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An Intelligent Algorithm for Blood Cell Recognition Based on HHT-BPNN *

Lixia Wan*, Wei Long, Fugui Li, Liang Luo

School of Information Engineering, Nanchang University, Nanchang 330031, China

Abstract

For the blood cell signal has the characteristics of nonlinear, non-stationary and M-morphous, an intelligent algorithm for blood cell recognition based on Hilbert-Huang Transformation and BP Neural Network (HHT-BPNN) is put forward, which convert the time domain features of the blood cell signal into energy features by combining empirical mode decomposition with Hilbert transform, and put the time domain features and the energy features together as the feature vector. Then, a model based on BP neural network is built by training and simulating that complete the work of effective identification and accurate count for M-morphous blood cells. Simulation results show that the algorithm proposed has high recognition accuracy with good recognition performance.

Keywords: Blood Cell Recognition; Hilbert-Huang Transform (HHT); BP Neural Network; Empirical Mode Decomposition; Feature Vector

1 Introduction

With the rapid development of the medical electronic technology, the blood cell recognition has become a hot topic in biomedical field gradually [1]. Currently, the most commonly used method in clinical diagnosis for blood cells' analysis is electric impedance method, whose principle is that when a blood cell go through the detection zone of micropore will generate a potential pulse, then we can complete the identification and counting for blood cells by detecting the pulse signals. However, the process of blood cells' detection will be affected by the negative pressure and concentration of cell suspension, which will arise the phenomenon of gang and edge, and form the M-morphous pulse that may be loss count or error count, so the accuracy of recognition and counting for blood cells will be influenced [2].

In this paper we put forward a intelligent algorithm based on Hilbert-Huang Transformation and BP Neural Network (HHT-BPNN) to research the recognition of blood cell signals. First of all, we take a decomposition by EMD on M-morphous pulse signal and extract the energy features of Intrinsic Mode Function (IMF), then selecting the time domain features and the

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*Corresponding author.
Email address: 1240147131@qq.com (Lixia Wan).

energy features together as the feature vector which is the input of BP neural network, at the same time, a BP neural network model is established to complete the recognition of M-morphous pulse signal. The simulation and experiment show that the characteristic dimensions of neural network has been reduced by HHT-BPNN algorithm and the convergence speed of the network has also been improved, which will improve the recognition accuracy for blood cell to a certain extent.

2 Analysis and Feature Extraction for Blood Cell Signal

2.1 The Analysis of Blood Cell Signal

When a blood cell go through the keyhole, the detection sensor in the keyhole will generate a series of electronic pulse signals [3]. The normal unimodal signal is shown in Fig. 1 (a) while M-morphous signal produced by the phenomenon of gang and edge is shown in Fig. 1 (b).

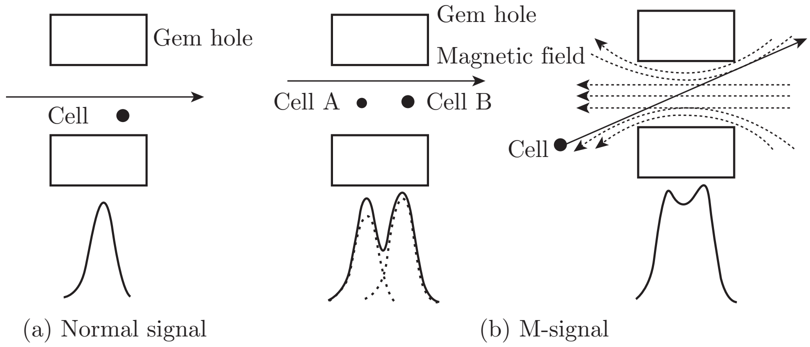

Fig. 1: Pulse signal characteristic diagram of blood cells

In the following research, M-morphous pulse signal is called as M signal for short. For the M signal, we should choose the five points of A, B, C, D, E as the the feature points of M signal which are shown in Fig. 2, where the V_0 is the smallest amplitude of the blood cell signal that has been removed the bottom interference signal, and A, C, B are representing the two peaks and one trough of M signal while D, E are the points where the amplitude of M signal is equal to V_0. Then we should take the ordinate value of A, B, C (marked as $Y1, Y2, Y3$) and the difference of horizontal coordinates between the five adjacent points of A, B, C, D, E (marked as $X1, X2, X3, X4$) as the time domain features.

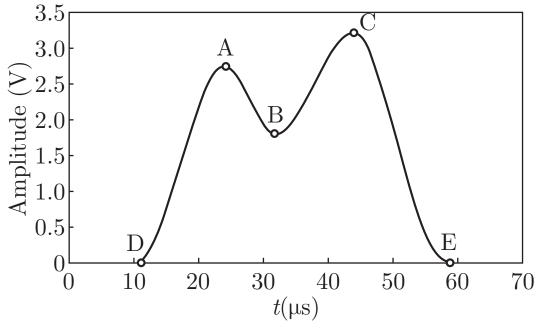

Fig. 2: The waveform of M signal