Indian Institute of Technology Jodhpur

Signals and Systems

EEL2010 Assignment 2

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1. Consider a scenario where we want to transmit (send) an digital image $f(m, n)$ (where $m, n \in \mathbb{Z}$) over a communication channel (link) C. Let f be of size full HD i.e. 1920×1080 samples (1920 columns and 1080 rows), and it is provided as a png file ("f.png"). However, due to constraints, we can only transmit 960×540 samples via the said channel C. Thus, we need to reduce the number of samples in f by a factor of 2 along row and column. This operation is known as downsampling. Let the downsampled image be denoted by $g(m, n)$ which is sent over the channel. On the receiver side, the received image g is upsampled i.e. the number of samples are increased by a factor 2 along rows and columns. Let g_u denote the upsampled signal. Now, consider the following tasks:

   (a) Task 1: Obtain g, by simply taking every alternate sample along rows and columns of f. Obtain, g_u by upsampling g (use interpolation). Now compare f and g visually.

   (b) Task 2: Apply a moving average filter on f. That is, replace each sample value in f by the average of samples in a 3×3 block. Let the resultant image be f_m which is still full HD in resolution. Now, obtain g by simply taking every alternate sample along rows and columns of f_m. Obtain, g_u by upsampling g (use interpolation). Now compare f and g visually.

   In which task, Task 1 or Task2, does the upsampled image g_u is visually closer to f and why? Does your answer hold for any arbitrary image f? Explain. [10]