Project Report - Group 14

# Wavelet Decomposition of Audio Signals

C.Sravan Chaitanya - S20190020205

K.Pradyumna Reddy - S20190020226

B.Manish Kumar - S20190020203

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## Introduction

Wavelet Decomposition is a wavelet transform where the Discrete-time signal is passed through more filters than the discrete wavelet transform.In this project we used an audio Signal for decomposition.

## Theory

Discrete wavelet transformation (DWT) consists of four filters, namely low-pass decomposition filter (LDF), high-pass decomposition filter (HDF), low-pass reconstruction filter (LRF), and high-pass reconstruction filter (HRF).The speech signal S is passed through LDF and HDF and down sampled by 2 to obtain the approx1 (approximation) and the detail1 signals, respectively.This is the first-level wavelet decomposition. The approximation1 is treated as the original speech signal and is decomposed to obtain approximation2 and detail2 signals using the corresponding decomposition filters. These are known as second-level wavelet decomposition. The approximation(n) and all the detail coefficients form the wavelet transformation of the nth-level wavelet decomposition. The approximation(n) is upsampled to form the length equal to the number of the original speech signal and is passed through the LRF to form approximation(n)R. Similarly, the detail signals detail1, detail2, detail3 ... detailn are upsampled individually to form thelength equal to the number of the original speech signal and are passed through HRF to obtain detail1R, detail2R, detail3R ... detailn R, respectively. Adding the signals approxn R + detail1R + detail2R +···+ detailn R gives the original speech signal S. Based on the combinations of the filters used, the wavelet transformation is described as Daubechies.

## Methodology

- Loading the audio signal

  Command - **audioread**

- Adding the noise

  Since there is no signal which doesn't have some noise in practical so , we added noise to our signal and we used it as source signal

- Wavelet Decomposition

  Decomposition of signals into various levels . In this project we will decompose the signal into different levels were the no.of levels is taken as input from the user . We will specify a number of specific wavelets we are taking as input . Then we will define the filters we will extract the level coefficients from the signal . We will reconstruct the approximation and reconstruct the details at different levels .

➢ Plotting the graphs

Command - **plot**

After extracting the coefficients of level's we will plot the coefficients of details and approximation and after reconstruction we will plot the details , approximation and signal .

➢ Playing the audio signal

Command - **audioplayer**

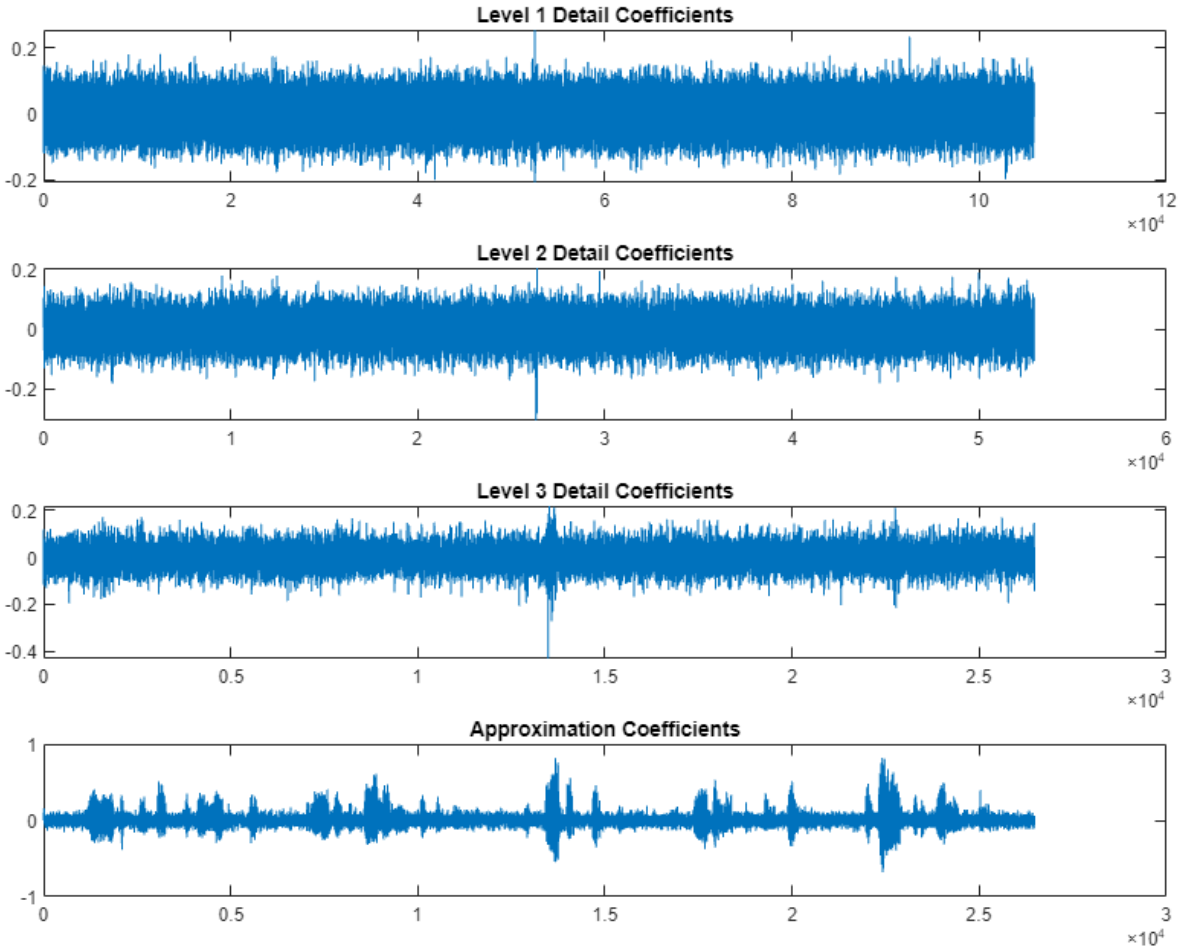
**play(audioplayer)**

We used command to differentiate the true signal and noisy Signal

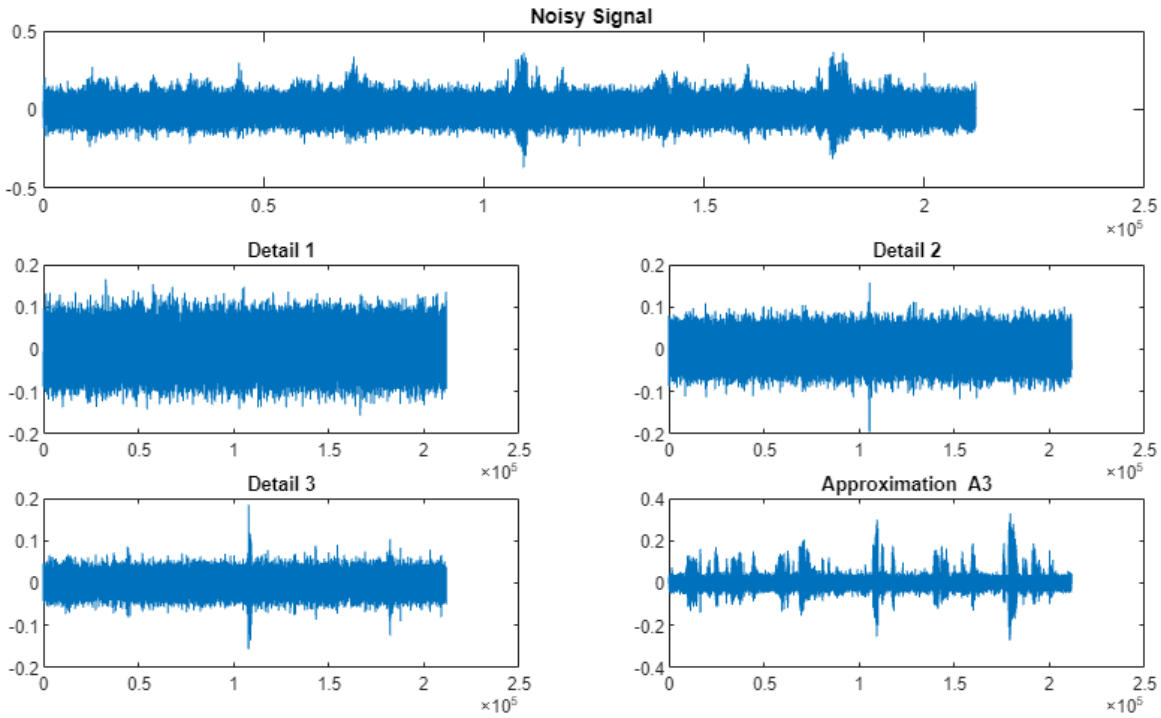
## Results

We are able to plot the speech signal , approximation and the details .

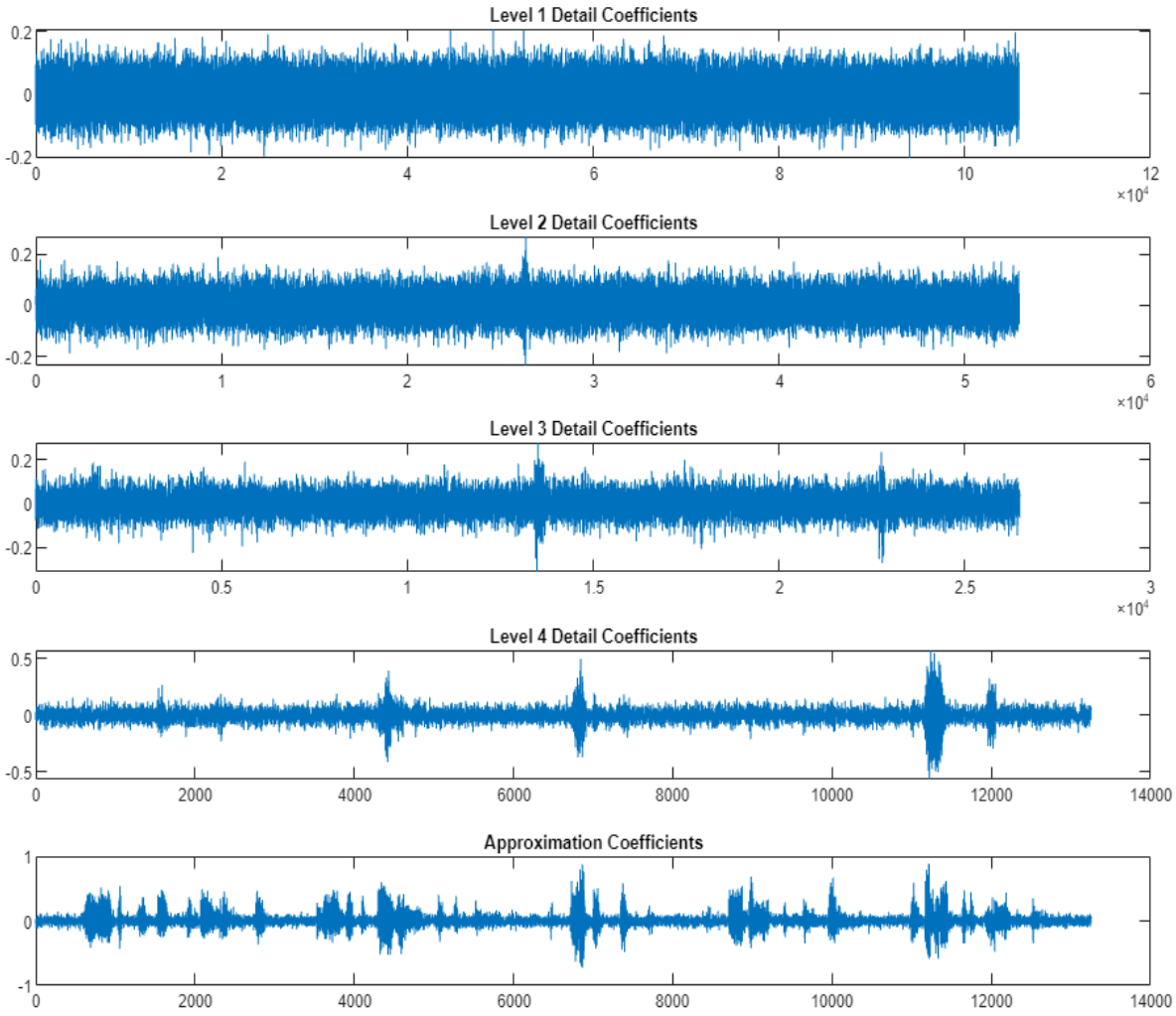
## Level-3  (wavelet - db13)



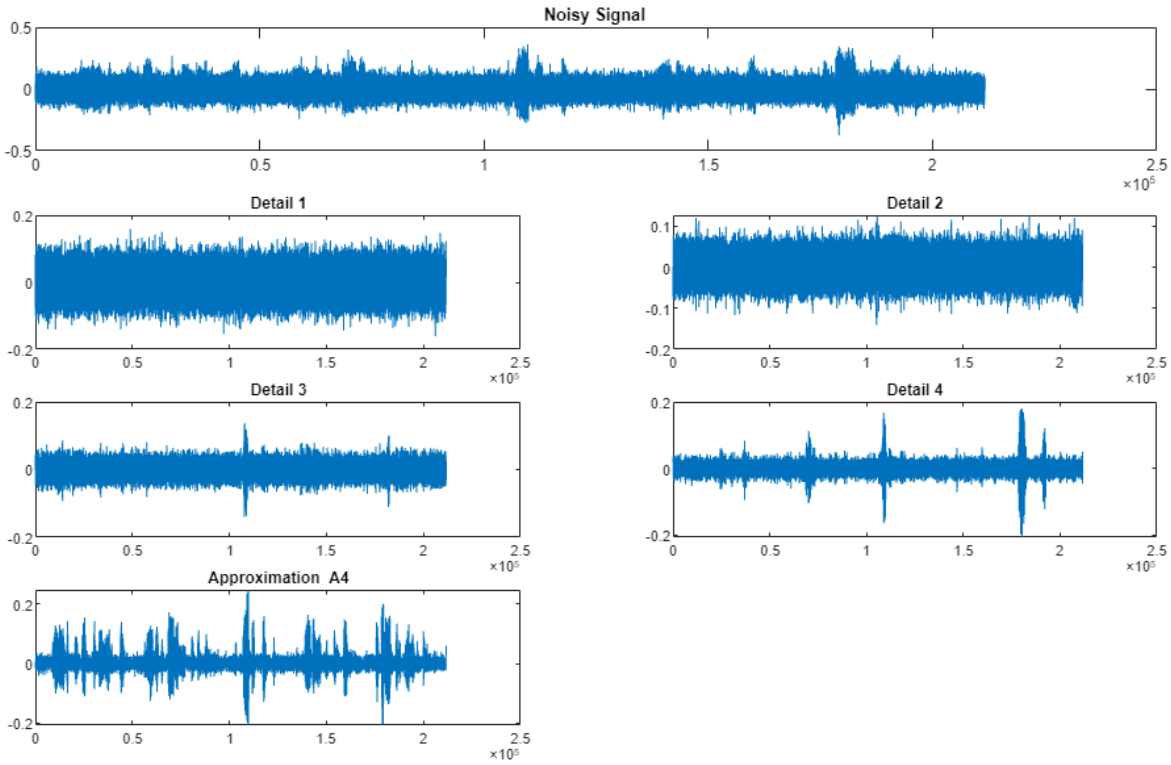
## Details and Approximation



## Level-4 (Wavelet - db13)



Details and Approximation




## Applications

We can apply the wavelet decomposition method in audio signal processing and image processing.One example is Denoising of audio signals and noisy image fusion methods

## Code / outputs link (click here)

## Contributions

C.Sravan Chaitanya - Matlab implementation , Report
K.Pradyuman Reddy - Theory , practical applications , PPT
B.Manish Kumar - Matlab implementation , References

## References

https://drive.google.com/file/d/1Jq7qVkvZ3Hv2LEPRuAdMPMdmyJd3P03j/view?usp=sharing

https://www.sciencedirect.com/topics/engineering/wavelet-decomposition

## Conclusion

We are able to decompose the audio signal into different levels by employing Wavelet decomposition.