REPORT

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Theoretical Explanantion

- Denoising : Noise is a high frequency unwanted disturbance in the signal. Hence removing the noise is an important factor for achieving the real signal.
  Denoising can be done by the concept of kernel i.e, replacing $x[n_o]$ by the average of its neighbouring values. The averaging can be done by taking any number of neighbouring values from one side and taking the same number of values from other side of $x[n_o]$.
  In our assignment we have taken average of 5 values i.e, replacing $x[n_o]$ by :
  $$(x[n_o-2]+x[n_o-1]+x[n_o]+x[n_o+1]+x[n_o+2])/5$$
  Consider a case where any of the $x[n_o-2]$, $x[n_o-1]$, $x[n_o+1]$, $x[n_o+2]$ are not defined, we simply replace it by $x[n_o]$.

- Deblurring : The deblurred signal y[n] can be expressed as the convolution of original signal x[n] with the impulse response h[n]
  i.e, $y[n]=x[n]*h[n]$

Now, taking the fourier transform on both the sides we get,

Y[n]=X[n].H[n]

Therefore, X[n]=Y[n]/H[n]

Where, $X[n]=\sum x_n e^{(-j.w.n)}$, $w = 2k\pi/N$

Hence, we get the fourier transform of original signal. Now to find the original signal we find the inverse fourier transform of X[n] :

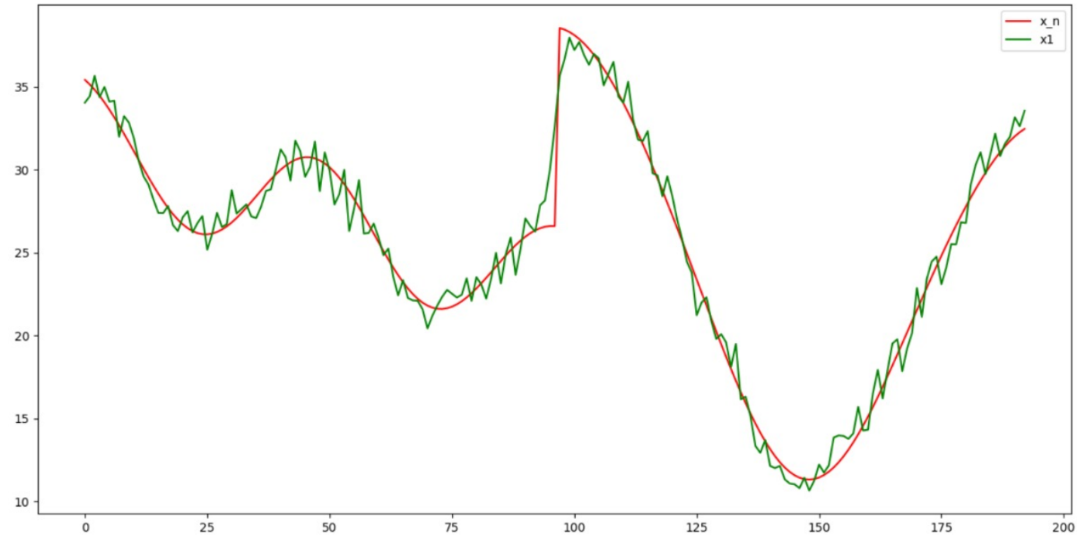
$$x[n] = \lim 1/N . \sum X_k e^{(j.w.n)}$$

Where, lim N tends to ∞ and $w = 2k\pi/N$

Graphs

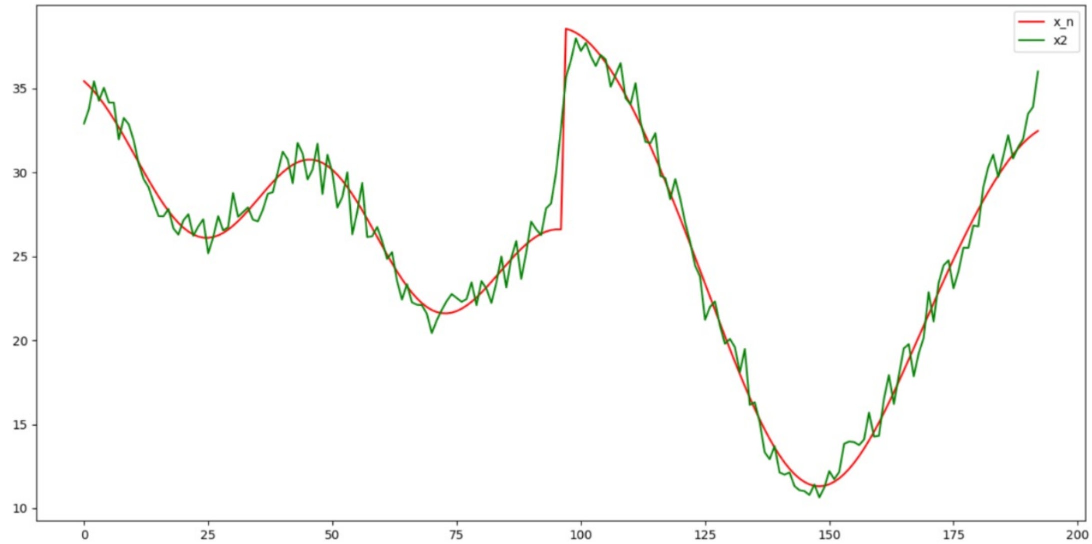
1. $x_1[n]$ vs $x[n]$

   $x_1[n]$: Denoising and then Deblurring



2. $x_2[n]$ vs $x[n]$

   $x_2[n]$: Deblurring and then Denoising



Hence, both the graphs of $x_1[n]$ & $x_2[n]$ are same except at the boundary values.

Conclusion

Choosing an appropriate kernel is significant for getting the optimum output while denoising the signal.

The Mean Squar Error (MSE) of y[n] = 2.0611474113471493

MSE of $x_1[n]$ = 1.1242589102555756

MSE of $x_2[n]$ = 1.2306692753164628

Hence from comparing the MSE of $x_1[n]$ & $x_2[n]$ we can say that $x_1[n]$ is more accurate and hence method 1 is more accurate than method 2.

Also, theoretically we can see that since the noise is additive in nature, it just adds to the signal after the deblurring i.e,

$y[n] = x[n]*h[n] + u$. So, theoretically also we should first remove noise to get $y'[n] = x[n]*h[n]$ and then deblurr it using inverse fourier transform.

Contribution :

1. Maniya Yash Rajeshbhai (B20CS033) :

   Wrote the code for denoising,DTFT,IFT, $x_1[n]$, $x_2[n]$ and plotting graphs of the signals.

   Added proper comments to the code.

   Designed readme file.

   Helped in concluding the results.

2. Tatvam (B20CS077) :

   Wrote the code for MSE, helped in designing $x_1[n]$ and $x_2[n]$.

   Worked on the theoretical aspects of the assignment and assisted for writing a proper codes for the DTFT and IFT.

   Wrote the conclusion of the given assignment.

   Wrote Report of the Assignment.