

Chapter 11

Bio-Inspired Techniques in Rehabilitation Engineering for Control of Assistive Devices

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ABSTRACT

The intelligent control of assistive devices is possible from bio-signals or gestures to find the user's intention. The goal of the user intention recognition system is to develop computational methods for decoding the acquired bio-signal data. One of the methods of accomplishing the objective will be using the pattern recognition system. The study of higher level control of assistive device using various data processing techniques with bio-inspired techniques is in progress. The knowledge of bio-inspired computation is essential for the neophytes to develop algorithms for identification of intention from bioelectric signals. Most literatures, demonstrates the application using signals and not much definite study describes the various bio-inspiring computation involved to develop the control of assistive devices in real-time. Therefore, this chapter presents a brief survey of the various bio-inspiring techniques used in interfacing devices for identification of information from the user intends.

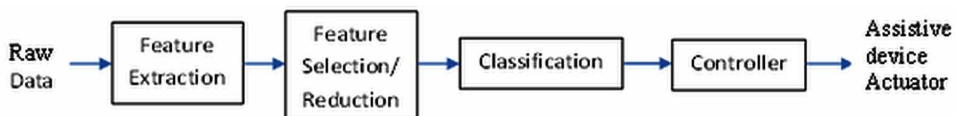
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1. INTRODUCTION

Pattern recognition is a method of identifying the input information into particular category or class from various classes. Various researches have been carried out in improving control of intelligent assistive devices in the various stages of pattern recognition techniques, namely data preprocessing, feature extraction, feature selection/reduction, classification along with the development of control strategy of electric motor. In pattern recognition, the data usually considered as the raw measurements or raw values taken from the subjects to be classified. A simple block diagram of pattern recognition based control of assistive devices is shown in Figure 1.

The term feature in pattern recognition, refer to the result of the transformations applied to the raw data in order to transform them into another domain or space using time domain/frequency domain/time-frequency domain technique. Although, many features can be extracted from raw data for decoding intention and not all of them possesses discriminant capabilities. Some of the extracted features could cause confusion and degrade the classifier. Further, smaller the dimension of the feature vector, lesser the computation time and memory requirements. Therefore, choice of features or reduction of features is essential. Feature dimension reduction provides a method to decide whether it is necessary to include more features that would significantly contribute to the performance of the classifier. It is not a trivial to select the best set of features or the best transformation. The features must be selected or transformed based on the given problem. For the feature selection, some neural networks, population based bio-inspired techniques can be used. The features selection process involves choice of subset of extracted features in feature space by starting with all/without features or subset consisting of random features from the feature space. Feature selection process in the context of assistive devices will be reviewed later in this chapter. The Fourier transform and time-frequency transform yield coefficients of larger dimension and few of its coefficients carry the useful information to obtain the good classification performance. In literature, researchers applied feature reduction using linear or nonlinear projection of features to transform high dimensional feature space to lower dimensional feature space. A very popular method of feature reduction is principal component analysis (PCA) in which the features are projected to lower dimensional space to visualize the underlying class

Figure 1. Block diagram of pattern recognition based control of assistive device



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