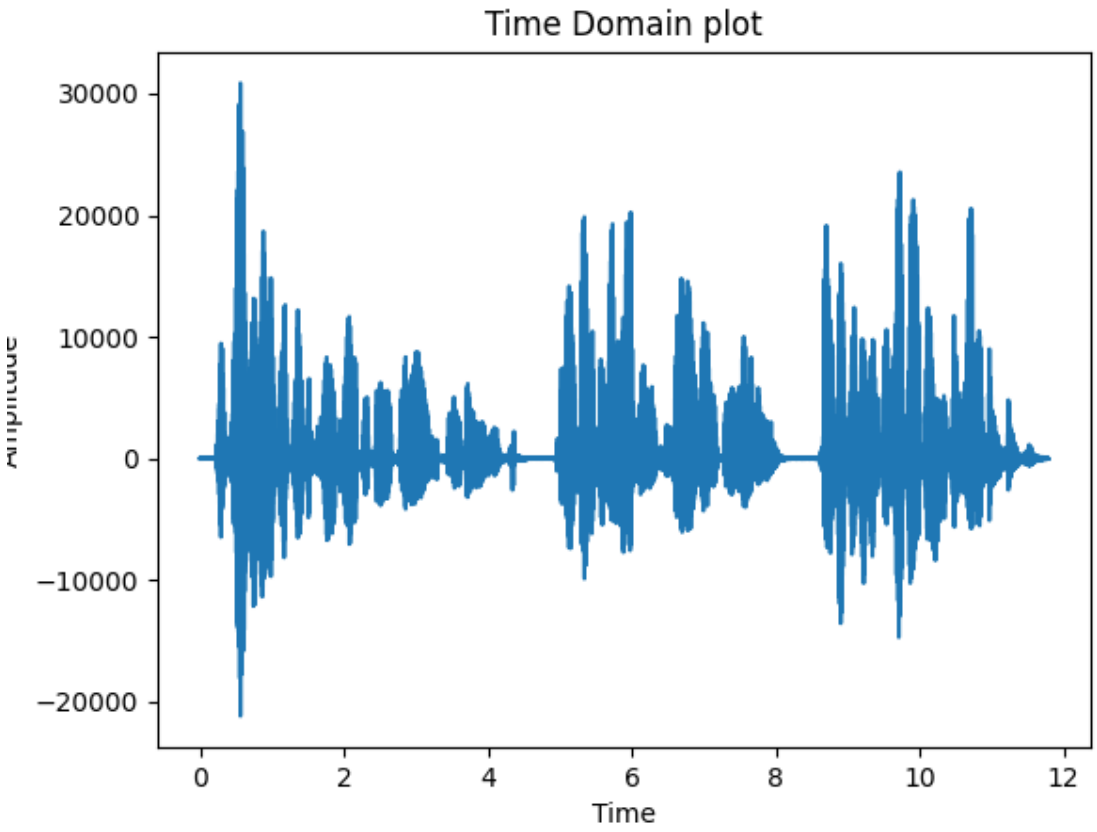
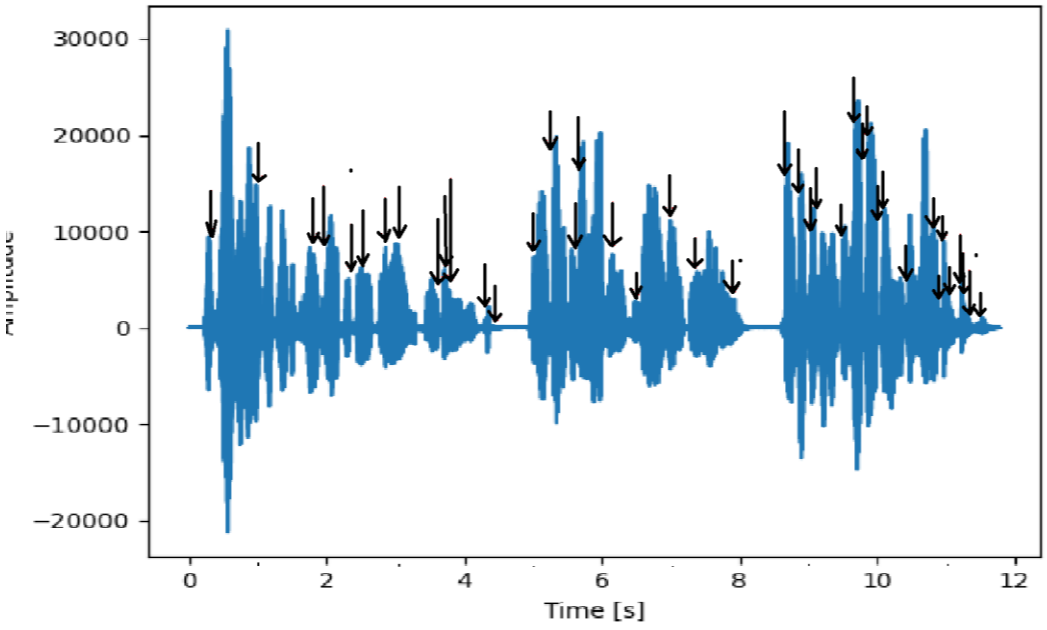
TIME DOMAIN PLOT



VOICED AND UNVOICED REGION ANALYSIS:



The voiced and unvoiced regions are marked using Wavesurfer in HMKB.lab file and also shown using black-arrows in MS Paint diagram.

Segment time-domain plot between [3.378-3.398]s i.e. 20 ns which corresponds to [148969 - 159851] samples, this refers to the voiced region segment from our sound file and the unvoiced segment corresponds to time [6.8-6.82]s and samples [299880- 300762].

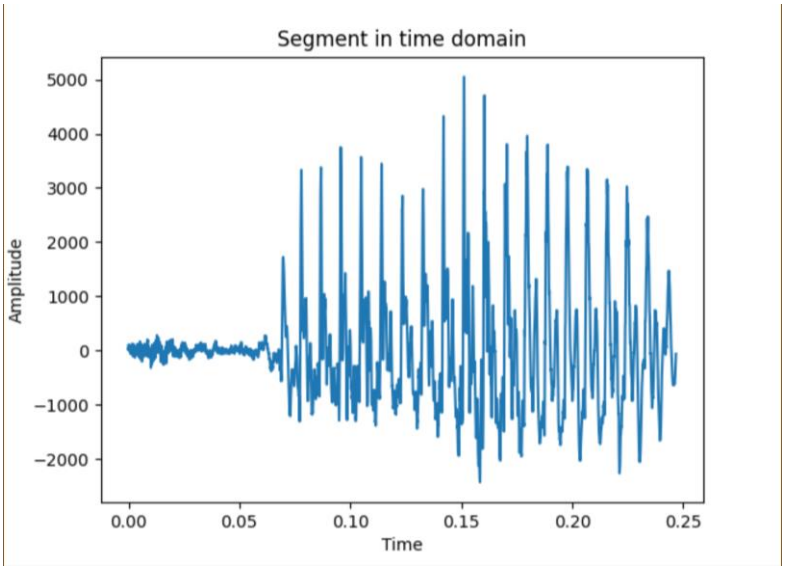


Figure 1Voiced Segment

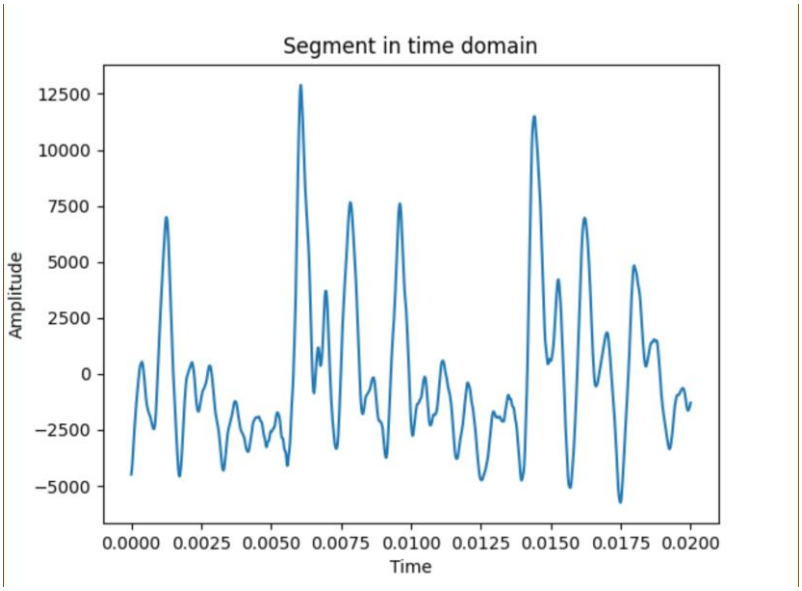


Figure 2Unvoiced Segment

Pitch Estimation and Fundamental Frequency:

The Pitch is measured using the Fundamental Frequency, which changes at different instants of time. We use concept of Zero-Crossing sometimes to calculate the time-period whose inverse can help us calculate the F0 , and also use autocorrelation based methods for calculating time-period and hence F0, however such methods fail easily when sounds are not strictly periodic. Thus we use algorithms such as **praat** , which has shown to work well for sounds containing male's and female voice transitions as well emotional and non-emotional speech.

We find the F0 of Voiced region is approximately ~ 120 Hz since the maximum F0 :120.5 Hz lies at 6.8s and minimum F0 119.6 Hz lies at: 6.81s

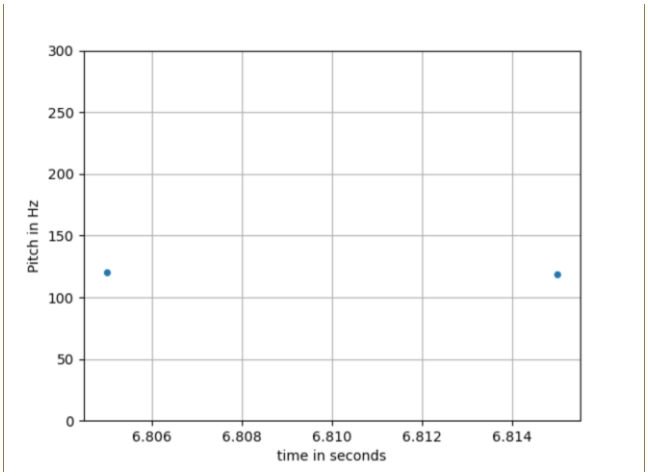
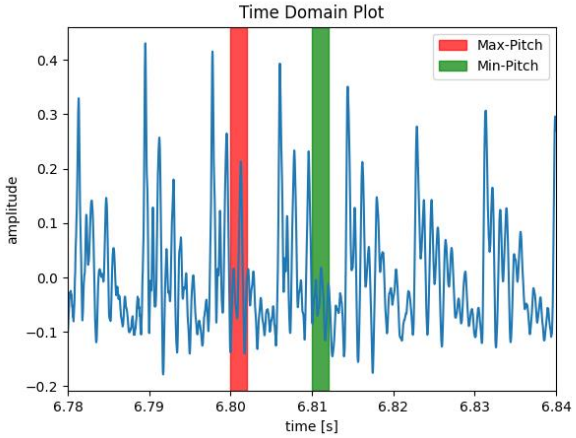


Figure 3Pitch Contour of voiced region



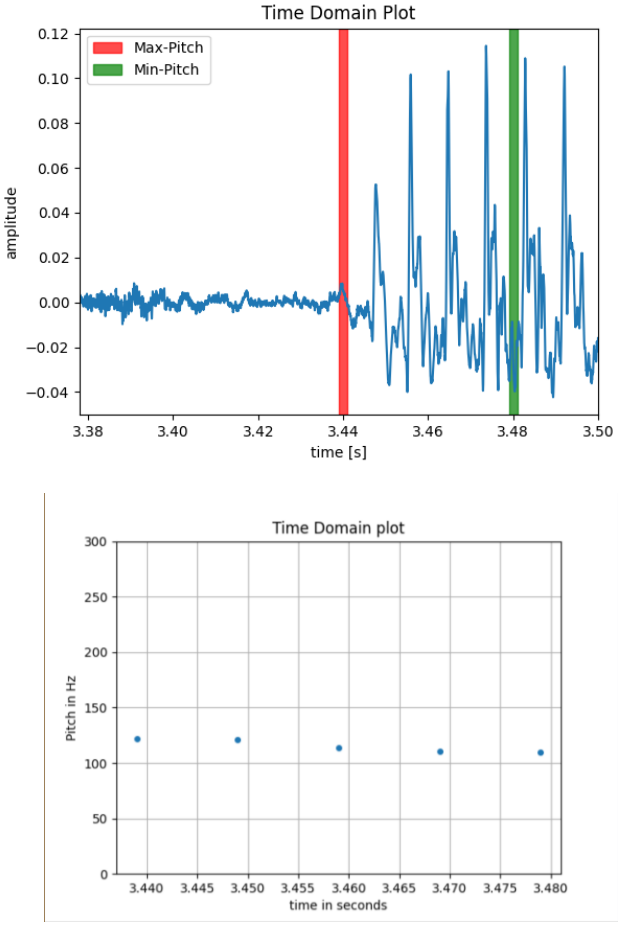


Figure 4Pitch Contour of unvoiced Region

We find the F0 of Unvoiced region is approximately ~ 114 Hz since the maximum F0 :121.6 Hz lies at 3.43 and minimum F0 109.4 Hz lies at : 3.47s.

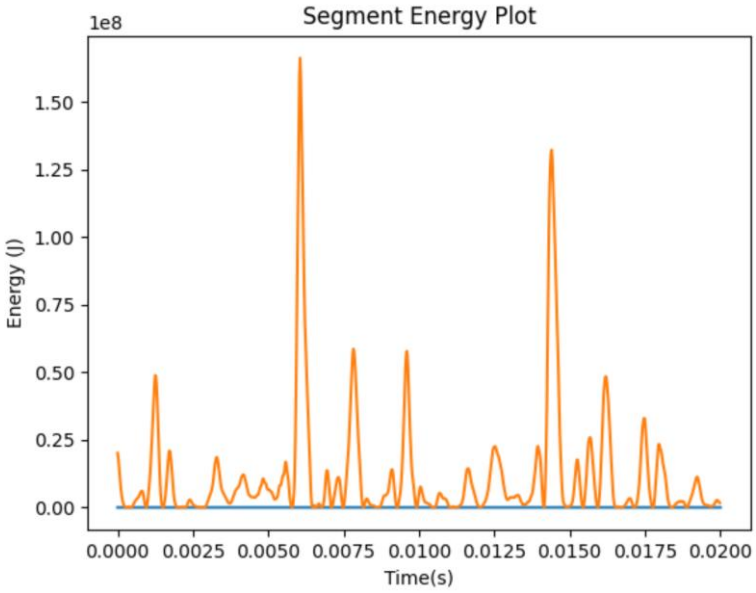
Zero Crossings:

The voiced regions have 27 zero crossings, indicates periodicity.

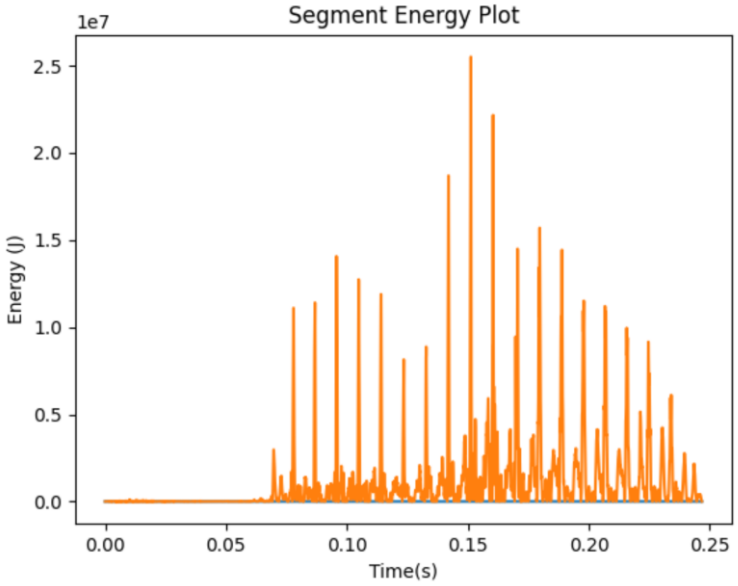
The unvoiced region has 382 zero crossing this due to high randomness it crosses the 0 more times than a periodic signal.

ENERGY:

Voiced regions being periodic in nature, and have frequencies having a high energy with a maximum observed energy level of 166152100 joules(J) which is extremely large order of **10^8 J**

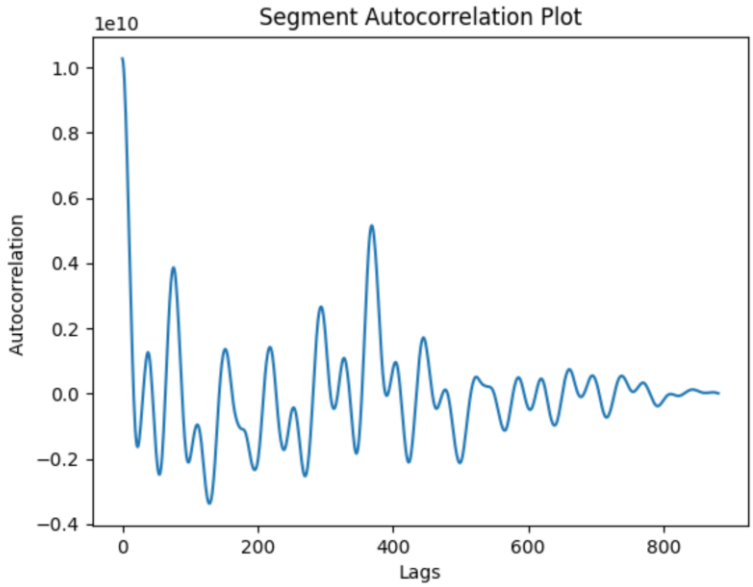


Unvoiced regions show quasiperiodicity and have relatively lower energy levels. A maximum energy level of 25512601 joules (J) is observed which is relatively lower compared to the Voiced Segment Plot with an order of **10^7 J.**



Autocorrelation:

Due to periodicity in voiced regions such regions should show high autocorrelation. The value of the autocorrelation is very high. We can clearly observe a peak at 0 lag and 400 lags ,and between 0& 200.



The autocorrelation of the unvoiced region shows no clear maxima, it is continuously decreasing, This is due to the non-periodic nature of unvoiced regions. Thus, it has low autocorrelation