Image Sequence Coding Using a Neural Vector Quantization

Sylvie S. Jumpertz- Eduardo J. Garcia

CCETT, Département of Picture Coding and Psychovisual Studies
4, rue du clos Courtel - B.P. 59 - 35512 Cesson Sévigné Cedex - France
e-mail : jumpertz@ccett.fr - garcia@ccett.fr

Some image sequence coding systems are already defined, and some are even normalised for specific applications. Researchs always try to improve this type of system to reduce the transmission bit rate while maintaining a good reconstructed image quality. The study presented here is in this direction : we try to improve the "classical" image sequence coding system by introducing a specific neural box. We have introduced in a system near of the normalised ETSI (1) sequence coding system a vector quantization realised with a Kohonen Map in which modifications was done on the learning neighbourhood.

I VECTOR QUANTIZATION AND KOHONEN MAP

The main problem of the vector quantization is the codebook generation : the classical algorithm for this codebook generation is the LBG algorithm (2). Kohonen has proposed a topological map wich can be used to build optimal vector quantizers (3). We have used this type of neural network to define our codebook. This network type keeps the topological relations existing in the input signal on its activation map. For our application we have chosen to use a structure where each neuron represents a codeword. At the learning end, weight connexion of a neuron represents vector components of the corresponding codeword. During the learning procedure, we present blocks randomly chosen in the image. At each iteration, the basic operation consists in determining the neurone c with the closest matching weights to input vector x. When the "winner" neurone c is found, we increase activity of this neurone and of its neighbourhood.

We have tested different neighbourhoods and learning gain functions (linear, exponential, inversely proportional to t, etc.), but we have obtained better results using a learning function which decreases once with the learning iteration and with the neurone position in the neighbourhood.

II INTEGRATION IN A CODING SYSTEM AND RESULTS

Once the codebook defined for our application, using the Kohonen map with made on the neighbourhood function, we have introduce this vector quantization in the nomalised ETSI sequence coding system based on the DCT. Specific modifications have be done on this system to be able to integrate this new quantization. To reduce the bit rate, we don't transmit the label of the codeword choosed for the block but its difference with the label found for the previous block. This method gives a better efficacy of the variable length code used at the end of the coding, by exploiting the topological capabilities of Kohonen map.

III RESULTS AND CONCLUSION

Simulations has been done on sequence TV images of 4:2:2 format. The learning phase, for the codebook generation, was done in each case on the first image of the sequence. We don't try to have a general purpose codebook but we propose to regularly refresh it. So, we increase the reconstructed image quality. We have try simulations with blocks 2x2, 4x4 and 8x8. The better results was obtained with 2x2 block size. For this size of block we had a compression rate of 0.6 bits per pel, and the signal to noise ratio was about 30dB.

Results presented here seems to be interessant in the fact that they are a direct application of neural network technique. Effectivly, the coding scheme used is really classical, only one "box", the quantization, is realised by using neural network technique. The coding system exploites the topological capabilities of the Kohonen map used to define the codebook. And this characteristic of the codebook obtained by this method permits to reduce significantly the bit rate transmission. It's interessant to observe that the definition of the codebook using the Kohonen map is really simple and can easily be realised by hardware in opposition with the LBG method.

IV REFERENCES

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