A HYBRID APPROACH FOR NOISE REDUCTION USING WIENER FILTER AND WAVELET TRANSFORM

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Abstract:

Speech signals may be blemished by dissimilar forms of additive noises that humiliate their excellence and clearness. Therefore, several noise reduction processes are planned to get rid of the additive noise from a speech signal. Noise reduction methodology is employed to considerably decrease noise and intrusion and, thence it progress the perceived excellence and clearness of a speech signal. The matter of noise reduction has attracted a substantial quantity of analysis attention over the past many decades. Wiener filter could be a measured of the foremost elementary noise reduction approaches, which has been described in various forms and adopted during a kind of applications. Wiener filter could be a classical noise reduction methodology that's wide used for removing noises from the speech signal.

During this paper, Wiener filter methodology supported frequency warp has been planned for noise reduction method. The applied frequency crooked methodology to the FIR filter is helpful in noise reduction of speech signals and yields higher speech perceived quality. Though it's not a secret that the Wiener filter might cause some harmful effects to the speech signal (appreciable or perhaps vital degradation in quality or
intelligibility), few efforts are rumored to point out the inherent relationship between noise reduction and speech distortion. By shaping a speech-distortion guide to see the degree to that the speech signals is crooked and 2 noise-reduction factors to work out the quantity of noise being attenuated, this paper studies the quantitative presentation performance of the Wiener filter within the framework of noise reduction. Wavelet Transform (WT) could be a powerful tool for removal of noise from varied signals. Combining WT with alternative noise reducing techniques might lead to any reduction of noise. Almost like WT, Singular decomposition (SVD) is additionally an efficient noise reduction tool. During this paper, Wiener filter and Wavelet transfer are employed in combination for the method of reducing the noise. In case, we’ve got multiple mike sensors, the multiple observations of the speech signal which might be used for noise reduction with less or perhaps no speech distortion.

Keywords—Noise Reduction; Wiener filter; Wavelet Transform (WT);

INTRODUCTION:

Signals never exist without noise. Removal of noisy is necessary from the data in order to proceed with further data analysis. Noise reduction techniques have a broad range of applications, from hearing aids to cellular phones, voice-controlled systems, multiparty teleconferencing, and automatic speech recognition (ASR) systems. The choice between using and not using a noise reduction technique may have a significant impact on the functioning of these systems. Noise reduction is a very challenging and complex problem due to several reasons. First of all, the nature and the characteristics of the noise signal change significantly from application to application, and moreover vary in time. It is therefore very difficult if not impossible to develop a versatile algorithm that works in diversified environments. Secondly, the objective of a noise reduction [26] system is heavily dependent on the specific context and application. Speech signals play an important role to convey messages. Due to this reason, the information of the speech should be preserved. The quality of speech signal can be degraded by interfering noise in a communication channel. When the quality and clearness of speech signal are degraded, it will be complicated to recognize and categorize the speech signal. Consequently, it is
aimed to reduce the noise in a way that the speech can be able to convey its carrying information.

Noise reduction is used in spacious series of applications such as hands-free and mobile phones, teleconferencing, in-car cabin communication, etc. For signal and image processing the Wavelet Transform (WT) is a powerful tool. In various research fields like signal processing, image compression, pattern recognition etc., WT is quite useful. Continuous Wavelet Transform (CWT) gives reliable and detailed time-scale information as compare to classical short time Fourier transform (STFT). Wiener filters are used for development of speech signal which is tainted with background noise. The procedure of speech enrichment for noise reduction aims to reduce the power of preservative noise by Wiener filtering. Combing the wavelet transfer and wiener filter, the noise is reduced using these algorithms.

**METHODOLOGY:**

**Wiener filter**

In signal process, the Wiener filter may be a filter wont to manufacture Associate in Nursing estimate of a desired or target random method by linear time-invariant (LTI) filtering of Associate in nursing ascertained crying method, forward celebrated stationary signal and noise spectra, and additive noise. The Wiener filter minimizes the mean sq. error between the calculable random method and therefore the desired method. The goal of the Wiener filter is to figure an applied math estimate of Associate in nursing unknown signal employing a connected signal as Associate in Nursing input Associate in Nursing filtering that celebrated signal to provide the estimate as an output. The Wiener filters are often wont to filter the noise from the corrupted signal to produce Associate in nursing estimate of the underlying signal of interest.

\[
G(z) = \sum_{i=0}^{N} a_i z^{-i} \]

\[
s[n] \rightarrow \quad x[n] \quad + \quad e[n]
\]

**Fig1. Wiener filter design system**
Wavelet transformer

A wavelet could be a mathematical relation helpful in digital signal process and compression. In signal process, wavelets create it potential to recover weak signals from noise. A wavelet could be a wave-like oscillation with associate amplitude that begins at zero, increases, so decreases back to zero. It will generally be unreal as a "brief oscillation" like one recorded by a measuring instrument or monitor. Generally, wavelets are on purpose crafted to possess specific properties that create them helpful for signal process. Employing a "reverse, shift, multiply and integrate" technique known as convolution, wavelets may be combined with notable parts of a broken signal to extract info from the unknown parts. In arithmetic, a raffle series could be an illustration of a square-integrable (real- or complex-valued) performs by an explicit orthonormal series generated by a wavelet.

![Wavelet transformer system design](image)

Fig 2. Wavelet transformer system design

Proposed System:

The speech enhancement methods are centered at suppression of the background noise. However, it is very difficult to suppress the noise when this is combined with Speech as there is a chance of information loss [2]. This can be overcome by estimating of the background noise in the speech signal. In the enhancement process, initially the voiced and unvoiced section of speech signal is detected. It is easy to estimate the noise during the pauses (Unvoiced section) in speech, and noise estimation in voice section is done by fundamental frequency [3].
In this section, a wave primarily based methodology for the speech sweetening is given supported hybrid wiener filter from slight modification in rule [10]. This methodology begins from the interference of speech signal, then preprocessing with completely different window functions on same length of block [12]. Further, frequency spectral analysis had done exploitation wave filter. Hence, during this methodology, the hybrid wiener filtering is performed on the wave speech coefficients for noise estimation and suppression [17, 23].
Multichannel wiener filter _discrete wavelet transforms (MWFDWT)

Discrete wavelet transform has attracted a lot of interest in signal de-noising. The DWT is understood as signal decomposition in an exceedingly set of freelance, spatially directed frequency channels [2-4]. A signal is more experienced two complementary filters and emerges as two signals, approximation and details. This can be known as decomposition. The parts are assembled back to the first signal while not loss of data. This method is named reconstruction [7]. The Gaussian noise can nearly be averaged go into low frequency wavelet coefficients [8].

All digital signals contain some degree of noise. The proposed de-noising algorithm attempts to remove the Gaussian noise from a signal. Ideally, the resulting de-noised signal will not contain more noise [9]. De-noising of natural images corrupted by Gaussian noise using wavelet techniques is very effective because of its ability to capture the energy of a signal in few energy transform values. The methodology of the discrete wavelet transform based image de-noising has the following three steps:

1) Transform the noisy image into frequency domain by discrete wavelet transform.
2) Apply Wiener filter on each sub-band, by using local window n xn
3) Perform inverse discrete wavelet transform to obtain the de-noised image.

The Wiener filter is used to removing Gaussian noise from a corrupted signal based on statistics estimated from a local neighborhood of each speech [1]. This filter depending on the noise power (i.e. noise variance in a corrupted signal). Where the variance is large, the filter performs little smoothing. Where the variance is small, the filter performs more smoothing; this filter often produces better results than other filtering used for speech enhancement [5]. In this paper we using this filter with local window applied on the DWT to remove Gaussian noise from each subband.
RESULT:

By defining a speech distortion index to measure the degree to which the speech signal is deformed. The noise reduction to quantify the amount of noise being attenuated, we have analytically examined the performance behavior of wiener filter and wavelet transformer for noise reduction technique. In speech 1, the SNR value for the wiener filter algorithm is 5.3, for the DWT is 5.8 and for the proposed system (MDWT-wiener) is 6.5 for de-noising signals.

In speech 2, the SNR value for the wiener filter is 6.2, for the DWT is 6.7 and for the proposed system (MDWT wiener) is 7.3 for feature extraction of noising signals. Since comparing from the existing system the efficient algorithm is used and the SNR value is significant for de-noising the signal. The algorithms which is used the proposed system is resourceful for speech distortion.

![Figure 4 (a) shows Input signal](image1)

![Figure 4 (b) Silence removal signal](image2)

![Figure 4 (c) Shows Noise removal signal (MWFDWT)](image3)

![Figure 4 (d) Wavelet based de-noise](image4)
Figure 4 (e) Shows Wavelet based de-noise signal

Figure 4 (f) SNR value for original and de-noised signal

Speech 1: Table 1. Snr Value Comparison For Speech Signal

This table shows the different type existing algorithm (Winer filter, DWT) and proposed algorithm (MDWT_Wiener) SNR value.

<table>
<thead>
<tr>
<th>Data</th>
<th>Algorithm</th>
<th>Snr Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Winer filter</td>
<td>5.3</td>
</tr>
<tr>
<td>2</td>
<td>DWT</td>
<td>5.8</td>
</tr>
<tr>
<td>3</td>
<td>MDWT_Wiener</td>
<td>6.5</td>
</tr>
</tbody>
</table>
Figure 3 shows the different types of existing algorithms (Wiener filter, DWT) and the proposed algorithm (MDWT_Wiener) SNR value comparison for speech 1 signal.

**Speech 2 Table 2: SNR Value Comparison For Speech Signal**

This table shows the different types of existing algorithms (Wiener filter, DWT) and the proposed algorithm (MDWT_Wiener) SNR value.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>SNR Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wiener filter</td>
<td>6.2</td>
</tr>
<tr>
<td>2 DWT</td>
<td>6.7</td>
</tr>
<tr>
<td>3 MDWT_Wiener</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Figure 4 shows the different types of existing algorithms (Wiener filter, DWT) and the proposed algorithm (MDWT_Wiener) SNR value comparison for speech 2 signal.

**Conclusion:**

Above results clearly indicate that the mix of DWT and MDWT–Wiener filter provides a higher signal to noise quantitative relation than and MDWT–Wiener alone. Inherent property of DWT that reduces noise and property of DWT to separate redundant information along provide higher result than and MDWT–Wiener alone. So, combination of DWT and MDWT–Wiener are going to be useful for reduction of noise from information signal.
REFERENCE:


