Applying the 3-D Wavelet Transform to Transmit Medical Video in Telemedicine

1 Introduction

In the last few years, the growth of the Internet and World Wide Web (WWW) have been very large. Nowadays, it is known that Internet become the most important communication medium of any future information society. On the other hand, Telemedicine is expanding rapidly and its usage is becoming a global interest. Therefore, it is clear that the development of Telemedicine should be combined with the increase of the Internet.

An important and real benefit of telemedicine is that more that one practitioner can telecollaborate. Due to the huge amount of transmitted data, high-bandwidth networks are needed in order to maintain the quality of the video and allow a correct diagnosis when it is reconstructed.

Therefore, we have focused our research on the compression of medical video sequences. The standard MPEG-2, presents several drawbacks. The Fast Wavelet Transform (FWT) has emerged as an attractive alternative. In this work, we present and evaluate a new lossy video compression scheme, based on the use of the 3-D wavelet transform and focused on medical video sequences.

2 Materials and Methods

We propose a new coding scheme for 3-D wavelet, which exploits both the spatial and the temporal redundancies.

We have proved and evaluated different wavelet mother functions such as Daubechie's W_4, Haar and Daubechie's W_8, and the number of steps that this function is applied, in order to evaluate the impact of the mother function on final performance.

We propose and evaluate two ways of thresholding: the percentile policy and the discarding of the less significant bits of all wavelets coefficients. We

propose a quantizer where the number of bits needed by each pixel coefficient to be encoded depends on the layer that this pixels belongs to. Finally, an entropy coding is performed: a run-length and a huffman compression is carried out to the coefficients.

3 Results

We have compressed and decompressed various medical video sequences. We achieve from compression rate of 9,46 and 44,54 dB (PSNR) with W_4 wavelet mother, percentil-95, two wavelet transform and two less sinificant bits discarded, to compression rate of 19,25 and 41,41 dB (PSNR) with the before wavelet mother, percentil-98, three wavelet transform and three less significant bits discarded.

4 Discussion

The Daub-4 obtains the best trade-off between compression rate and quality. We consider that more than 3 applications of the 3D-FWT is not worthwhile.

Analyzing the results for the different percentiles and number of bits discarded we can conclude as well that the more bits and coefficients are discarded the more compression rate is achieved. So an optimal configuration must be chosen in order to obtain a reasonable compression rate without influencing the quality.

The compression rate and quality obtained are excellent, which confirms the potential of the 3-D FWT for medical videos.

Compression rates achieved are quite good, as well as the quality, especially when compared with the compression rate and quality achieve by the standard MPEG-2, with no extra cost in computation time (around ten percent less).

Our implementation of Wavelet Transform is more suitable for medical video since images are not divided in blocks, avoiding the presence of artifacts in the reconstructed image. More precisely, this process takes care of the particular details of the images and makes unnecessary the application of softening filters.