Abstract

Actual image and video coding standards such as the H.264 and the High Efficiency Video Codec are based on an integer approximation of the Discrete Cosine Transform (DCT). However, wavelet based algorithms show better performance than the integer discrete cosine transform based algorithms for still images. Also, exploiting the human visual system characteristics like the fovea aliasing can improve the quality of the reconstructed image.

In the work reported in this thesis a new wavelet based image compression algorithm called Fovea Hierachical Trees (FVHT) is presented. FVHT is a wavelet based algorithm that also uses fovea coding for increasing the quality of the image reconstruction. The advantage of this algorithm over classic wavelet algorithms such as the ones used in the Joint Photographic Experts Group 2000 (JPEG2000) standard is its quantization step. In order to reach an optimal quantization, FVHT uses the same method than the Set Partitioning in Hierarchical Trees (SPIHT) algorithm which is known for reaching optimal quantization over wavelet based compression. Fovea coding is also included on the quantization step which leads into a complexity of $O(n)$ which is comparable with the current image compression standards. The results reported in this thesis show an increased quality of reconstruction against methods based on the DCT which comprise most of the algorithms used on current image compression standards.

In addition, two new models for video compression and a second image compression algorithm are proposed: SPECK based Codec (SP-Codec), Adaptive Wavelet/Fovea based Codec (AWFV-Codec), and Adaptive Fovea Set Partitioned Embedded Block Coder (AFV-SPECK) respectively. Both proposed algorithms applies wavelet based compression methods over individual frames for increasing the quality of the reconstructed video. This is an advantage over classic methods that use the DCT. The spatial transform of SP-Codec is the Set Partitioned Embedded Block Coder (SPECK) algorithm. This algorithm exploits the wavelet decomposition properties for optimization of the quantization step. The results reported in this document show an increase of the quality of individual frames against the H.264 standard using the same compression ratio. The second proposed model, AWFV-Codec uses the proposed image compression algorithm for quantization AFV-SPECK which uses the same quantization method as SPECK but with the addition of fovea coding. As

with FVHT, AFV-SPECK includes fovea coding on the quantization step, reaching a computational complexity of $O(n)$. The results obtained from AWFV-Codec show an increase of the quality of the reconstructed frames inside the fovea area. Furthermore, it is also reported how if the movement information of the video fall inside the fovea area, the reconstructed frames increase its overall quality.

The proposed models and algorithms increase the quality of classic methods by combining wavelet based approaches and fovea coding. However, fovea coding require the fixation point of the observers in order to determine the fovea area. As future work, other quantization methods will be investigated and the proposed models will be optimized for speed and memory usage.