

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

*Problem Set No. 1*

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Issued: January 12, 2004

Due: January 21, 2004 (in class)

Reading: Chapter 1, Chapter 2.1-2.3, skim 2.4, Chapter 3.

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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. Chapter 2, Problem 2.1

Problem 4. Chapter 2, Problem 2.5. In regard to whether “the viewer can perceive the vertical variation properly”, we are looking for a rough answer based on the HVS spatial frequency response (Fig 2.6).

Problem 5. Chapter 2, Problem 2.6

Problem 6. Chapter 2, Problem 2.7 (continuation of above problem)

Problem 7. Chapter 3, Problem 3.1

Problem 8. 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.