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A Survey on Brain Tumor Image Registration to Assist in Performing the Surgery

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***Abstract*—** In this paper we discuss about the technologies used to register brain tumor images. This registration performed before surgery. In particular we analyzed the ultrasound and MRI. The advantages and disadvantages of these technologies also considered.

***Keywords*—** Mutual Information, Correlation ratio, Magnetic resonance image, Ultrasound Image.

I. INTRODUCTION

In imaging science, image processing is manipulation of images. It uses mathematical operations by using any form of signal processing. The input is an image and the output of image processing may be either an processed image or a set of characteristics or parameters related with the input image [1].

The image processing has so many categories [2] . Those are

- Computer graphic artifacts
- Computer vision
- Digital photography
- Feature detection (computer vision)
- Graphics file formats
- Image compression
- Image noise reduction techniques
- Image processing software
- Image segmentation
- Interpolation
- Mathematical morphology
- Medical imaging
- Stereophotogrammetry
- Wavelets

In this, medical imaging is the area where numerous researches are going on. There exist so many research papers in medical imaging [3, 4, and 5] The medical imaging is the process of representations of the of a body (interior) visually. It is used in clinical analysis and medical intervention. Medical imaging assist us to diagnose and treat disease by revealing the internal structures hidden by the skin and bones [6].

Medical Imaging particularly used in detection of cancers. There exist more than 120 types of cancers. Some of the common types of cancers are [7] .

Bone Cancer
Brain Tumor
Breast Cancer
Childhood Cancer
Colorectal Cancer
Endocrine Tumor
Head and Neck Cancer
Lung Cancer
Melanoma
Prostate Cancer
Testicular Cancer
Thyroid Cancer

Brain tumors are the [8]:

- Leading cause of children death related to cancer(males and females) under age 20 (leukemia is the first).
- Second leading cause of male adult death related to cancer with ages 20-39 (leukemia is the first).
- Fifth leading cause of female adult death related to cancer with ages 20-39.

Hence there is a need for diagnosing the brain tumor.

The neurosurgical procedures are affected by intraoperative deformation. The three dimensional (3-D) ultrasound data can be acquired and updated to preoperatively acquired MR data. This 3-D ultrasound data detect brain shift during image-guided neurosurgery. Therefore, it can be utilized as a base for correcting data for image and preoperative planning for intraoperative deformations [9]. For protecting the image data we can use any one information security method [10] .

Before brain shift the Image registration has been done. There measurement of the tumor can be obtained by some metrics. Those are

Mutual-Information (MI),
Correlation Ratio(CR),
Correlation Coefficient (CC),
Sum of Squared Differences (SSD).

Out of this, mutual information was most generally used, which gives out the mean measurement of the tumor. The actual measurement of the tumor can be implemented by the next metric Correlation ration (CR).. The image registration is done by using a novel algorithm with a metric CR for the magnetic resonance and 3D ultrasound images.

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II. RELATED WORK

The related works for brain tumor detection as given in the table 1.

Table .1.Related work for Brain tumor detection

Title	Description
Brain Shift Estimation In Image-Guide Neurosurgery Using 3-D Ultrasound Data.[9]	Brain shift is detected by acquiring 3-D ultrasound data during image-guided neurosurgery and can be used as a basis for correcting image data and preoperative planning for intra-operative deformations.
Comparing Two Approaches To Rigid Registration Of Three-Dimensional Ultrasound And Magnetic Resonance Images For Neurosurgery.[11]	This generates a pseudo-ultrasound from a segmented MR image and uses cross-correlation as the cost function to register the pseudo-US to the real ultrasound data.
Multi-Modal Image Registration Based On Gradient Orientations Of Minimal Uncertainty[12]	It introduce a new multi-scale technique for multi-modal image registration based on the alignment of selected gradient orientations of reduced uncertainty
Towards A Better Comprehension Of Similarity Measures Used In Medical Image Registration[13]	It presents results of registration between 3D MR and 3D Ultrasound images to illustrate the importance of choosing an appropriate similarity measure.
Mutual Information Based Registration Of Medical Images [14]	It presents an overview of the medical image processing literature on mutual information based registration.
Block Matching A General Framework To Improve Robustness Of Rigid Registration Of Medical Images[15]	In this article a general framework is built on block matching strategies. This framework combines two stages in a multi-scale hierarchy.
Ultrasound Imaging In Neurosurgery: Approaches To Minimize Surgically Induced Image Artifacts For Improved Resection Control[16]	In this intra-operative ultrasound imaging is used in brain tumor surgery to identify tumor remnants.
Robust MRI Brain Tissue Parameter Estimation By Multistage Outlier Rejection.[17]	This article addresses the problem of the tissue type parameter estimation in brain MRI in the presence of partial volume effects.
New Prototype Neuro navigation System Based On Preoperative Imaging And Intraoperative Freehand Ultrasound: System Description And Validation.[18]	This report presents IBIS Neuro Navigation, a new prototype neuro navigation system that uses tracked intra-operative ultrasound to address surgical navigation issues related to brain shift.
The Correlation Ratio As A New Similarity Measure For Multi Modal Image Registration[19]	It addresses the determination of a new measure based on standard statistics from a theoretical point of view.

III. CONCLUSION

This survey concludes that the image registration of magnetic resonance and 3D ultrasound brain tumor images can be done by using similarity metric like mutual information and correlation ratio. While comparing both the metric, the correlation ration is giving the accurate measurement of the tumor. While the mutual information gives the mean measurement of the tumor. So correlation ration is most preferable metric that should be used for image registration for the brain tumor before the surgery.

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