Compression of MP3 1-D audio signal using DCT

DSIP IA2

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Abstract :

Multimedia files are commonly utilised in today's society; nevertheless, the amount of storage space required for these files is increasing, and sound files have no alternative, therefore compression is the only option. Compression is the process of reducing the size of a large data stream. Voice compression is a branch of digital signal processing that focuses on lowering the bit rate of speech signals in order to improve transmission speed and meet the storage demands of rapidly evolving multimedia. The goal of transparent coding of audio and speech signals at the lowest possible data rates is achieved in many applications, such as the design of multimedia workstations and high-quality audio transmission and storage. As a result, data transmission and storage become expensive. However, if we can reduce the amount of data we use, both transmission and storage become less expensive.

Introduction

Audio compression is used to solve the problem of reducing amount of data required to represent digital audio. It follows the conventional approach of getting rid of unnecessary duplicate data to achieve this task. we make use of Discrete cosine transform(DCT) to code and implement an audio compressor. Common audio formats like MP3 employ Discrete Cosine Transform (DCT) to transform the audio data to a form that lends itself well to compression.

A discrete cosine transform (DCT) expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. The DCT gives a real-valued frequency decomposition of a real-signal x(n). In particular, a DCT is a Fourier-related transform similar to the discrete Fourier transform (DFT), but using only real numbers. DCT can be used for speech compression because of high correlation in adjacent coefficients. We can reconstruct a sequence very accurately from very few DCT coefficients. This property of DCT helps in effective reduction of data

Methodology, block diagram

In this we have created a code where we take music mp3 and then it is converted into wav file. The whole program is written in MATLAB.

The file is read into the MATLAB using audioread function. The audioread provides a single, unified Matlab function for reading audio files in a range of different file formats, including wav, mp3 etc. In addition, audioread provides support for common modifications performed during sound input, namely resampling (changing the sampling rate), casting multi-channel signals to mono, and loading only a limited time range of the sound.

Then we apply DCT Discrete cosine transformation on the signal for compression of the signal. This is at the sender side who wants to compress the signal.

We use IDCT inverse Discrete cosine transformation on the receiver side. For all the transformations we have created custom function in MATLAB. To display the output we plot original, compressed and difference of the signals.

Diagram

Description automatically generated

Pseudo code / flowchart

1. Read the audio file.
2. Save the signal into the list.
3. Use Discrete Cosine Transformation to compress the signal using user defined the function.
4. The compressed signal now at the receiver side.
5. Inverse Discrete Cosine Transformation is used over the signal using user defined function at receiver side.
6. The decompressed signal is evaluated. The difference is calculated between original and compressed audio.
7. Subplot was plot to display original signal, compressed signal and difference between signal.

Result and Analysis

As a part of this project, a signal was compressed using Discrete Cosine Transform. The evaluation of the signal was done.

The following results have been obtained:

The Peak Signal to Noise Ratio is 33.4239.

The Mean Squared Error is 4.5458e-04.

The Signal to Noise ratio is -0.1645.



Graphical user interface, text

Description automatically generated

Conclusion

Compression of MP3 1-D audio signal using DCT Discrete cosine signal is studied and implemented in MATLAB. We have also learned and implemented IDCT at receiver side and evaluation of the signal was also done.

References

1. <https://en.wikipedia.org/wiki/Discrete_cosine_transform>
2. <https://users.cs.cf.ac.uk/Dave.Marshall/Multimedia/node231.html>
3. <https://www.geeksforgeeks.org/discrete-cosine-transform-algorithm-program/>