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Ali Bahri\*, Said Briki\*\*

\* Electric engineering department, LABO Laboratory, El-Oued University, Algeria

\*\* Electric engineering department, LAAB Laboratory, Biskra University, Algeria

 E-mail: ali\_bahri@univ-eloued.dz, said-briki@univ-eloued.dz

Abstract

We have developed an improved approach for enhancing speech corrupted by additive white Gaussian noise. An efficient denoising approach based on singular value decomposition (SVD) and Savistky-golay filter is proposed to reduce the White Gaussian noise (WGN).

***Keywords***: speed, WGN, .........,... at least 5 key words)

1. **Introduction**

The signal subspace algorithm was originally developed by Ephraim and Van Trees [1] for white input noise and was then extended to deal with colored noise (for example, noise in the form of Speech) by Hu and Loizou [2].

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| **Fig.1.** Speech signal and its contour of maximum |  **Fig. 2.** The maximum SV of each frame versus frame index**.** |

1. **Our approach**

In this section we propose an enhancement approach based on SVD whose the enhancement is made frame by frame. The enhanced signal is reconstituted by grouping all the enhanced frames. one relating to the signal, the other to additive noise (we have supposed that the noise is additive). Either a random signal :

 (1)

2.2. Subspace decomposition method

In practice, the autocorrelation of the noisy signal matrix analysis is impossible since we don't have an infinite number of samples.

### 2.2.1. Construction of the Hankel matrix

This denoising strategy begins with the creation of a Hankel data matrix by dividing a noisy speech signal into partially overlapping segments.

**3. Results and Discussion**

We evaluate and compare the performance of our approach with different speech enhancement techniques.

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| **Table 1.** Best of PESQ and SegSNR values and corresponding SG filter order |
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|  | PESQ | SegSNR |
| Initial SNR | Best PESQ | SG order | Best SegSNR | SG order |
| -10dB | 1.3221 | 6 | 0.2514 | 26 |
| -5dB | 1.8925 | 5 | 2.0336 | 26 |
| 0dB | 2.3996 | 3 | 3.9012 | 27 |
| 5dB | 2.6829 | 5 | 4.6191 | 26 |
| 10dB | 3.0503 | 5 | 4.6191 | 26 |
| 15dB | 3.3241 | 5 | 9.5933 | 27 |
| 20dB | 3.7217 | 7 | 12.6424 | 27 |
| 25dB | 3.9235 | 3 | 15.8007 | 27 |
| 30dB | 4.0873 | 5 | 18.9597 | 27 |

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**4. Conclusion**

In this paper, a subspace approach based on SVD performed from Hankal matrix was implemented to deal the enhancement of speech degraded by additive WGN noise. The main contribution is the efficient threshold that we have developed and Savitzky-Golay filter applied to enhance the intelligibility of speech after denoising procedure (eliminate musical noise).

**References**

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