Discrete Cosine Transform and its applications

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Overview

1. Discrete Cosine Transform
   - Introduction
   - Applications
2. Speech Signal Compression using DCT
   - Block-Diagram
   - Demo

Introduction to DCT

The discrete cosine transforms defined as the representation of the signal(Finite sequence of data points) in terms of a sum of the cosine functions oscillating at different frequencies and amplitudes.
DCT:

$$X[k] = \sum_{n=0}^{N-1} x[n] cos[\frac{\pi}{N}(n + \frac{1}{2})k] \quad where \quad k = 0, 1....N - 1 \qquad (1)$$

IDCT:

$$x[n] = \frac{2}{N}(\frac{1}{2}X[0] + \sum_{k=1}^{N-1} X[k] cos[\frac{\pi}{N}(n + \frac{1}{2})k]) \quad where \quad n = 0, 1.....N - 1 \qquad (2)$$

Applications of DCT

- Lossy compression of Audio and Image
  - Removing the higher frequency components.
  - Intuition behind this is most of the signal information tends to concentrate on the lower frequency component.
  - Ex:- JPEG image compression.
- Speech Enhancement using DCT
  - Remove the higher frequency components present in the noisy speech(Noise+Speech) signal.

Speech Signal Compression using DCT

Block Diagram

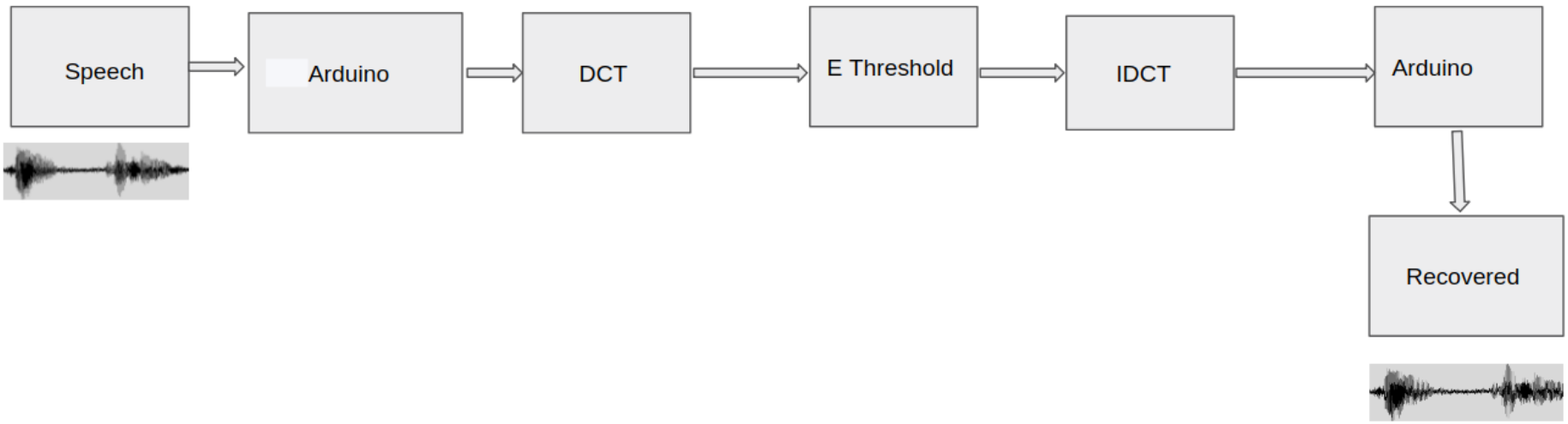
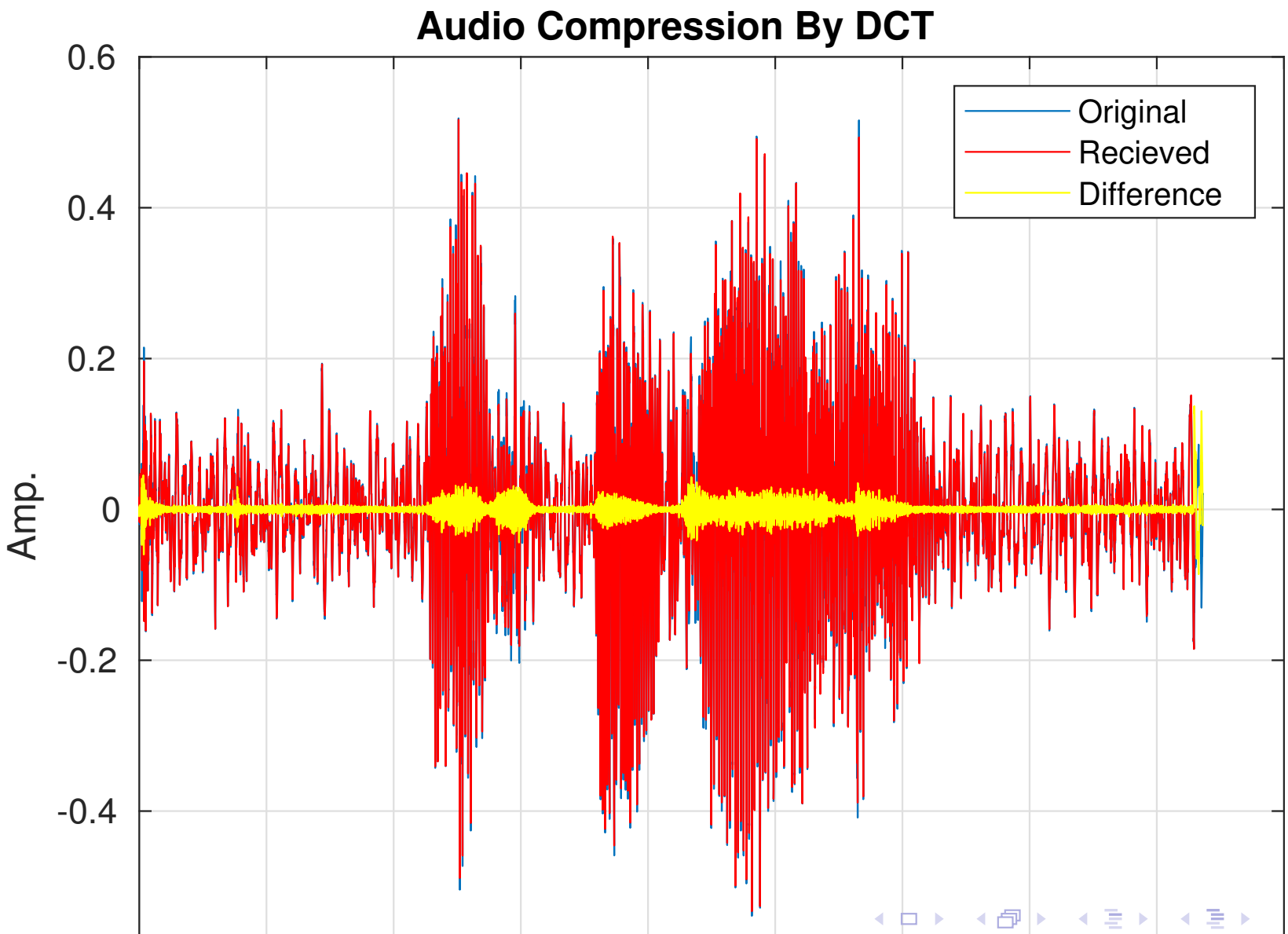


Figure: Flow of Operations

Demo


Audio Compression By DCT
Original
Recieved
Difference
Amp.
0.6
0.4
0.2
0
-0.2
-0.4