…)**	**High**

Table 1: Subjective comparing of compression methods

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