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RESEARCH ABSTRACTS

- ## A SURVEY ON OPTICAL IMAGING

Optical imaging is the use of near infrared light to image the tissue. The use of NIR light is very beneficial as NIR is harmless and the optical properties of the tissue gives more accurate information on the tissue compared to the other techniques to image the tissue. But the drawback is the poor spatial resolution resolution because of the high scattering rate of NIR photons.

Optical imaging has branched into several techniques such as optical topography, optical coherence tomography, optical diffusion tomography and fluorescence optical diffusion tomography. These techniques are extensively discussed in this paper.

Optical topography gives 2D images that are mostly used in functional imaging of infant brains.

Optical coherence tomography (OCT) gives images of the tissue microstructure by near-surface illumination. Although it has the penetration limit problem, OCT provides very high-resolution images and therefore preferred in areas like retinal diseases.

Optical diffusion tomography gives an image of the optical parameters of the tissues. These scattering and absorption parameters are reconstructed from boundary measurements of NIR photons. The reconstruction process is ill-posed and requires many iterations. Therefore many techniques have been introduced in literature to solve this problem. ODT has the deep tissue imaging capability, thus it has been used in many areas such as breast imaging, brain imaging and imaging of hemodynamics.

Fluorescence optical diffusion tomography (FODT) is an imaging technique which combines the deep tissue imaging capabilities of ODT with the high contrast and specifity properties of fluorescent dye tagging. FODT requires fluorophore to be injected into the tissue. Then the optical parameters and fluorophore parameters are both calculated from measurements in a way similar to ODT.

This paper gives a survey of these imaging techniques aiming to introduce the interested reader to the optical imaging area. The area is still open to contributions especially in the field of ODT and FODT as the derivation of the optical parameters is still a time-taking issue.

- ## A SURVEY ON THE AGING PROBLEM AND ITS EFFECTS ON THE BRAIN:

Aging process comes with its effects like gray hair, wrinkled skin, brittle bones accompanied by functional and structural impairment, discomfort and suffering. The idea in the studies of aging is to take it as a disease and try to diagnose and cure it before it is too late. So the studies are going on in cellular or anatomical levels, but the question of how early the morphological changes begin and which areas are more vulnerable to these changes still remains a problem.

Studies have shown that aging makes some visible changes in the brain such as decrease in the total brain weight & volume, cortical thinning, gyral atrophy, widening of sulci, expansion of ventricular volume and neurological disorders. Thus the importance of cerebral cortex in various motor and cognitive functions has drawn the attention on this subject. Moreover, if the normal aging process can be understood, the deviations from the normal brain structures will allow us to detect diseases which affect the brain like dementia (for ex. Alzheimer) or multiple sclerosis in the early stages!

This study covers the studies of aging on the brain. However, still remaining as an unsolved problem, many studies have shown contradictory results because of the difficulties of the problem and many studies have evolved in time with the advancements of the technologies. The first part of this survey paper gives the basics of the brain to understand the relevant papers and in the second part several of the methodologies applied will be discussed to give an idea to the reader about the problem and the possible solution methods.

- **QUANTIFICATION OF THE VOLUMETRIC DIFFERENCES IN PROGRESSIVE SUPRANUCLEARPALSY & CORTICOBASAL DEGENERATION DISORDERS**

Progressive Supranuclear Palsy (PSP) and Corticobasal Degeneration (CBD) are two neurodegenerative parkinsonian disorders that result in severe disability but both are still under diagnosed. PSP and CBD symptoms start around age 60 and patients have a life span of about 5 years after diagnosis because of the inability to move and to care for themselves. The current clinical diagnosis depends on the presence and progression of clinical features and the definite diagnosis of these diseases can only be made by neuropathological examination. Therefore, a three dimensional (3D) MRI study on these diseases may be very helpful in clinical diagnosis.

The main objective of the proposed project is to find a characteristic pattern of volume loss in the brain structures using an MRI based three dimensional (3D) technique that will allow measuring the volumes of the total intracranial volume (TICV), total brain volume, left hemisphere, right hemisphere, brainstem, midbrain, pons, medulla oblongata, cerebellum, corpus callosum, frontal lobe, parietal lobe, occipital lobe, temporal lobe, and the white and gray matters of all the lobes.

Application of discriminant analysis will help determine the patterns of volume loss in these parkinsonian disorders. Association between structure volumes, age and sex will be evaluated by regression analysis. Different classification approaches (*Bayesian classifiers, Expectation Maximization (EM) algorithm, Support Vector Machines, Artificial Neural Networks, fuzzy logic, linear regression*) will be applied to find a significant inverse correlation between these diseases. Depending on the segmentation and classification, we will try to differentiate PSP and CBD diseases.

- **A SURVEY ON MICROARRAY IMAGE PROCESSING**

The ultimate goal of microarray imaging is to find the differences of the gene expressions under two separate conditions. Understanding how gene expressions change will allow us to better understand and cure the diseases. This technology has the advantage of collecting a large amount of data in a single experiment, but still some challenges exist to quantify and compare this data as it is a highly probabilistic science.

Microarray imaging is a very powerful technique to study the gene expressions, understand the interactions between the genes, and to discover the functions of the unknown genes. Understanding gene expression behaviours would help to diagnose several diseases like cancer or diabetes in the early stages and it would help to find person-specific cures.

In this paper, the process to form the microarray image is explained first. In the second part, current image processing techniques are explained. Image processing task is divided into 4 main parts, namely the gridding, denoising, segmentation and information extraction. In these 4 main parts, the most recent approaches as well as the methods used in the commercial packages are discussed.