

WAVELET DENOISING OF THE NOISE ESTIMATION ON PHASE MATCHING

PENG WU^{1,2}, JIE LIU² AND JINGJIAO LI¹

¹College of Information Science and Engineering
Northeastern University
No. 11, Lane 3, Wenhua Road, Heping District, Shenyang 110004, P. R. China
Wu.peng@163.com

²Software College
Shenyang Normal University
No. 253, North Huanghe Ave., Shenyang 110034, P. R. China
Nan127@sohu.com

Received March 2010; revised July 2010

ABSTRACT. *Most of the wavelet threshold denoising methods need to calculate the corresponding threshold. The estimation of noise variance will directly affect the effect of threshold denoising method. This paper describes a new phase matching method of the noise variance estimation. The real-time noise can be estimated by this method. The experiments show that the method can greatly improve the signal to noise ratio and can obtain better denoising effect.*

Keywords: Phase matching, Wavelet transform, Noise estimation, Wavelet threshold

1. **Introduction.** In order to improve signal to noise ratio, the traditional methods of removal noise have been used in signal processing, such as time domain related method and average method as well as frequency domain filtering technique [1]. Clearly, these methods can not get better result in the case that noise is not related to signal. The adaptive filtering methods can not simultaneously receive the actual noise. The delayed reference noise is used to estimate the actual noise. If the noise delay is not used correctly, false results will be obtained [2]. The same defect is also existence in neural network in order to offset noise [3]. Over the last few years, higher-order spectral denoising method has been used in de-noising processing, but only to remove the Gaussian white noise in its mathematical sense [4-7]. It is invalid to filter colored noise. This paper describes new phase-matching noise estimation methods that accurately estimates real-time noise. It is unique features that the noise is estimated by noise difference. The paper also gives the mathematical proof and Matlab simulation. The main advantages of the results over others are not pre-determine the type of noise. Directly this method can remove noise to improve signal to noise ratio. The estimated results are used in the wavelet thresholding method. Better de-noising effect is showed in this paper.

2. **Signal Phase Matching to Obtain Real-time Noise.** The first assumption is that the signal and noise are linear addition. The additional noise is the most common phenomenon in nature. In this paper, this kind of noise is estimated. Based on this assumption, the mathematical function can be expressed:

$$r(t) = s(t) + n(t)$$

the $s(t)$ is the real signal. $n(t)$ is additional noise signal. In order to study the problem, the polar coordinates is used. The above formulae can be expressed in the frequency