**Watermark in motion vectors – part 2**

In the paper they choose a random block for encoding (BlockForEncode=50). I want to make the selection not random.

1. Select two random frames from a video (frame x and frame y) and divide each frame into 8x8 blocks.
2. Perform subtraction between selected frames (frame y – frame x) and save the difference picture.
3. Calculate MSE (mean square error) between all 8x8 blocks in the selected frames.
4. Sort the MSE results from the maximum MSE to the minimum MSE, divide the range into 3 levels:

Medium MSE

High MSE

Low MSE

The Low MSE range will include blocks with MSE less than 5% (MSE<= 5% ).

The Medium MSE range will include blocks with MSE between 10% and 75 % ( 5% < MSE <= 75% ).

The High MSE range will include blocks with MSE higher then 75% .

1. The watermark encoding will be like in the paper algorithm, but with some changes. The paper algorithm encoded only one block per frame and uses a couple of frames to encode the entire watermark. Now I want to encode the watermark in one frame only (selected frame y) and to use a couple of blocks according to the MSE calculation as follows :

* First priority is to encode the watermark in the low MSE range blocks. This blocks will be divided into 8 sections as follows :

Block in reference frame (frame x) window

Search window

2

1

8

7

6

5

4

3

2

8

7

6

5

4

3

1

Selected Block in frame y

Next step is to divide each block in frame x (reference frame) into 8 sections. The search range is restricted according to the bits we want to encode, for example if we want to encode "000" (section 1) the current block searches its best matching section 1 in reference frame (similar to the old algorithm) in this way only the desired section is searched in each block, not the entire block is searched and we can encode 3 bits in each section.

|  |  |
| --- | --- |
| section | Bits to encode |
| 1 | 000 |
| 2 | 001 |
| 3 | 010 |
| 4 | 011 |
| 5 | 100 |
| 6 | 101 |
| 7 | 110 |
| 8 | 111 |

* Second priority is to encode the watermark in the medium MSE range blocks. This blocks will be divided into 4 sections as follows :

3

Search window

1

2

2

1

4

4

3

Selected Block in frame y

Block in reference frame (frame x) window

The search range is restricted according to the bits we want to encode, for example if we want to encode "00" (section 1) the current block searches its best matching section 1 in reference frame (similar to the old algorithm) in this way only the desired section is searched in each block, not the entire block is searched and we can encode 2 bits in each section.

|  |  |
| --- | --- |
| section | Bits to encode |
| 1 | 00 |
| 2 | 01 |
| 3 | 10 |
| 4 | 11 |

* Third priority is to encode the watermark in the High MSE range blocks. This blocks will be divided into 2 sections as follows :

Search window

1

2

2

1

Selected Block in frame y

Block in reference frame (frame x) window

The search range is restricted according to the bits we want to encode, for example if we want to encode "0" (section 1) the current block searches its best matching section 1 in reference frame (similar to the old algorithm) in this way only the desired section is searched in each block, not the entire block is searched and we can encode 2 bits in each section.

1. The watermark is a random sequence of bits, in case the sequence is bigger than the number of blocks in the low MSE range, move to medium range and then to high range blocks.
2. The encoding process will still use the mode selection as in the paper algorithm, if it is impossible to do inter prediction do intra or ipcm.
3. The output will be the encoded frame, the original frame, the encoded video.
4. Calculate the psnr of the encoded frame and the encoded video.

Decoding process:

1. Get those 2 frames you selected in the encoding process (frame x and frame y), calculate the MSE of each 8x8 block and according to those calculations decode the watermark from the video.