IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

Instruments DNA Registration and Calibration

Ahmed Sabr

University of Bridgeport, Biomedical Engineering, USA

Abstract: In this paper, image analysis and processing has been discussed. Image analysis involves the manipulation of the patient's 3D model to extract relevant information from the data. Computer assisted surgery (CAS) represents a surgical concept and set of methods, that use computer technology, for pre-surgical planning and for guiding or performing surgical interventions.

Keywords: DNA, MRI, Registration, CT, Calibration.

I. INTRODUCTION

Computer assisted surgery (CAS) represents a surgical concept and set of methods, that use computer technology, for pre-surgical planning and for guiding or performing surgical interventions [1]. The most important component for CAS is the creation of a virtual and accurate model of the patient (figure 1). This can be conducted using a number of medical imaging technologies including CT, MRI, X-Rays, Ultrasound, etc.

This imaging data can be acquired before the surgery (Pre-Operative imaging data) or during the surgery (Per-Operative imaging data) using the new intraoperative OR solution (figure 1). For the generation of the three dimensional model of the patient, the anatomical region to be operated has to be scanned and uploaded into the computer system. It is possible to employ a number of scanning methods, with the datasets combined through Data fusion techniques. The final objective is the creation of a 3D dataset that reproduces the exact geometrical situation of the normal and pathological tissues and structures of the region [2].

II. METHODOLOGY

Image analysis and processing, Image analysis involves the manipulation of the patient's 3D model to extract relevant information from the data. Using the differing contrast levels of the different tissues within the imagery,

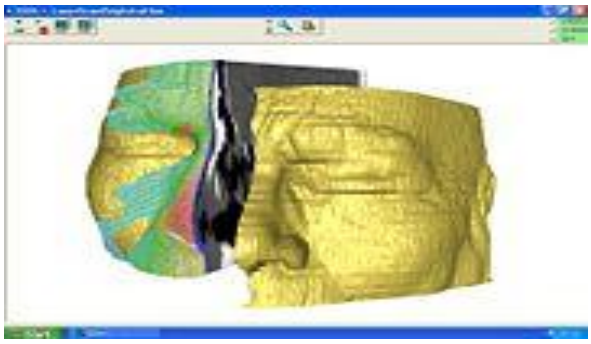

Figure1: Creation of a 3D virtual model of the patient

as examples, a model can be changed to show just hard structures such as bone, or view the flow of arteries and veins through the brain. Diagnostic, preoperative planning, surgical simulation, using specialized software, the gathered dataset can be rendered as a virtual 3D model of the patient; this model can be easily manipulated to provide views from any angle and at any depth within the volume. Thus the surgeon can better assess the case and establish a more accurate diagnostic [3]. Furthermore, the surgical intervention will be planned and simulated virtually, before actual surgery takes place (figure2).

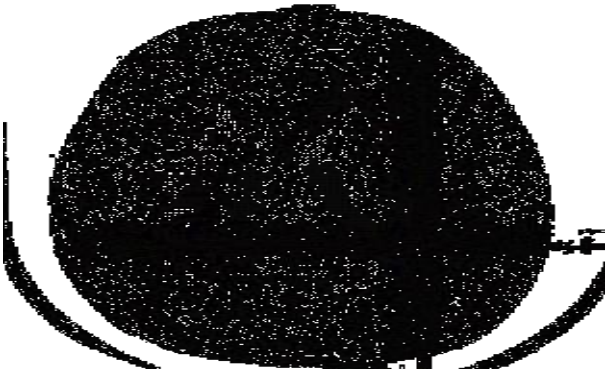

Figure2: Fusion of Anatomical MR and CT images

III. APPLICATIONS

There are many application of computer assisted surgery.

- Computer assisted neurosurgery.
- Computer assisted oral and maxillofacial surgery.
- Computer assisted ENT surgery.
- Computer assisted orthopaedics surgery.
- Computer assisted visceral surgery.
- Computer assisted radiosurgery

IV. ADVANTAGES OF COMPUTER ASSISTED SURGERY

CAS starts with the premise of a much better visualization of the operative field, thus allowing a more accurate preoperative diagnostic and a well-defined surgical planning, by using surgical planning in a preoperative virtual environment [5]. This way, the surgeon can easily assess most of the surgical difficulties and risks and have a clear idea about how to optimize the surgical approach and decrease surgical morbidity.

During the operation, the computer guidance improves the geometrical accuracy of the surgical gestures and also reduces the redundancy of the surgeon's acts. This significantly improves agronomy in the operating theatre, decreases the risk of surgical errors and reduces the operating time [8].

DOI 10.17148/IJARCCE.2015.41209

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

V. NEURONAVIGATION

The word “Neuronavigation” describe the set of computer-assisted technologies used in neurosurgery to guide or "navigate” within the confines of the skull or vertebral column during surgery.

Neuronavigation and integrated OR solution, neuro-imaging technologies such as computed tomography (CT) and magnetic resonance imaging (MRI)—along with the ever-increasing capabilities of digitalization, computer-graphic modelling and accelerated manipulation of data through complex mathematical algorithms via robust computer technologies made possible the real-time quantitative spatial fusion of images of the patient's brain with the created “fiducial coordinate system” for the purpose of guiding the surgeon's instrument or probe to a selected target [7]. In this way the observations done via highly sophisticated neuro-imaging technologies (CT, MRI, angiography) are related to the actual patient during surgery. The ability to relate the position of a real surgical instrument in the surgeon’s hand or the microscope’s focal point to the location of the imaged pathology, updated in “real time” in an "integrated operating room", highlights the modern version of this set of technologies at its finest. In its current form, neuronavigation began in the 1990's and has adapted to new neuro-imaging technologies, real-time imaging capabilities, new technologies to transfer the information in the operating room for 3-D localization, real-time neuro-monitoring, robotics, and new and better algorithms to handle data via more sophisticated computer technology [3].

In its later conceptualization the term neuronavigation has started to fuse with that of “surgical-virtualization”, in which a neurosurgeon is able to visualize the scenario for surgery in a 3-D model of manipulate computer data. In this way the physician can "practice and check" the surgery, try alternative approaches, assesses possible difficulties, etc., before the real surgery takes place.

VI. REGISTRATION

Image Registration, Registration process is the determination of a geometrical transformation that aligns points in one view of an object with corresponding points in another view of that object or another object”.

Registration Process, The registration process can be subdivided in two parts as shown by the following flow chart (figure 3).

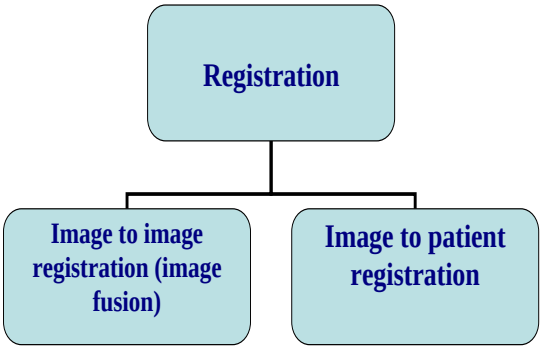

Figure 3: Types of Registration

Image to image registration (image fusion), Image Fusion is the process of combining relevant complementary information from two or more images into a single image. The resulting image will be more informative than any of the input images.

These fusion can include magnetic resonance image (MRI), computed tomography (CT), and positron emission tomography (PET). In radiology and radiation oncology, these images serve different purposes. For example, CT images are used more often to ascertain differences in tissue density while MRI images are typically used to diagnose brain tumours.

Registration is necessary in order to be able to compare or integrate the data obtained from different measurements. the generation of the three dimensional model of the patient, the anatomical region to be operated has to be scanned and uploaded into the computer system. It is possible to employ a number of scanning methods. the term neuronavigation has started to fuse with that of “surgical-virtualization”, in which a neurosurgeon is able to visualize the scenario for surgery in a 3-D model of manipulate computer data (figure 4).

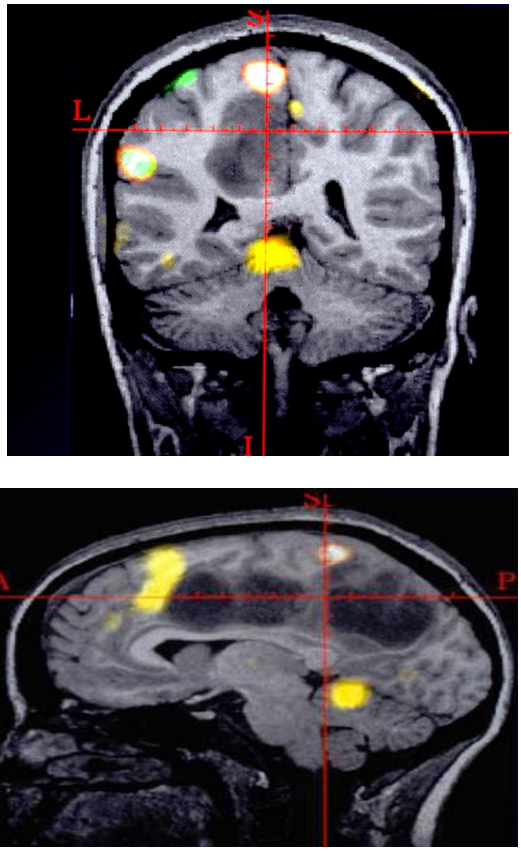

Figure 4: Fusion of Anatomical and functional images

VII. RESULT

Image to patient registration, Image to patient registration is the concept and set of methods needed to correlate the reference position of a virtual 3D dataset gathered by computer medical imaging with the reference position of the patient. The image to patient registration can be based on:

DOI 10.17148/IJARCCE.2015.41209

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

- Anatomical based registration
- Fiducial based registration
- Surface based registration
- Automatic based registration

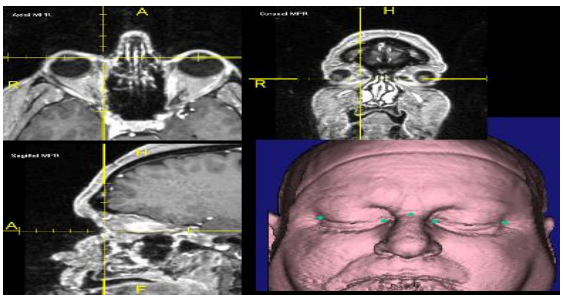

Figure 5: Anatomical registration (image space)

Pre-calibration tools, there are tools which must be used pre surgical such as: probe, z-touch. Those are used to determine the exact position of the pathological tissue. Instrument usually that can be used during surgery such as: suction, bipolar or even an endoscope [6].

Reference array cone consist of, reference spheres and Special scale to the system.

Operational method, Held z-touch which is active marker on the patient head and it emitter IR and press ON switch and by moving the ray around the easy forehead, nose and repeat it in the same regions then , the patient head forms will appear on the screen and after that the patient identified (figure 5) . After choosing the proper site of surgery, the surgical tools such as section, knife or ablator, can be calibrated allowing them to be tracked by the navigation system [9].

Pre calibrated pointing devices are used to determine the 3D position of points where it is impractical to place a marker. The camera receives the infrared light from the devices and measures the angle of incidence of the light rays to determine the position of the device in space. There are several sizes of clamp and star reference depending on size of tools (figure 6).

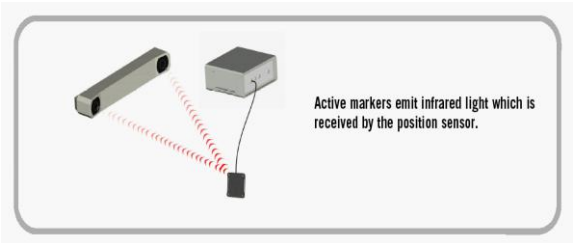

Figure 6: Pre calibrated pointing devices

VIII. CONCLUSION

Registration and calibration are of paramount important in Neuronavigation. The registration can be subdivided in two parts. First: image to image registration also called image fusion where to or more state of imaging data are correlated in the same reference frame. This image can be anatomical of functional. This fused imaging data is used to create a model of the patient allowing to plan. Second image to patient registration here the imaging of the patient along with the pre-surgical planning are correlated with real patient on the OR table using special technique as mentioned in the text above. Also it is possible to calibrate any surgical instrument to be treated by the navigation system. Bipolar suction endoscope will help the surge to localize this instrument while using them. This increase the safety of the surgery since the surgeon can know precise position of the tip of the instrument displayed on the navigation system.

ACKNOWLEDGMENT

I would like to knowledge Prof. **Prabir Patra** Head of Department of Biomedical Engineering, for the support.

REFERENCES

[1] Gaytmenn R, Sweet D. Quantification of forensic DNA from various regions of human teeth. J Forensic Sci 2003;48(3):622-5..
[2] Sweet D, Lorente JA, Valenzuela A, Lorente M, Villanueva E. PCRbased DNA typing of saliva stains recovered from human skin. J Forensic Sci 1997;42(3):447-51
[3] Farooji, N. R., Vatani, A., & Mokhtari, S. (2010). Kinetic Simulation of oxidative coupling of methane over perovskite catalyst by genetic algorithm: Mechanistic aspects. Journal of Natural Gas Chemistry, 19(4), 385-392. doi: 10.1016/s1003-9953(09)60084-0.
[4] Sivagami AV, Rao AR, Varshney U. A simple and cost-effective method for preparing DNA from the hard tooth tissue, and its use in polymerase chain reaction amplification of amelogenin gene segment for sex determination in an Indian population. Forensic Sci In 2000;110(2):107-15.
[5] Dimo-Simonin N, Grange F, Brandt-Casadevall C. PCR-based forensic testing of DNA from stained cytological smears. J Forensic Sci 1997;42(3):506-9
[6] Lijnen I, Willems G. DNA research in forensic dentistry. Methods Find Exp Clin Pharmacol 2001;23(9):511-7.
[7] Kamali Shahri M, Alavi M. Investigation of Kinetic Model of Oxidative Coupling of Methane over Mn/Na2O3/SiO Catalyst, [M.Sc. thesis], Iran University of Science & Technology, 2007.
[8] Tesini DA, Harte DB, Crowley K. Dentistry's role in identification of missing and unknown children: update on the dental bite impression technique. J Mass Dent Soc 1999;48(2):29- 34, 50
[8] Kiatkittipong W, Tagawa T, Goto S, Assabumrungrat S, Silpasup K, Praserthdam P. Chem Eng J, 2005, 115(1-2): 63.
[9] Johansen RJ, Bowers CM. Digital analysis of bite mark evidence using Adobe Photoshop. Forensic Imaging Services: Santa Barbara, Calif.; 2000.