

Digital video processing

Exam 17.3.2006

1. Explain briefly (max. 3 rows):
 - a) PAL video
 - b) Critical flicker frequency
 - c) Projective mapping
 - d) Optical flow
 - e) Vector Huffman coding
 - f) Video object plane (VOP) (6 p)

2. Video sampling rate conversion.
 - a) Let us consider conversion from progressive video to interlaced video. Assume that the resulting 2:1 interlaced video has the same field rate as the frame rate of the progressive video. Draw the sampling lattices, the corresponding reciprocal lattices, and Voronoi cells of the reciprocal lattices. Determine also the ideal prefilter needed in the conversion. (3 p)
 - b) If the conversion is made without prefiltering aliasing will occur. Illustrate with a drawing the aliasing effect on the reciprocal lattice. Assume that the spectrum of the video signal has circular shape, so that it just fits to the Voronoi cell of the reciprocal lattice of the progressive video. (1 p)
 - c) In practice, we decide to perform prefiltering using the equation:
$$\hat{f}(t, y) = \frac{1}{4} f(t-1, y) + \frac{1}{2} f(t, y) + \frac{1}{8} [f(t, y-1) + f(t, y+1)]$$
where $f(t, y)$ is the image value at the field t and line y . Derive the impulse response and the frequency response for this filter. (2 p)

3. Explain the principles of the following motion estimation methods:
 - a) Hierarchical block-matching algorithm (2 p)
 - b) Deformable block-matching algorithm (2 p)
 - c) Three-step search (2 p)

4. Video coding.
 - a) What kind of coding improvements did the MPEG-1 standard provide compared to H.261? (2 p)
 - b) What are the essential differences between MPEG-1 and MPEG-2? (2 p)
 - c) What is meant by fine-granularity scalability and how is it utilized in MPEG-4? (2 p)