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MRI Imaging, Comparison of MRI with other Modalities, Noise in MRI Images and Machine Learning Techniques for Noise Removal: A Review

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Abstract:

Medical imaging is to assume greater and greater significance in efficient and precise diagnosis process. It is a set of various methodologies which are used to capture internal or external images of human body and organs for clinical and diagnosis needs to examine human form for various kind of ailments [1]. Computationally intelligent machine learning techniques and their application in medical imaging can play a significant role in expediting the diagnosis process and making it more precise. This review presents an up-to-date coverage about research topics which include recent literature in the areas of MRI imaging, comparison with other modalities, noise in MRI and machine learning techniques to remove the noise.

Keywords: MRI images, Image modalities, MRI noise removal, Machine learning

1. INTRODUCTION

Medical Image Processing has assumed greater significance in recent years due to better prognosis and diagnosis capabilities that have come with advancements in it. It is playing a vital role in the diagnosis and prognosis of cancer-based diseases developed in human body most commonly in lungs, brain, breast and another kind of this is also spreading frequently in old ages is Alzheimer disease. In this era of fast technological developments through the use of computer software, medical imaging modalities have been developing to capture high quality medical images. A radiologist or medical expert with the help of these images can diagnose the disease with high precision and accuracy. Medical imaging techniques can also be used when planning for examining patients as well as when to proceed to surgery. The expanding volume of these medical images have made inevitable the use of computers to perform all steps easy for treatment process and all detailed analyses of the symptoms, specifically, computer algorithms as a tool for having atlases of anatomical structures and other areas of interest for radiological therapy.

Magnetic Resonance Imaging (MRI) is one of the common and widely used imaging techniques in medical imaging due to its excellent capability for soft tissue imaging such as brain imaging and muscles and excellent for early diagnosis and detection of brain tumors, treatment monitoring and other brain abnormalities. There are also available other medical imaging techniques such as x-rays, computed tomography (CT) and ultrasound, but MRI imaging has some properties such as high-resolution images of the internal structure of the brain, that makes it more suitable method [2]. Unlike other conventional radiology like x-rays, computed tomography (CT) and ultrasound, no radiations are involved in MRI scanning and a better choice when frequent imaging is required for diagnosis, especially in the brain [3]. MRI scanning is particularly advantageous at providing highly detailed images of brain soft tissues while other techniques not [4]. MRI has one major advantage that information acquired from it can be more diverse and coherent than any other imaging method. The MRI technique creates scans from measured signals coming directly from the object without any needs to inject contrast agents. It does not have the problems regarding the radiation as it works in the radio frequency range. Finally, it can create different images focusing on one specific property of a same object by just changing some intrinsic parameters of the system. The problem with this technique is related to application of magnetic fields in the encoding process. These images are subject to different noises while capturing the data that can affect the image quality and diagnostics. Therefore, improving the quality of the generated images from both resolution and signal-to-noise ratio (SNR) perspective is critical. Therefore, applying a