


Chapter 13

Metaheuristics in Deep Learning in 3D Medical Images for Alzheimer's Disease

Dhanush Rachaveti

 <https://orcid.org/0000-0002-6214-0194>

Vellore Institute of Technology, Chennai, India

M. Subalatha

Heatechs Instruments, India

R. S. Amutha

Vellore Institute of Technology, Chennai, India

ABSTRACT

Alzheimer's disease is a progressive disorder that affects primarily memory and thinking abilities and causes the problems of everyday life. Traditional methods of diagnosis are time-consuming and prone to error due to human mistakes. Deep learning systems have proven to be efficient systems for the diagnosis of Alzheimer's disease from brain MRI scans. The systems are based on state-of-the-art machine learning techniques to automatically classify MRI data into various phases of dementia. Deep learning techniques have proven to have high accuracy in classifying these data, particularly using various types of brain imaging information in combination. The diagnosis can be done at a quicker speed using specific algorithms in Deep Learning models that identify nearly optimal solutions. These techniques are also efficient in fine-tuning and feature selection in deep learning models to detect various phases of Alzheimer's disease. Designing lightweight and real-time

DOI: 10.4018/979-8-3373-0523-3.ch013

deep learning models further makes them viable to implement in clinical practice permitting early intervention.

INTRODUCTION

Alzheimer's disease (AD), or dementia, is a progressive disease that destroys brain cells. It makes thinking and remembering difficult. It is difficult for the person to perform daily tasks such as writing, reading, and speaking. In severe Alzheimer's disease, it causes serious ailments such as heart disease and respiratory problems, which can ultimately cause the death of the person, (Beheshti & Demirel, 2016).

Slowing the development of Alzheimer's disease and enhancing patient outcomes depend on early diagnosis. Yet, the diagnosis of Alzheimer's disease at an early stage continues to be challenging due to its insidious onset and multifactorial development. Alzheimer's disease is projected to affect one in every 85 individuals by the year 2025, and it is one of the most common neurological disorders, (Alzheimer's Association, 2019). The disease is accountable for approximately 60%-80% of the total number of dementia cases globally, exerting a substantial influence on aging populations, (Afzal et al., 2019). The Clinical Deterioration Rating (CDR) scale and the Global Deterioration Scale (GDS) are two common clinical rating scales for the detection of cognitive decline and the severity of Alzheimer's disease.

Structural brain changes are significant determinants of the progression of Alzheimer's disease. Hippocampal loss, enlargement of the ventricles, and cortical thinning are typical results of an MRI scan in individuals suffering from the disease. The hippocampus memory system for processing is particularly affected, leading to spatial perception, judgment, and executive function impairments, (Schlaggar et al., 2019; Umbach et al., 2020). These degenerative changes interfere with brain information communication, leading to cognitive impairment, progressively worsening. Due to the challenge of early diagnosis, sophisticated computational algorithms are under investigation to enhance detection sensitivity.

Recent advances in artificial intelligence (AI) and deep learning (DL) have significantly improved the processing of medical images. Deep learning-based models, particularly convolutional neural networks (CNNs), are commonly employed in the detection of abnormalities in brain MRI scans, (Moradi et al., 2015). Deep learning models have also been proven useful in the detection of abnormalities in other medical imaging modalities such as mammography, ultrasound, and other brain imaging tests, (bron et al., 2015). Deep learning models are capable of processing enormous databases of data and identifying very subtle patterns in images, and thus they are a valuable tool in the diagnosis of Alzheimer's disease (AD).

20 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/metaheuristics-in-deep-learning-in-3d-medical-images-for-alzheimers-disease/387499

Related Content

Predicting Stock Market Price Using Neural Network Model

Naliniprava Tripathy (2022). *Research Anthology on Artificial Neural Network Applications* (pp. 1414-1426).

www.irma-international.org/chapter/predicting-stock-market-price-using-neural-network-model/289019

Comprehensive Modelling of ANN

Meghna Babubhai Patel, Jagruti N. Patel and Upasana M. Bhilota (2022). *Research Anthology on Artificial Neural Network Applications* (pp. 31-40).

www.irma-international.org/chapter/comprehensive-modelling-of-ann/288949

HONU and Supervised Learning Algorithms in Adaptive Feedback Control

Peter Mark Benes, Miroslav Erben, Martin Vesely, Ondrej Liska and Ivo Bukovsky (2016). *Applied Artificial Higher Order Neural Networks for Control and Recognition* (pp. 35-60).

www.irma-international.org/chapter/honu-and-supervised-learning-algorithms-in-adaptive-feedback-control/152096

The Role of Neural Networks in Computerized Classification of the Electrocardiogram

Chris D. Nugent, Dewar D. Finlay, Mark P. Donnelly and Norman D. Black (2006). *Neural Networks in Healthcare: Potential and Challenges* (pp. 60-80).

www.irma-international.org/chapter/role-neural-networks-computerized-classification/27273

Traditional and Non-Traditional Optimization Techniques to Enhance Reliability in Process Industries

Ravinder Kumar, Hanumant P. Jagtap, Dipen Kumar Rajak and Anand K. Bewoor (2020). *AI Techniques for Reliability Prediction for Electronic Components* (pp. 67-80).

www.irma-international.org/chapter/traditional-and-non-traditional-optimization-techniques-to-enhance-reliability-in-process-industries/240491