Chapter 2
Pattern Recognition and Robotics

P. Geethanjali
VIT University, India

ABSTRACT

During the last few decades, there has been a considerable growth of interest in pattern recognition in the field of robotics. An application of pattern recognition in robotics includes mobile robots and service robots. Visual and signal recognition of patterns enables the robots to perform a variety of tasks such as object and target recognition, navigation, grasping, and manipulation, assisting physically challenged people. This chapter surveys trends in robotics with pattern recognition that focuses more on the interaction between robot assistive device and human with signal pattern recognition. This interaction helps to enhance the capability of people in rehabilitation and in the field of medicine. Finally, this chapter includes the application of pattern recognition in the development of a prosthetic hand.

INTRODUCTION

Pattern recognition has evolved in the field of robotics for rehabilitation of people, surgeons and natural human robot interaction. Signal pattern recognition finds application in prosthetic devices, orthotic devices, brain controlled wheelchair etc. in the field of rehabilitation to assist the disabled people resulted from accidents, peripheral vascular disease, diabetes etc. to improve their day-to-day activity. In rehabilitation engineering robots are employed to serve as an external assistants or artificial extensions of missing or impaired limbs known as prosthesis. Besides prostheses, the assistive robotic systems are also developed to help disabled people through physical interaction using interfaces such as joysticks and keyboards. Information to access hand-free, man-machine communication to help the disabled people can be obtained from various forms of human bio-signal including electroencephalogram (EEG), electrocardiogram (ECG), electrooculogram

DOI: 10.4018/978-1-4666-4940-8.ch002

(EOG), electromyogram (EMG) also referred as myoelectric signal (MES). Among them EMG signals pattern recognition has been widely used for the control of prosthetic devices. EEG signals pattern recognition has been widely used for the control of wheelchair for people who have disruptive communication path between brain and body due to spinal cord injury.

The most important advantage of hands-free EMG/EEG controlled robot systems over other types of control system, such as body-powered mechanical systems, assistive robotic systems, is in the capability to control from an intention of the user. An intention of the user can be detected either from EMG/EEG signals through pattern recognition. Decoding and extracting information contained in the EMG/EEG signals is a tempting task undertook by many engineers and physiologists in various fields of research such as man-machine communication channel to help people with/without disabilities, virtual-environment applications. The development of an intuitive and accurate man-machine communication opened the door for a life opportunity to the disabled people includes mobility impaired people and people who have lost their limbs. Enormous number of research papers exists in the area of man-machine communication in the development of robotic assistive devices using pattern recognition techniques.

In addition to signals, images also used in localization and mapping for navigation of mobile robots. Robots with new capability are available due to recent advances in pattern recognition algorithm and high speed processor. Visual pattern recognition can be used in human-robot interaction, security, surgical assistant etc. To achieve full autonomy, a robot must able to recognize visual images. For example robots are developed for the retail market which detects and recognizes the items placed in basket. This necessitates the use of pattern recognition technique from the images captured using camera.

This chapter will discuss the application of pattern recognition in robots for assisting the disabled people. This chapter will provide implementation of pattern recognition based motion control of a prosthetic drive, through continuous myoelectric signal acquisition, classification with and without principal component analysis using neural network classifier.

PATTERN RECOGNITON IN ROBOTS

The problem of pattern recognition involves decision making in most of the robotics applications. The process of preprocessing in pattern recognition of signal/image processing is required to remove noise and redundant data. In the decision making approach, the process consists of data segmentation, feature extraction and feature selection/ reduction as shown in Figure 1.

After preprocessing of data, it is necessary to extract the features that will potentially help in decision making. Features contain information and the extraction of relevant features for decision making application depends upon the patterns and the number of decisions under consideration. Several approaches are available for extraction of features, selection of features and classification in different robotic applications.

Enormous number of research papers exists in the area of development of myoelectric controlled prosthetic hand. Pattern based-recognition for myoelectric control of prosthetic devices may be explained under feature extraction and/or feature dimensionality reduction, and classification of myoelectric data. Sardis, G.N. & Gootee, T.P. (1982) identified patterns of pre-specified motion from the feature space of variance (VAR) and zero crossing (ZC). Later, Lee, S., & Sardis, G.N. (1984) used integral absolute value (IAV) also known as mean absolute value (MAV) along with VAR, ZC for the myoelectric control of arm. Hudgins, B., Parker.P., & Scott, R.N. (1993) investigated the information content in the transient burst of