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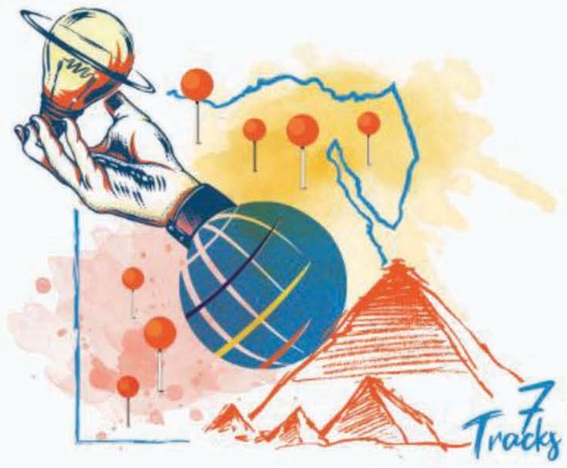

AUDIO DENOISING

CAN'T HEAR FROM NOISE!

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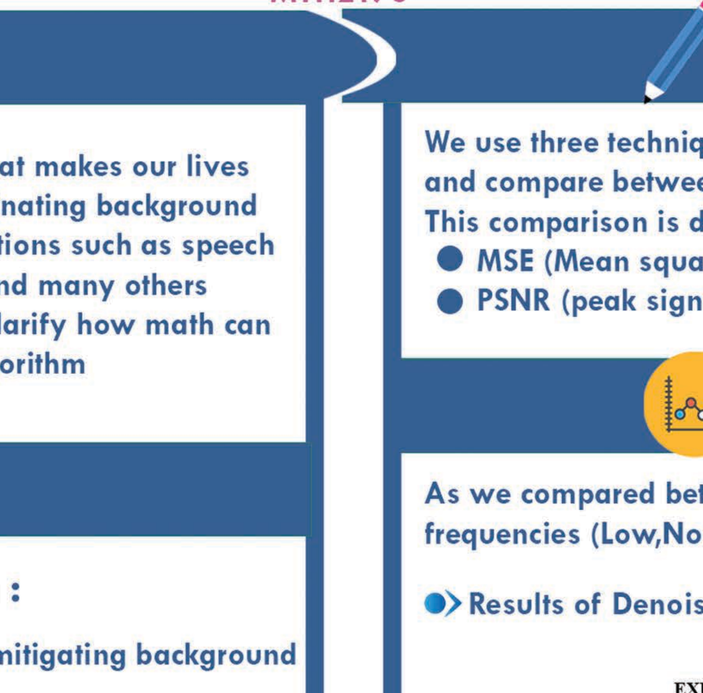
Abstract

Audio denoising is a fundamental art that makes our lives easier, it plays an important role in eliminating background noise. It is also utilized in various applications such as speech enhancement, consumer electronics and many others
Three techniques will be discussed ,and clarify how math can be used to evaluate each algorithm

Introduction

Denoising in Audio Processing :

- Enhances sound recording quality by mitigating background noise
- Noise is random signal added from hardware or nature
- Exploration of principles, methodologies and emerging technologies for audio quality refinement



Literature Review

Here's a brief overview of Audio Denoising over years :

1. Early Audio Recording (19th Century Late)
2. Wireless Communication (20th Century Early)
3. Digital Audio (20th Century Onward Late)
4. Internet and Social Streaming (21st Century)

Mathematical Modeling

Wavelet transform is a mathematical tool used in audio denoising, denoising and determining PDEs using Threshold algorithm, wavelet thresholding, heat equation, and smooth thresholding in the wavelet domain

This is the main equation :

$$\frac{\partial u}{\partial t} = \alpha \nabla^2 u + S\lambda(W(u))$$

- $S\lambda(x) = \text{sign}(x) \max(0, |x| - \lambda|)$
- λ is a threshold value

Analysis

We use three techniques for audio denoising (WAVELET, FIR, IIR) and compare between them to know the best one
This comparison is done by calculating the :

- MSE (Mean square error)
- PSNR (peak signal-to-noise ratio)

Results

As we compared between three signals with three different frequencies (Low,Normal,High) owith our parameters.

Results of Denoisng :

EXPERIMENT 3 (Low Frequency):

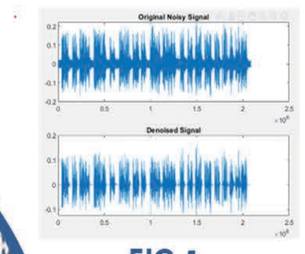


FIG.1

EXPERIMENT 2 (High Frequency):

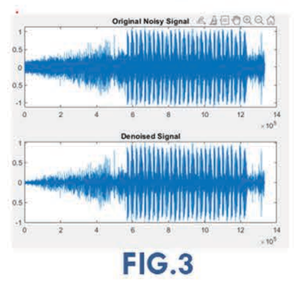


FIG.3

EXPERIMENT 1 (Normal Frequency):

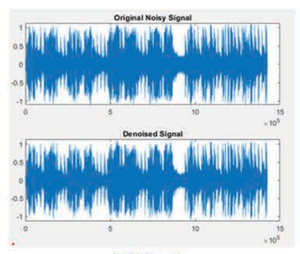
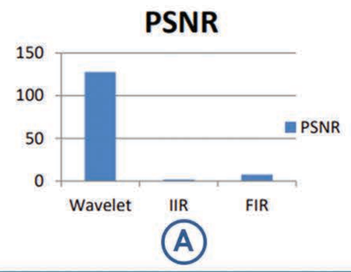
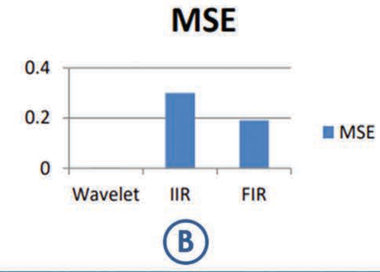


FIG.2

Parameters Results :





Conclusion & Future Works

Wavelet Method for Audio Performance

- Best method for high-performance audio files
- Recommended for use at normal frequency (40 - 60) kHz

Future Works

- Testing Bilinear Transform, Impulse Invariance and Step Invariance
- Potential testing of Adaptive LMS technique

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