Chapter 8
Tremor Identification Using Machine Learning in Parkinson's Disease

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ABSTRACT

Tremor is an involuntary quivering movement or shake. Characteristically occurring at rest, the classic slow, rhythmic tremor of Parkinson's disease (PD) typically starts in one hand, foot, or leg and can eventually affect both sides of the body. The resting tremor of PD can also occur in the jaw, chin, mouth, or tongue. Loss of dopamine leads to the symptoms of Parkinson's disease and may include a tremor. For some people, a tremor might be the first symptom of PD. Various studies have proposed measurable technologies and the analysis of the characteristics of Parkinsonian tremors using different techniques. Various machine-learning algorithms such as a support vector machine (SVM) with three kernels, a discriminant analysis, a random forest, and a kNN algorithm are also used to classify and identify various kinds of tremors. This chapter focuses on an in-depth review on identification and classification of various Parkinsonian tremors using machine learning algorithms.

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INTRODUCTION

Tremor and Its Classifications

An involuntary action which is rhythmic is known as tremor which is caused by either alternating or synchronous contractions of antagonistic muscles. It is movement of muscle contraction and relaxation involving twitching movements of one or more body parts. It affects the hands, arms, eyes, face, head, vocal folds, trunk, and legs. Tremor is the most common of all movement disorders, which occurs in most normal individuals in the form of physiologic tremor (Hallett, 1991).

Tremor is most commonly classified by clinical features, cause or origin. Figure 1 shows the various types of tremors.

- **Cerebellar Tremor (Intention Tremor):** It is a slow, broad tremor of the extremities that occurs at the end of any kind of body movement, such as trying to press a button or touching a finger to the tip of one's nose. It is mostly caused by lesions in or damage to the cerebellum resulting from stroke, tumor, or disease such as multiple sclerosis or any degenerative disorder. It can also result from chronic alcoholism or overuse of some medicines. The tremor is often most prominent when the affected person is active or is maintaining a particular posture. Cerebellar tremor may be accompanied by other manifestations of ataxia, including speech problems, rapid, involuntary rolling of the eyes, gait problems (Elble, 2017).
- **Dystonic Tremor:** It occurs in individuals of all ages who are affected by dystonia. Dystonia is a movement disorder in which sustained involuntary muscle contractions cause twisting and repetitive motions followed by painful and abnormal postures. Dystonic tremor may affect any muscle in the body and is seen most often when the patient is in a certain position or moves a certain way. It occurs irregularly and often can be relieved by complete rest. Touching the affected body part or muscle may reduce tremor severity (Elble, 2017).
- **Essential Tremor**: It is of the most common type of tremor. Although the tremor may be mild and non-progressive in some people, but it is slowly progressive, starting on one side of the body and gradually affecting both sides. The hands are most often affected body part. Other parts like the head, voice, tongue, legs, and trunk may also be involved in some cases. Mild gait disturbance is also a symptom in essential tremor. Tremor frequency may decrease as the person ages, but the severity may increase, affecting the person's ability to perform certain tasks or activities of daily

Figure 1. Types of tremor