

## Chapter 6

# Soft Computing–Based Early Detection of Parkinson’s Disease Using Non–Invasive Method Based on Speech Analysis

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### **ABSTRACT**

*This chapter aims to use the speech signals that are a behavioral bio-marker for Parkinson’s disease. The victim’s vocabulary is mostly lost, or big gaps are observed when they are talking or the conversation is abruptly stopped. Therefore, speech analysis could help to identify the complications in conversation from the inception of the symptoms of Parkinson’s disease in initial phases itself. Speech can be regularly logged in an unobstructed approach and machine learning techniques can be applied and analyzed. Fuzzy logic-based classifier is proposed for learning from the training speech signals and classifying the test speech signals. Brainstorm optimization algorithm is proposed for extracting the fuzzy rules from the speech data, which is used by fuzzy classifier for learning and classification. The performance of the proposed classifier is evaluated using metrics like accuracy, specificity, and sensitivity, and compared with benchmark classifiers like SVM, naïve Bayes, k-means, and decision tree. It is observed that the proposed classifier outperforms the benchmark classifiers.*

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## INTRODUCTION

Parkinson's disease is caused by deteriorating condition of the central nervous system which primarily disturbs the motor function. The symptoms gradually start to appear as time progresses. Common symptoms in the beginning stage of Parkinson are reduced cognition, gait abnormality, decreased body movement, tightness of muscles or oscillating movement of some parts of the body. The brain starts getting affected as the disease starts progressing through advanced stage (Carroll et al., 2016). Mental disorder is yet another common behaviors exhibited by the Parkinson patients. The factor which influences the Parkinson disorder is quite mystery but it is assumed that both genes as well as the environment contributes to the development of the disorder (Lorraine and Anthony, 2015). There is high possibility for the family members to be affected by this disorder. People smoking tobacco and taking hot beverages might have reduced risk while those who suffer from injury in head or having exposure to pest control chemicals have high possibility of getting this disorder.

Periodic automated non-invasive early Parkinson's disease detection method could recover the life of the patients and avert higher treatment costs. This chapter aims to use the speech signals which is a behavioral bio-marker for Parkinson's disease. Although, Parkinson's disease detection could be performed based on psychological, cognitive and physiological bio-markers, speech and conversation will start getting affected from the initial stage onwards. The victim's vocabulary is mostly lost or big gaps are observed when they are talking or the conversation is abruptly stopped. Therefore, speech analysis could help to identify the complications in conversation from the inception of the symptoms of Parkinson's disease in initial phases itself. Speech can be regularly logged in an unobstructed approach and Machine Learning techniques can be applied and analyzed. The Parkinson's dataset from UCI repository is used for Parkinson's disease detection.

Fuzzy Logic based classifier is proposed for learning from the training speech signals and classifying the test speech signals. Brainstorm optimization algorithm is proposed for extracting the fuzzy rules from the speech dataset, which is used by fuzzy classifier for learning and classification. The performance of the proposed classifier is evaluated using metrics like accuracy, specificity and sensitivity and compared with benchmark classifiers like SVM, Naïve Bayes, k-Means and Decision Tree. It is observed that the proposed classifier outperforms the benchmark classifiers. Parkinson Disorder affects the communication of the patient (Smith & Caplan, 2018). This will lead to loss of control on speech and linguistic. The impairment of cognition and motor in open for more research opportunities. Even though several people are affected by this disorder, the symptoms exhibited are varying from one person to another. Diagnosing the disorder in the preliminary stage is vital for accurate remedy because it could extend the life span of the victim (Gupta et al., 2018). Even though several methods are existing for early diagnosis of the disorder, they are inefficient. It is highly necessary to diagnose the disease in early stage because, as the severity of the disorder progresses, it leads to other disabilities related to walking or even standing because the muscles get so rigid in the legs. Thus, analyzing the speech signals would be an effective means to diagnose the disorder in its preliminary stage. Recently, with the advent of sophistications in Artificial Intelligence techniques, automating the learning and analysis of speech signals would be on high expectations.

Amongst the learning mechanisms used by the Machine Learning algorithms, rule-based learning is gaining popularity amongst researchers. Especially in the recent years, biologically inspired optimization algorithms are frequently used for learning purpose. Swarm Intelligence based optimization algorithms

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