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Assignment – 2 (Signal and System)

In this assignment we are doing image processing. In which we compare multiple images and for that we are using different techniques.

Firstly, an image of 1920×1080 samples is given. And we want to transmit it through a channel C but the constraint is that it only allows 960×540. So, we need to do down-sampling of this image.

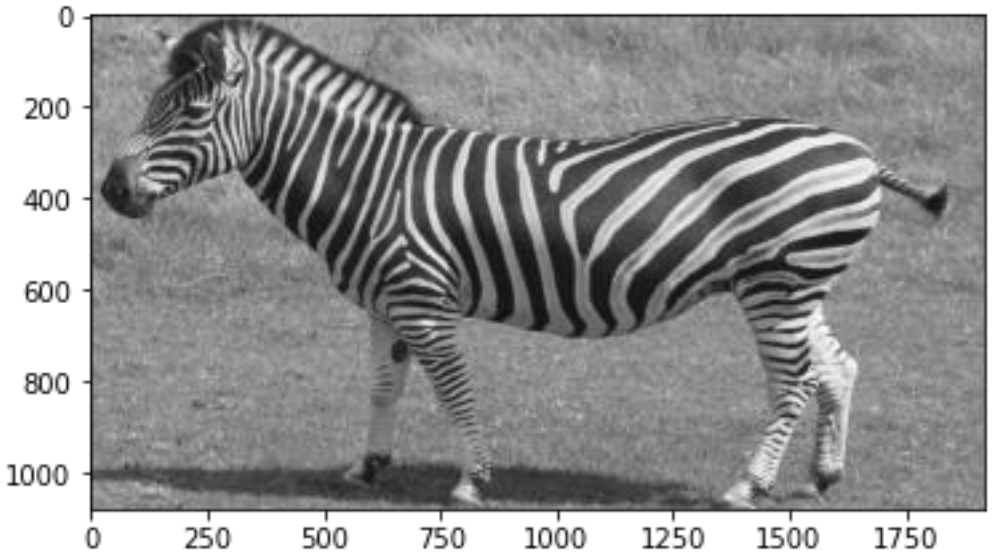

Fig: - This is our original image with dimension 1920×1080.

- There are different methods of down-sampling but here for the first task we are just choosing alternate pixel and this will help in the reduction of sample by a factor of 2.

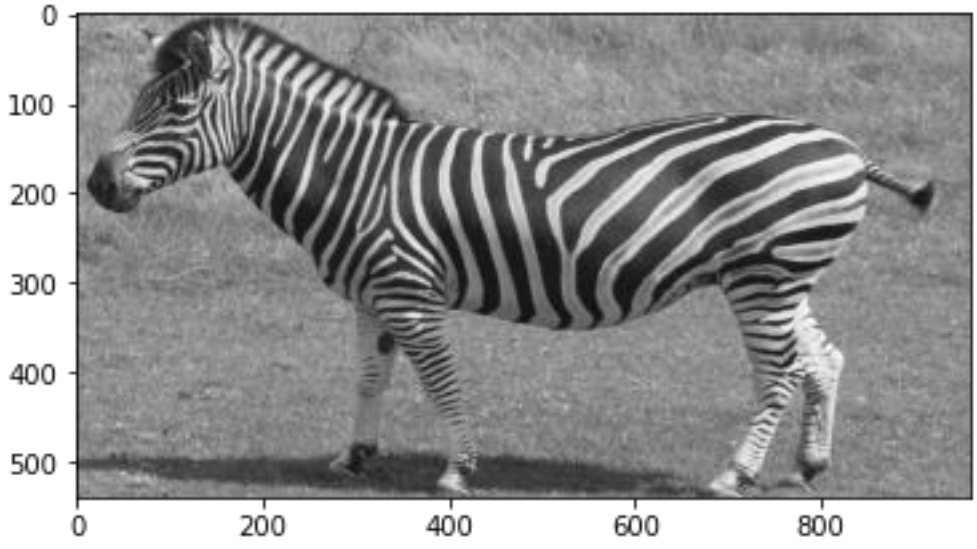

Fig: - This is down-sampled image with dimension 960×540

- Now after receiving the image through the channel we want to up-sample this image i.e., increase the number of samples by a factor of 2. And for this I'm using **linear interpolation** method by using inbuilt library of **OpenCV**. Image interpolation works in two directions, and tries to achieve a best approximation of a pixel's colour and intensity based on the values at surrounding pixels.

- Now in **Task 1**, we need to compare our original image and this up-sampled image. So, for that we just subtract the matrix value of original image and up-sampled image. And then I just visualise this difference.

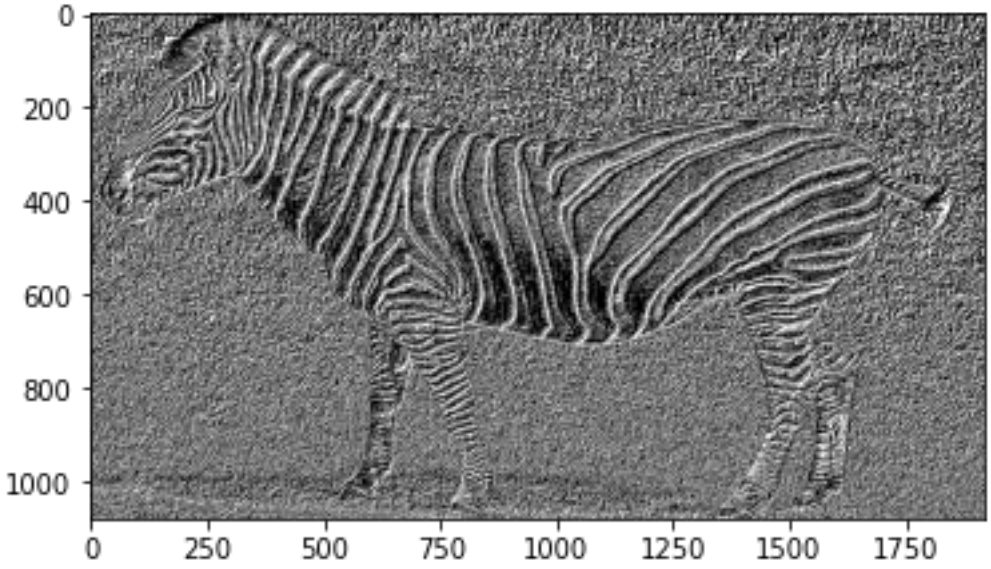

Fig: - Difference between original image and up-sampled image (by using interpolation)

- Now in Task 2, we need to first use a moving average filter of size 3×3 (also called a low pass filter) for our original image. A low pass filter is the basis for most smoothing methods. An image is smoothed by decreasing the disparity between pixel values by averaging nearby pixels.

Fig: - As we observe both images closely, it is observed that the edges are not so sharp in case of Averaging as we are using Low pass filter here.

- Now we down-sampled the Averaging image (f_m) by a factor of 2 by just dropping alternate pixels. And name them as g.

- Now up-sampled this image (g) again by using linear interpolation. And name them as g_u.

- Our last objective is to compare original image i.e., f with up-sampled image i.e., g_u. And for this just take a difference of f and g_u matrix, and observe the image.

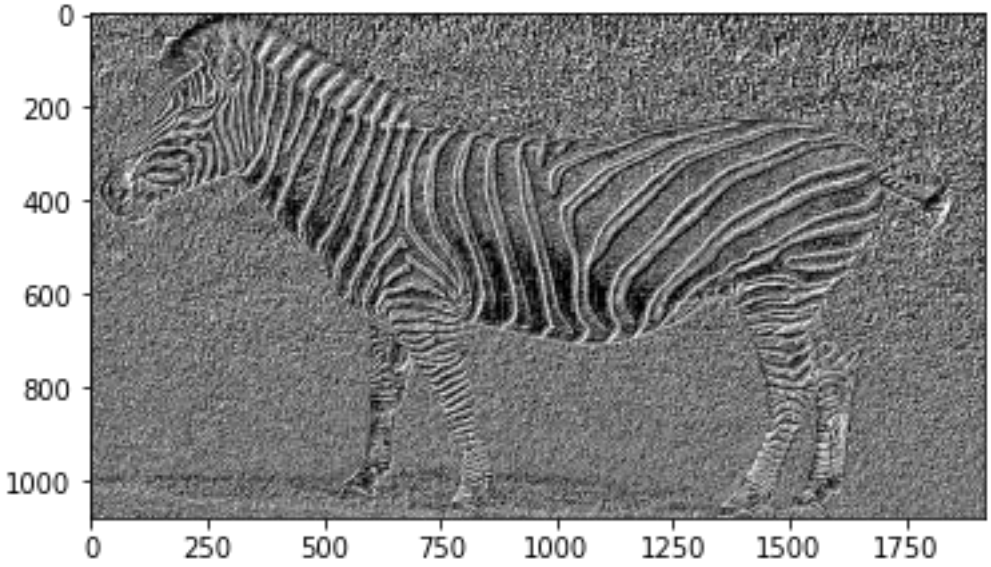

Fig: - Difference between original image and up-sampled image (in case of moving average)

Conclusion: -

- Image of task 1 is visually closer to original image (Similarity of image in Task 1 is 87.5% and in Task 2 is 83.6%).
- In Task 2 we are using Low pass filter and it makes image blurry because it does not detect edges.
- Edge is basically high frequency signal because there is sudden jump in intensity which can be detected by High pass filter but not by low pass filter.
- Yes, my answer holds true for any image as we are using Low pass filter in Task 2 it always blurs the edges and in every case Task 1 gives visually closer image.

For codes, I'm attaching a file from there you will get all codes.