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# Soft-computing based diagnostic tool for analyzing demyelination in magnetic resonance images

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ABSTRACT

This paper proposes a soft-computing based diagnostic tool for analyzing (white matter changes) demyelination due to radiation therapy given to brain tumor cases. The tool exploits the pattern of changes in gray level distribution using a temporal sequence of magnetic resonance (MR) images. Appearance of white matter changes due to demyelination varies from patient to patient. Further, there exists inherent impreciseness in the white matter change patterns. These characteristics make use of fuzzy features well suited for describing image based temporal patterns. Correlation between these temporal patterns and actual onset of demyelination can be captured by fuzzy rules because of the inherent uncertainty associated with changes in gray level pattern in the image and occurrence of the disease. The tool is based on hybrid approach of two popular approaches of genetic algorithm based machine learning (GBML) techniques namely Michigan and Pittsburgh approach. The genetic algorithm (GA) based machine learning tool generates an optimized rule set to indicate positive (P), negative (N) or doubtful (D) cases of demyelination.



## 1. Introduction

White matter changes are harmful side effect of radiation therapy given for the treatment of brain tumor cases. RT causes permanent changes in the white matter tissues. This can result in memory loss, loss of balance, lack of co-ordination, etc. These changes can be controlled, provided these are diagnosed at early stages. The white matter changes can be due to other reasons also. This paper proposes a soft-computing based diagnostic tool to analyze for the white matter changes due to radiation therapy on the temporal MR images before they are distinctly visible in the MR images [1]. The relative efficacy of the tool appears to be acceptable for the test cases considered.

The MRI has a unique advantage of providing multi-spectral images of tissues with a variety of contrasts based on parameters like T1, T2, and PD [2,3]. But detecting diseases (like tumor, infection, and white matter changes) at an early stage in the MRI is an acute problem. Most of the existing approaches on brain diagnostic tool reviewed in the literature use prior subjective knowledge obtained from experts [4–9]. Wang et al. [7] proposed a tool for the early detection of Alzheimer's disease in patients. Here, structural MR imaging has been exploited for detecting Alzheimer disease. Udupa et al. [9] proposed a method using dual echo and fast spin-echo MR imagery for the quantification of multiple sclerosis (white matter changes due to treatment protocol). The method uses fuzzy connectedness principle to estimate the volume of diseased tissue. Wang et al. [11] proposed learning of fuzzy rules by GA for Hepatitis diagnosis. The search capabilities and the scope for exploiting data patterns represented by training examples [10–12] have led to the use of GA in the developing rule based fuzzy diagnostic systems.

Most of the existing approaches on brain diagnostic tool performing segmentation or visualization (2D or 3D) use prior subjective knowledge for diagnosis. In this paper, a scheme is proposed to use GA for supervised learning of diagnostic knowledge in the form of fuzzy rule based system (FRBS) using labeled

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