TD 7 -Video compression codec and comparison with MPEG standard

The deadline for handing in the report corresponding to TD 5,6 and 7 is the 13^{th} of November 2017. The written reports will be sent to agrapa@i3s.unice.fr.

In the last laboratory, you have performed **motion compensation** starting from a reference frame F_R by using the **backward motion vectors** (previously obtained from motion estimation with block-matching between F_R and F_C). As a result, you obtained the **prediction error** E_{res}, as the difference between F_C and F_{CC} (motion-compensated frame).

Therefore, in order to predict a frame starting from the previous one, we use the motion vectors between the frames and the corresponding prediction error that was previously compressed (remember image codec lab.). You can use the attached figure as a guide.

The purpose of this lab session is the implementation of a video codec and the comparison of its performance with a MPEG standard for video compression.

Tip: trim your video to at most 1-2 seconds for the following requirements.

Requirements

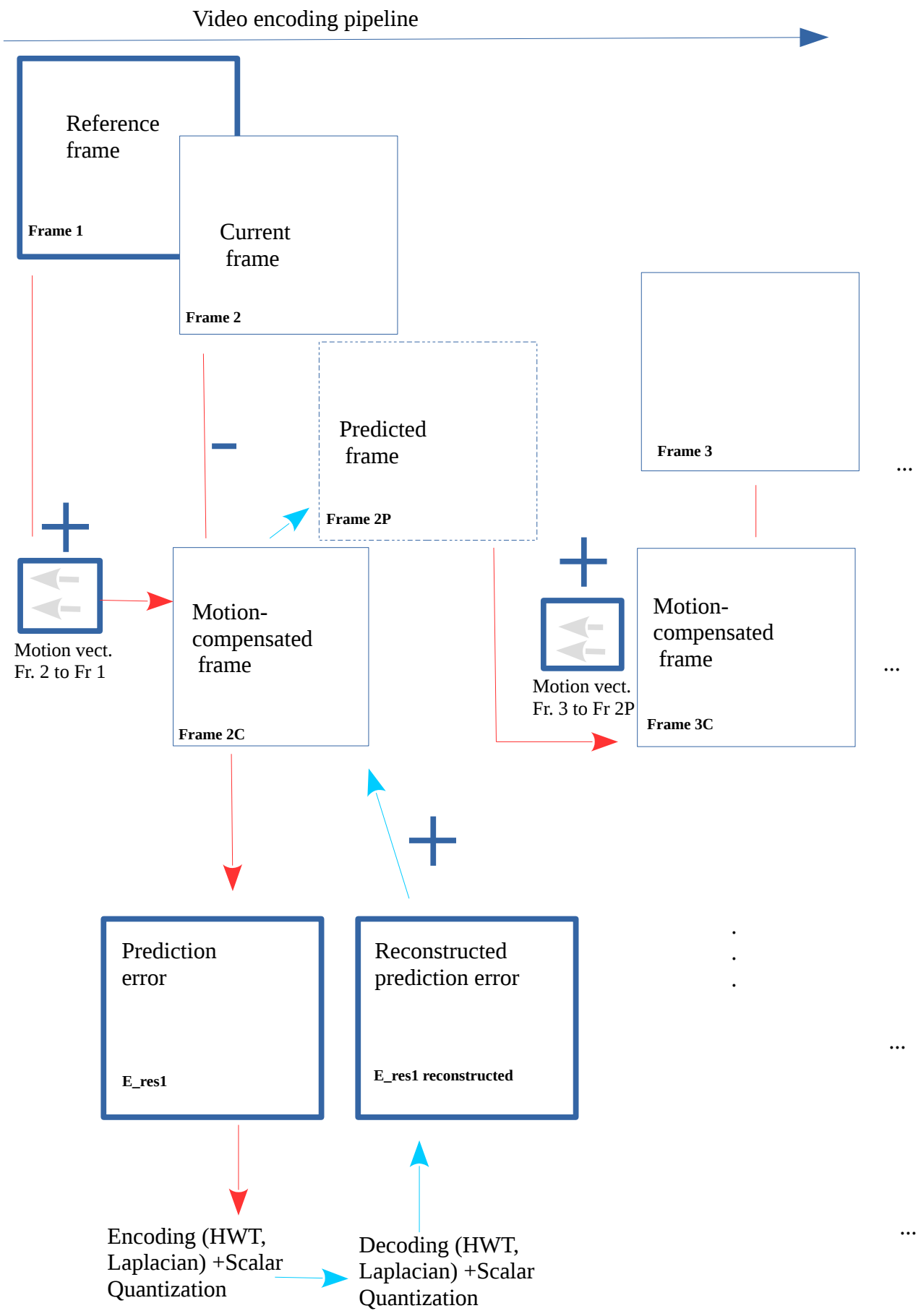
- Apply the still-image codec (remember last lab sessions) to the first frame of the video, F_R.
- Determine the motion-compensated frame between the first two frames and store the associated compressed (encoded) E_{res}. Reconstruct (decode) the E_{res} and then predict the second frame accordingly, with

respect to the **reconstructed** E_{res} and the **motion compensated frame** (see figure).

- Determine the motion-compensated frame between the third frame and the previous predicted second frame, storing again the associated compressed E_{res}, and predicting the third frame in a similar manner.
- Iterate the previous points to predict all frames from your video, starting from the previous one and store the corresponding compressed E_{res}.
- Reconstruct the frames in your video, with the help of the motion vectors and reconstructed E_{res}.
- Compute the distortion between the reconstructed frames and original ones. Subsequently compute the total average distortion (related to the total number of frames) of the video.
- Plot a graph of the total average distortion vs. video bitrate (nr. of bits in unit of time, e.g Kbps or Mbps), for different quantization steps of the wavelet subbands. Comment your results.
- Plot a graph of the PSNR (considering the total average distortion) vs. video bitrate, for different quantization steps of the wavelet subbands. Comment your results.

MPEG video coding standard

- Using a MPEG compressor provided by the development environment of your choice, write your video sequence in a MPEG-4 (.mp4, .m4v, etc.) format, for different quality values.
- Plot a graph of the total average distortion vs. video bitrate as well as of the PSNR vs. video bitrate for all of the compressed videos at the previous point. Comment your results.
- Compare the previous plots between MPEG-4 and the your codec version. Provide the interpretation of your results.


Video encoding pipeline
Reference frame
Frame 1
Current frame
Frame 2
Predicted frame
Frame 2P
Frame 3
Motion vect. Fr. 2 to Fr 1
Motion-compensated frame
Frame 2C
Motion vect. Fr. 3 to Fr 2P
Motion-compensated frame
Frame 3C
Prediction error
E_res1
Reconstructed prediction error
E_res1 reconstructed
Encoding (HWT, Laplacian) +Scalar Quantization
Decoding (HWT, Laplacian) +Scalar Quantization