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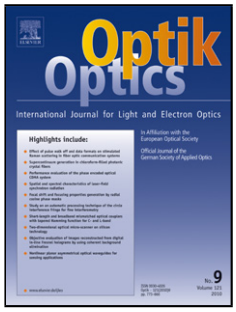

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Pattern Recognition of SEMG Based on Wavelet Packet Transform and Improved SVM

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Abstract

The purpose of this paper is to solve the problem of low recognition accuracy of three-degree-of-freedom myoelectric prosthesis and long training time.According to the nonstationarity of the EMG signal , the wavelet packet is used to decompose the EMG signal and the energy and variance of the wavelet packet coefficients of the four-channel EMG signal are extracted as feature vectors.Then Particle Swarm Optimization(PSO) was combined with improved support vector machine(ISVM) to construct a new model(PSO-ISVM). Under the premise of ensuring the sparseness of the SVM, the slack variables and the decision function was improved to reduce the constraint conditions for solving the optimal face in the quadratic programming. SVM is optimized by the PSO in order to improve the accuracy of the model.The experimental results show that the improved algorithm can effectively identify six kinds of commonly used upper limb movements compared with the traditional SVM. The average recognition rate reaches 90.66% and training time can be shortened 0.042s.

Keywords: Three degrees of freedom electromyographic prosthesis;EMG;wavelet packet;SVM;Particle Swarm Optimization

1.Introduction

Surface electromyographic signal (sEMG) is a bioelectric signal generated on the skin surface during the contraction movement of the human body, which is a direct response to the functional status of the human nerves and muscles. It has the advantages of no trauma and convenient extraction, and has been widely used in clinical, medical research and rehabilitation diagnosis.

The demand for myoelectric prostheses has evolved from simple decorative to functional requirements. Currently myoelectric prosthesis has gradually transitioned from single degree of freedom to multiple degrees of freedom, and the control method has transitioned from the threshold control to proportional control.But at present, threshold control system is one of the mainstream of domestic market[1][2]. Danyang artificial limb factory adopted this method to produce 2 or 3 degrees of freedom myoelectric prosthesis; Yu Hongliu[3] used Dynamic Threshold to distinguish hand movements and accuracy increases by 10%. But control effect of this method is not intuitive. The conversion between different degrees of freedom must be carried out in a predetermined order[4].

Current many universities and research institutes have focused their research on mode control methods, the key to pattern recognition is to extract feature values and select classifiers.The most popular classifiers include SVM, neural networks, et al.He Tao[5] used wavelet transform to extract the feature vector of the EMG, and he used the SVM to identify the feature classification. The results showed that the method has high classification accuracy. Zhang Yanyan et al. [6] proposed to use the

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