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The Features Extraction of Infants Cries by Using Discrete Wavelet Transform Techniques

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Abstract

This article proposes the study and experiment of infant sound features extraction by using discrete wavelet transform (DWT) techniques. The DWTs using in this research are Haar, Symlet2 and Coiflet1 mother wavelets. In this classification, the Dunstan baby language is the infant sound data. The extracted features from the infant sound by DWT are learned by using the extreme learning machine (ELM) neural network. The results of this learning are compared in term of learning accuracy. From the experimental result, it is found that the average result of the ELM with Haar wavelet features extraction at number node of 30 is better than results of ELM with other wavelets in term of learning accuracy. However, there are insignificant differences in learning accuracy when the number of nodes is increased from 20 to 30 nodes.

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1. Introduction

The infant care agencies or a new mother can't understand an infant behaviour because an infant can't communicate with other person by human language. Priscilla Dunstan works together with research organizations in order to study behaviour of babies [1]. They had surveyed a number of 1,000 peoples in 7 countries associated with the sound of children crying all 30 nationalities during the new born to six months. They found that the baby needs to communicate with a parent or caregiver by the behaviour of the pronunciation of the same sound. For examples,

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"Neh" indicates a hungry, "Owh" baby is likely onset sleepy, "Heh" babies needs to respond to the babysitter that they discomfort, "Eairh" babies have gas or bloating in the abdomen and "Eh" indicates burping of the baby .

Because the baby sound is non-periodic signal, the discrete wavelet transform (DWT) techniques [2]-[3] such as Haar, Symlets and Coiflets are used to extract the features of the baby sound for their behaviours classification. The selected DWT are compared the coefficients that provides the best accuracy for the classification of infants behaviours.

The neural networks have been used to recognize the human voice by tone and duration characteristic [4]. Because the baby sounds are difference to the human voice, the modified neural network is used to classification the babies sounds. The extreme learning machine (ELM) is s presented by Huang, et al [5].The ELM is interested model to classify the babies behaviours from DWT coefficients, and the single layer feed forward neural network (SLFN) [6] will be used to evaluate the accuracy of the classifications. The results will be compared by hidden layers of 10, 20 and 30 nodes.

2. Methodology

2.1 Discrete Wavelet Transforms (DWT)

The DWT coefficients are usually sampled from the continuous wavelet transform (CWT) on a dyadic grid, choosing the parameters of translation $b = n2^m$ and scale $a = 2^m$. The mother wavelet in DWT (ψ) is defined as

$$\psi_{a,b}(t) = \frac{1}{\sqrt{a}}\psi\left(\frac{t-b}{a}\right) \tag{1}$$

Where ψ is the mother wavelet, *a* is the scale, *b* is the translation.

DWT is used to analyze the signal *x(k)* by decomposing it into its coarse and detailed information, which is accomplished by using successive high-pass and low-pass filtering operations as equation (2) and (3).

$$y_{high}(n) = \sum_{k=-\infty}^{\infty} x(k)h(2n-k) \tag{2}$$

$$y_{low}(n) = \sum_{k=-\infty}^{\infty} x(k)g(2n-k) \tag{3}$$

Where $y_{\mathrm{high}}(n)$ and $y_{\mathrm{low}}(n)$ are the outputs of the high-pass and low-pass filters, *h* and *g* are impulse response coefficients of mother wavelet as shown in table 1.

Table 1: The coefficients of Haar, Symlet2 and Coeiflet1mother wavelets.

Coefficients	Wavelet		
	Haar	**Symlet2**	**Coiflet1**
h_0	0.7071067812	-0.1294095226	-0.0156557281
h_1	0.7071067812	0.2241438680	-0.0727326195
h_2		0.8365163037	0.3848648469
h_3		0.4829629131	0.4829629131
h_4			0.3378976625
h_5			-0.0727326195
g_0	-0.7071067812	-0.4829629131	0.0727326195
g_1	0.7071067812	0.8365163037	0.3378976625
g_2		-0.2241438680	-0.8525720202
g_3		-0.1294095226	0.3848648469
g_4			0.0727326195
g_5			-0.0156557281