

Digital Video Processing (EE392J)
Department of Electrical Engineering
Stanford University

Problem Set No. 1

Issued: January 16, 2002

Due: January 23, 2002 (in class)

Reading: Chapter 1, Chapter 2.1-2.3, Chapter 3.

Problem 1. In class we say that the frequency spectrum of an analog video signal such as monochrome (B&W) NTSC television consists of smeared line spectra arranged in clumps that are harmonically related. What is the frequency spectrum of the monochrome component of the PAL (Phase Alternation Line) television signal which is used in much of Europe? PAL uses 2:1 interlace, 625 total lines/frame (580 active lines/frame), 25 frames/sec, and has a 4:3 aspect ratio.

Problem 2. You are watching a 20 inch-diagonal NTSC television (with 4:3 aspect ratio) and you notice a ghost image that appears to be offset .2991 inch to the right from the primary image (you have super-precise eyes!). (a) What is the time delay of the multipath (reflected signal) versus the primary signal? (b) What is the form of the impulse response of the channel that the television is experiencing?

Problem 3. A friend sends you two consecutive fields of an interlaced video sequence. He says that the video sequence is supposed to contain the outline of a moving rectangle, but it doesn't look like a rectangle to him. The rectangle is supposed to have a linewidth of 1 pixel, and when you view these two fields in succession on an interlaced display you see the four vertical lines as shown below, where each vertical line has a height of 29 pixels. Can this be produced by a moving rectangle, and if so what are the possible sizes and motions?

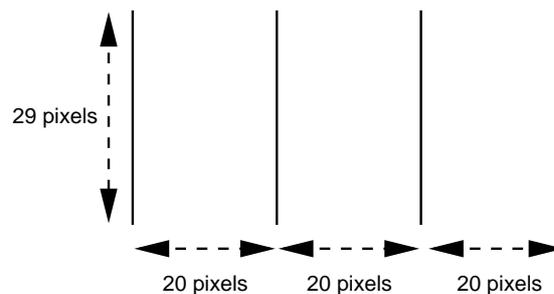


Figure 1: You only see four vertical lines on your interlaced display.

Problem 4. Chapter 2, Problem 6

Problem 5. Chapter 3, Problem 1

Problem 6. To estimate the motion in a scene you examine the intensity of two captured video frames, $s(n_1, n_2, \tau_1)$ and $s(n_1, n_2, \tau_2)$ captured at $t = \tau_1$ and $t = \tau_2$ respectively, and you compute the frame difference between them: $d(n_1, n_2) = s(n_1, n_2, \tau_2) - s(n_1, n_2, \tau_1)$.

(a) If the frame difference is nonzero, can you say that motion has occurred in the scene? Please explain.

(b) If the frame difference is exactly zero, can you say that no motion has occurred in the scene? Please explain.