TD 5 -Motion estimation and compensation-video compression

Introduction in Motion Estimation

Motion estimation is a process which is used in video compression in order to reduce **temporal redundancy** between adjacent frames. It examines the movement of objects in an image sequence to try to obtain motion (velocity) vectors representing at best the estimated motion.

Motion vectors can be related to the whole image or just a small part of the image like rectangular blocks or even pixels. They can approximate the motion of the camera or the motion of an object inside the scene.

Among the block-based motion estimation techniques, the simplest yet extremely computationally intensive is the exhaustive block-matching.

Requirements:

- Use a bunch of adjacent frames of a video (i.e "xylophone.mp4" or you can visit the following link to download other videos:
  http://calvin.inf.ed.ac.uk/datasets/tigdog/
  http://trace.eas.asu.edu/yuv/, etc.
- Implement the exhaustive block-matching algorithm:
  - Import the video and read 2 consecutive frames from the chosen video sequence (convert from RGB to grayscale images, if necessary).
  - The first frame is denoted as Reference Frame F_R. The second frame is known as the Current Frame F_C.
  - We assume there is a translational motion over macroblocks blocks of size (16x16).

– Define a search parameter "p", that corresponds to the range in pixels of the vertical/horizontal components of the motion vector.
– For every macroblock of F_C, search the best match in F_R. To evaluate the best match in a search region (defined by the search parameter), evaluate the minimum cost function between the corresponding blocks at each possible location. You can use as a metric the cost function "Mean Square Error (MSE)", defined as such:

$$mse(F_R, F_C) = \frac{1}{N^2} \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} \left[F_R(i,j) - F_C(i,j) \right]^2 \qquad (1)$$

– Create the motion vectors with the minimum cost function and display them superimposed over F_C (quiver plot).