An insight to Medical Imaging Processing

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Abstract

The paper presents an insight to the ongoing highly research oriented field of medical image processing. It is the technique of creation of visuals of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of organs or tissues. The magnetic resonance imaging technique (MRI) is the most prominent form of medical image processing. The paper highlights the concept, which is followed by recent trends in the area. The paper also presents the generated MRI scanned images in the end.

Keywords*—medical image processing, magnetic image resonance, image processing, computer aid system design.*

1. INTRODUCTION

The image processing techniques usually process images in the form of 2D signals and involve standard signal processing techniques on them. In general, image processing is classified in the forms of digital image processing and medical image processing. This paper has focus on medical image processing tool. Now-a-days, the medical imaging and processing tools are playing important roles in various applications. These kinds of applications take place throughout the clinical track of events; just not only limited to diagnostic settings, but majorly in the area of preparation and evaluating before surgical operations [1]. The medical imaging incorporates noise and speckle like ultrasound, thus encumbering the doctors' judgment.

The motive of this paper is to gather and analyze different tools for medial image processing. Of the various image processing tools created, the Fig. 1 shows generic, registration, segmentation, visualization, reconstruction, simulation and diffusion techniques, which possess different functionalities.

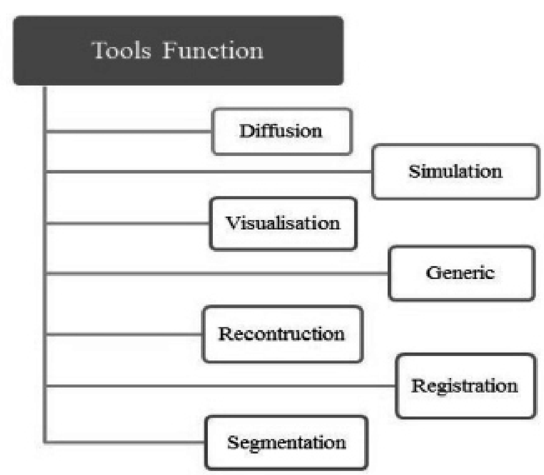

Fig. 1 Functions of tools

II. MEDICAL IMAGE PROCESSING

Medical Image Processing is the process which is used to a create visual representations of an interior of the human body for clinical analysis, medical intervention and diagnostic purposes. Medical imaging tends to reveal internal structures hidden by means of the skin and bones, as well as to scrutinise and treat disease. Medical imaging also aids in formulating a database of normal anatomy as well as physiology to make it possible to identify many abnormalities. Although image processing of removed organs and tissues can be performed for medical reasons, there are procedures which are considered part of pathology instead of the medical imaging. Thus, this paper has general focus on the survey of medical image processing tools. In the next section, an overview of different types of image processing tools will be presented. The figure below illustrates the medical image processing tools that will be surveyed in part III.

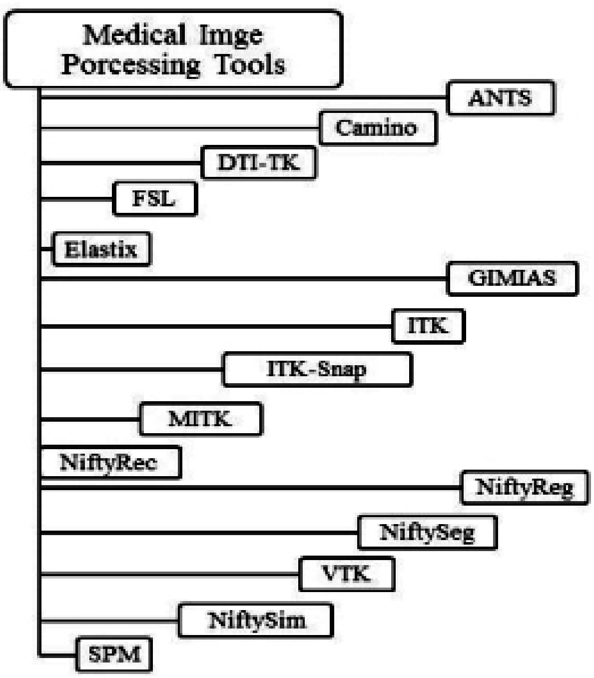

Fig. 2 Tool for Medical Image Processing

The major purpose of image processing is to enhance and improve the appearance of an image, thus, there are lot of image processing tools available. These tools provide assistance to scientists with an extensive set for analyzing operations. Most image processing methods involve treating the image as 2D signal and applying various signal-processing techniques to it.

In recent times, medical imaging has undergone a major advancement in modern medical field. This technology is important as it is applied before an actual operative surgery [2]. For many years, different sorts of medical imaging have been formulated, different type of medical image processing adapts different type of technology. Each of the medical images have their own advantages and disadvantages. The Bio-medical image processing has experienced dramatic expansion upto zenith, and is an interdisciplinary research field which attracts expertise from many fields like applied mathematics, physics, biology computer sciences, engineering, statistics and medicine. Computer-aided diagnostic image processing has become an important part of clinical routine already. Along with a rush of new development in high technologies and use of various imaging modalities, various other challenges arise; for instance, how to process and analyze a significant number of images in order to produce high quality information for disease diagnoses and treatment.

III. MAGNETIC IMAGE RESONANCE

During last few decades, with an increase in availability of relatively inexpensive computational processing resources, magnetic resonance imaging (MRI), Doppler ultrasound, computed tomography (CT), and various imaging techniques based on nuclear emission (PET (positron emission tomography), SPECT (single photon emission computed tomography), etc) have all been valuable additions to the radiologist's tools towards more reliable detection and diagnosis and cure of disease. Excellent detailed discussions can be found in literary sources like Nishimura [3] and Liang and Lauterbur [4].

MRI is a tomography imaging technique which generates images of internal physical and chemical peculiar of an object from externally measured nuclear magnetic resonance (NMR) signals information. MRI imaging is based on the well known NMR phenomenon which was discovered by Sir Bloch and his co-workers at Stanford [5] and Purcell with his colleagues at Harvard [6] in 1946. An MR scanner shown in Fig. 3 consist of three main hardware components: the main magnet, the magnetic field gradient system, and radio-frequency (RF) section. The main magnet is a permanent magnet which generates a strong uniform static field, referred to as the B0 field, and polarizes nuclear spins in an object. The RF system consists of a transmitter coil which generates a rotating magnetic field (B1 field), for driving a spin system, and a receiver coil that converts magnetization into an electrical signal. On human imaging systems, the strength of B1 is typically a small fraction of a Gauss.

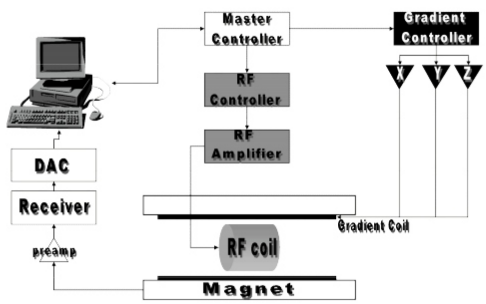

Fig. 3 Basic drawing of the instrumentation of MRI

An MRI system is rather complex. But, the imaging principles of it are rather straightforward, especially from a viewpoint of the signal processing. The imaging process involves forward as well asinverse Fourier transforms as shown in Fig. 4.

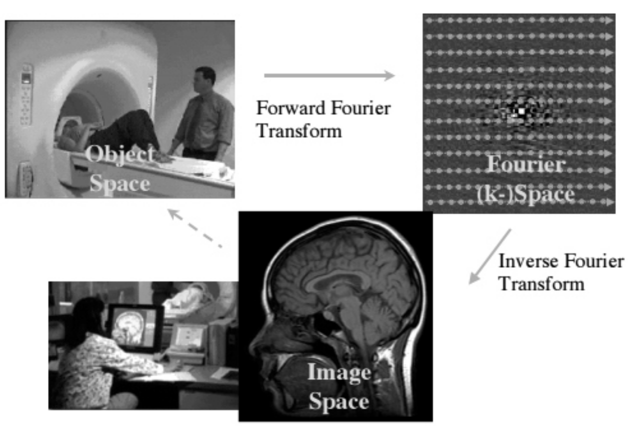

Fig. 4 Image Signal Processing in MRI

The imaging process do not involve utilization of ionizing radiation and hence does not have any associated potential harmful effects. MRI signals used for image formation come directly from the main object only.

IV. COMPUTER AIDED DIAGNOSTIC PROCESSING

Medical image processing deals in problem-specific approach for enhancement of raw medical image data, selective visualization and further analysis. A comprehensive overview on a range of topics in medical image processing appears in [7]. Here, I have focused on image segmentation and multi-spectral analysis.

A. Image segmentation:

Image segmentation is defined as the partitioning of image into regions which are meaningful for a specific task. This may, for instance, incorporate the detection of brain tumor from MR or CT images (Fig. 5). Segmentation is one of the first procedure which leads to image analysis and interpretation. The goal is easy to propose, but difficult to achieve in an accurate manner.

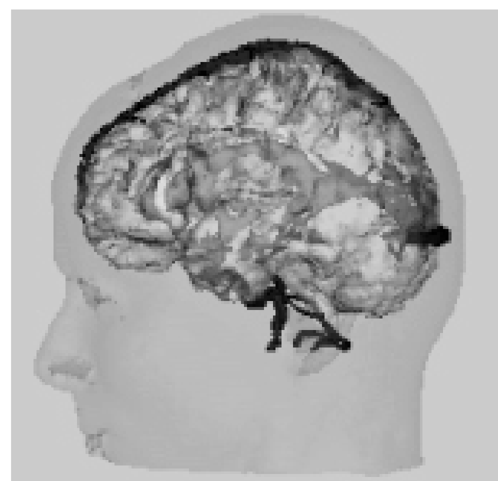

Fig. 5 The 3D rendering of a segmented skin surface (pink), brain tissue (brown), a tumor (green) and major blood vessels (navy blue), from MRI volume. This aids surgeons to visualize the actual locations of different locations of tissues.

Image segmentation approach is usually classified owing to both the features and the type of techniques used. Various features include texture, pixel intensities and edge information, etc. Many techniques based on these features can be classified into structural and statistical methods, broadly. Structural methods depend on the spatial properties of an image, such as regions and edges. Various edge detection algorithms can be applied to extract boundaries between different brain tissues [8-10]. However such algorithms are sensitive to noise. The region growing [11, 12] is one of the popular structural techniques. In this approaches, an image is divided into small regions, which can be referred as “seeds”. Then, all boundaries between adjacent regions are scrutinized. The strong boundaries (in terms of certain specific properties) are kept intact, whereas weak boundaries are rejected and the adjacent regions are then merged. This process is carried out iteratively till no boundaries are left weak enough to be rejected. However, the performance of this method depends on seed selection and also, whether the regions are well defined, and therefore, it is not considered as a robust one.

V. MRI IMAGE SCANS

The MRI images scanned by the machines look similar to these shown in Fig. 6-8

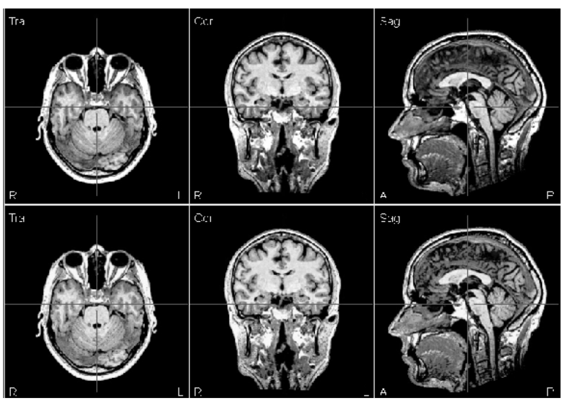

Fig. 6 MRI scanning of a human brain

Fig.7 Intricate parts highlighted in an MRI of brain

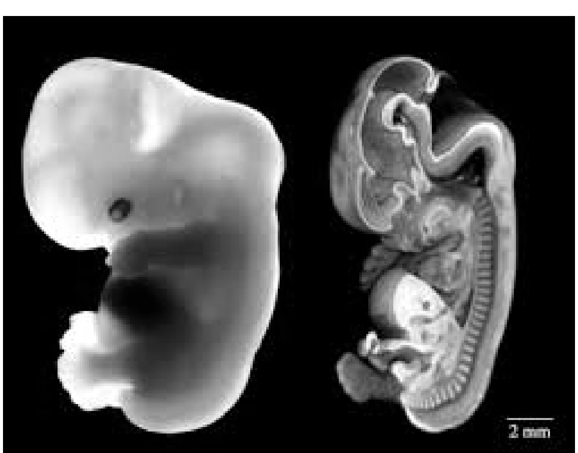

Fig. 8 MRI scans of a human embryo

VI. CONCLUSION

The work presented here shows an overview of medical image processing, which is the field of high potential in today's medical and biomedical engineering fields. The medical image image processing tools are widely used by a number of surgeons around the world fro diagnostic purposes. Of many medical image processing techniques available, the magnetic resonance imaging is the most widely used concept.

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