UNIVERSIDADE DE AVEIRO
DEPARTAMENTO DE ELECTRÓNICA, TELECOMUNICAÇÕES E INFORMÁTICA

Audio and Video Coding (2013/2014)

Lab work n$^{\circ}$ 2 — Due: 28 Nov 2013

Using the classes developed in the project 1, you have to implement a video codec for video sequences previously saved in files or directly aquired by a digital camera. The codec should rely on block based motion compensation and predictive coding. The project is divided in four stages and you can consider each one as a different version of the codec.

1 Tasks

On a **first stage**, you should develop a lossless intra-frame encoder that comply to the following requirements:

1. The frames should be encoded using spatial predictive coding (for example, using the linear predictors of JPEG and the non-linear predictor of JPEG-LS).
2. Entropy coding should be performed using Golomb codes.
3. All the information required by the decoder should be included in the bit-stream (frame size, prediction mode, code parameters, etc.).

On a **second stage**, you should develop a lossless hybrid encoder (intra + inter coding) that comply to the following requirements:

1. The block size and search area for inter-frame coding should be an input parameter of the encoder.
2. The periodicity of the key frames should be an input parameter of the encoder. For the frames that are encoded in intra-frame mode use the method developed in the first stage.
3. All the information required by the decoder should be included in the bit-stream (frame size, block size, search area, code parameters, etc.).
4. Entropy coding should be performed using Golomb codes.

Based on the lossless video codec developed in stage 1 and stage 2, in the **third stage** you should extend it in order to allow lossy coding. The encoder should receive three additional input parameters, indicating the quantization steps used for quantizing the prediction residuals of the Y, C_b and C_r components. The quantized values will be entropy coded using Golomb codes or another coding method if you want (bitplane decomposition, arithmetic coding, etc.).

On a **fourth stage**, you should implement another lossy version of the codec, based on transform coding of the predicted residuals (DCT as in the JPEG standard or wavelets as in JPEG2000 standard) and quantization of the coefficients. Once again, the quantized values will be entropy coding using Golomb codes or another coding method if you want.

2 Report

The report should describe the solutions that you have adopted for the several components of the codec and include a user's manual. Average compression results, in kbits per second, and the quality of the decoded video in the lossy version, PSNR and RMSE, shall be provided.

If your codec has parameters that allow adjusting the encoding speed versus the encoding efficiency, then present results showing the effectiveness of those functionalities. A few graphs, displaying bitrate versus frame number, shall be included (these will permit the observation of the instantaneous bitrate for a given video sequence). Other graphs like PSNR versus bitrate should be provided.