Computer assisted detection of liver neoplasm's and its 3D volumetric measurement

THE UNIVERSITY OF TEXAS

MD Anderson Cancer Center

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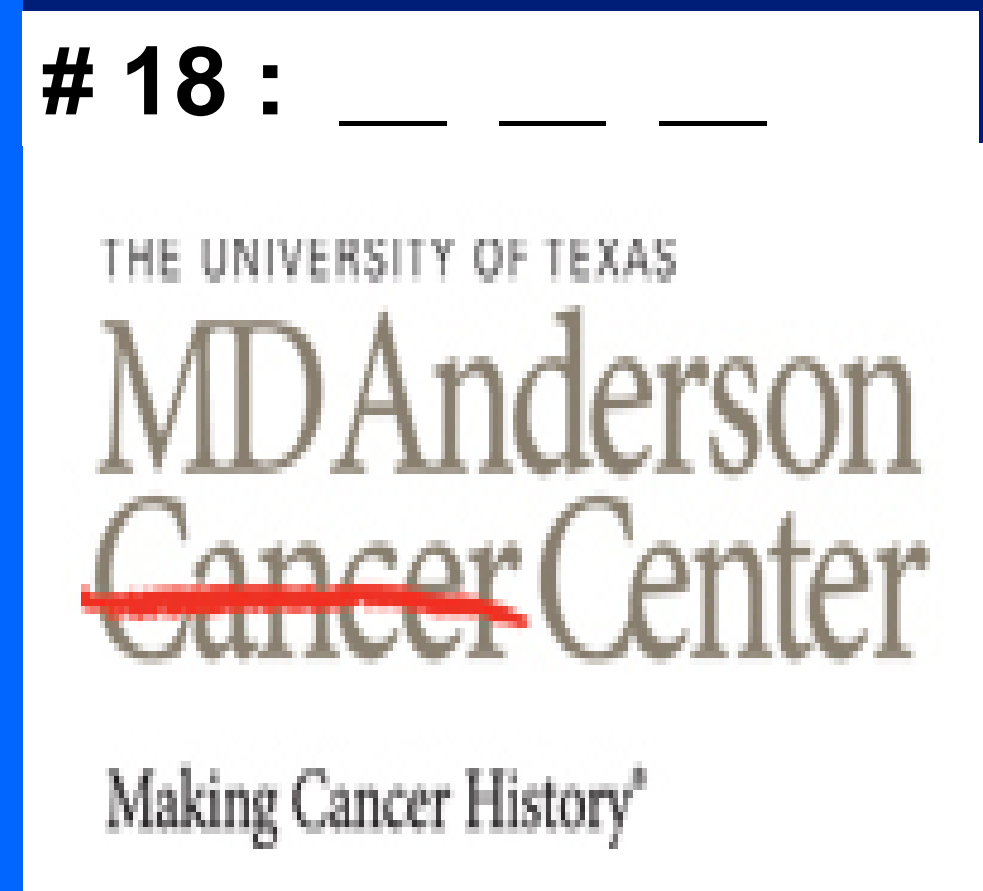
♦ Abstract

Imaging is currently performed in oncologic patients for staging. Images are evaluated by radiologist and lesions with the liver are detected manually. Currently there is no software available which is able to detect and measure tumor volumes automatically. We are developing a software that may be able to detect tumor and give volumetric measurements automatically. Using this software a radiologist may be able to compare computer generated volumetric data in serial imaging of the patients over time, which may help in assessing progression or regression of disease and help in treatment planning.

♦ Introduction

The scanning technologies that exist today generates about images ranging from 400 to 1500 per patient. It is cumbersome and time consuming for a radiologist to study each and every image and read it . There is a need of revolution to be carried out in the image processing segment to help radiologist come up to a decision much faster than what they can do it today. By using some image processing algorithms we can try to make this process faster for them. By use of image processing algorithms we will not only develop 3D view of the organ but also we will develop and generate 3D view of tumor and prepare volumetric data of the tumor.

Apart from that we will develop case comparative study of the patient so radiologist can compare two image sets of the same patients over time.

In this case comparative study we should be able to compare two sets of data of the same patient, and be able to asses change in tumor size and volume which may help in appropriate treatment planning of the patient.

♦ History

There are many existing software's that are currently used by radiologist there is a software called terarecon which provides 3D view of the organ there is also a software called CAD computer aided detection which automatically detects tumor in an image but still has its weakness, it is not 100% accurate on whether the image has tumor or not since it does not automatically measure the tumor or asses the tumor volume.


Image with Tumor
(Segmentation of 2 Dark tumors)

Image without Tumor
(False representation of tumor)

♦ System Design

The System will be developed in following processing
1. Smoothing :- The S/W process the images and remove all the noise associated with the images during the scanning and internal movements of the organs.
2. Registration:-We will find the density (hounsfield) of objects in the image and compare it with the look up table created in the image
3. Segmentation:- We will segment the tumor from the image after all the subparts of the liver are segmented from the liver image by looking into the lookup table.
4. 3D View:- We will create the 3D view of the tumor from the axial view of the tumor and stacking these images.
5. Volumetric Data:- The volumetric data about the tumor. Like its surface area and the volume of the tumor.
This is all that is planned for tumors that are visible to naked eye. There is a research that has to be carried out and in order to find how we can find tumors in an image at a very early stage. When it is in size not visible to naked eye

♦ Challenge

There are number of challenges involved in designing this system. Since we are looking at a set of 400-1500 images we should be able to build a 3D view from the axial view using 12-15 images from the whole set that to those have to be selected by the system. The next challenge is to segment the tumor from the image and generate a 3D view of the tumor.
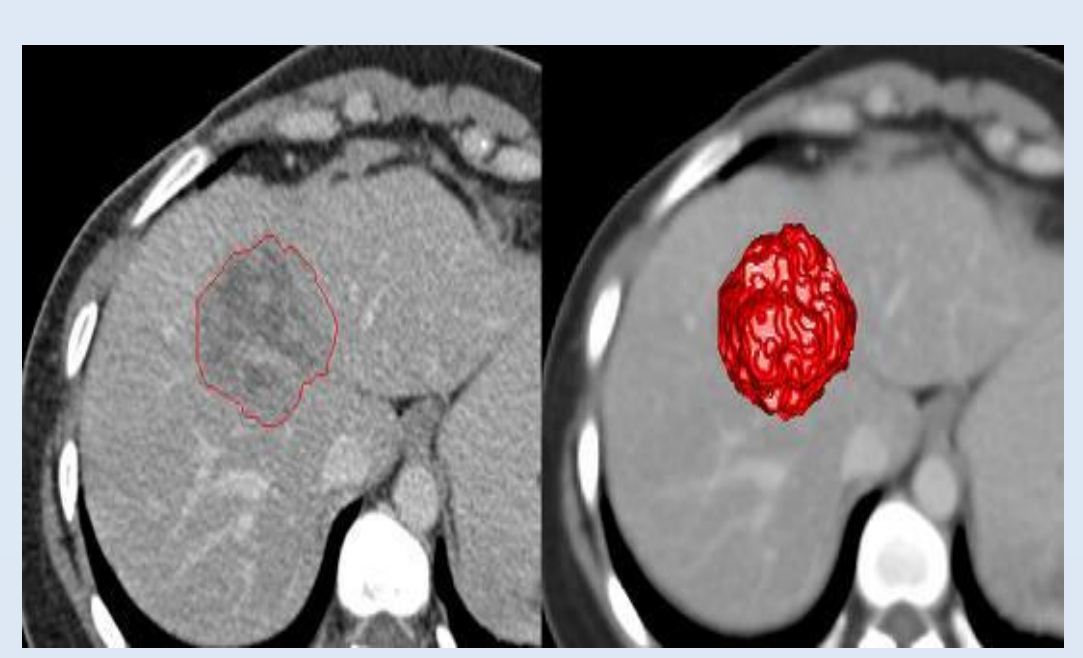

♦ Methods & Parameters

Image Smoothing :- we are planning to implement Perona and Malik equation and by adding the adaptive edge prevention technique. This work will be reviewed and depending on the results the smoothing technique will be finalized.
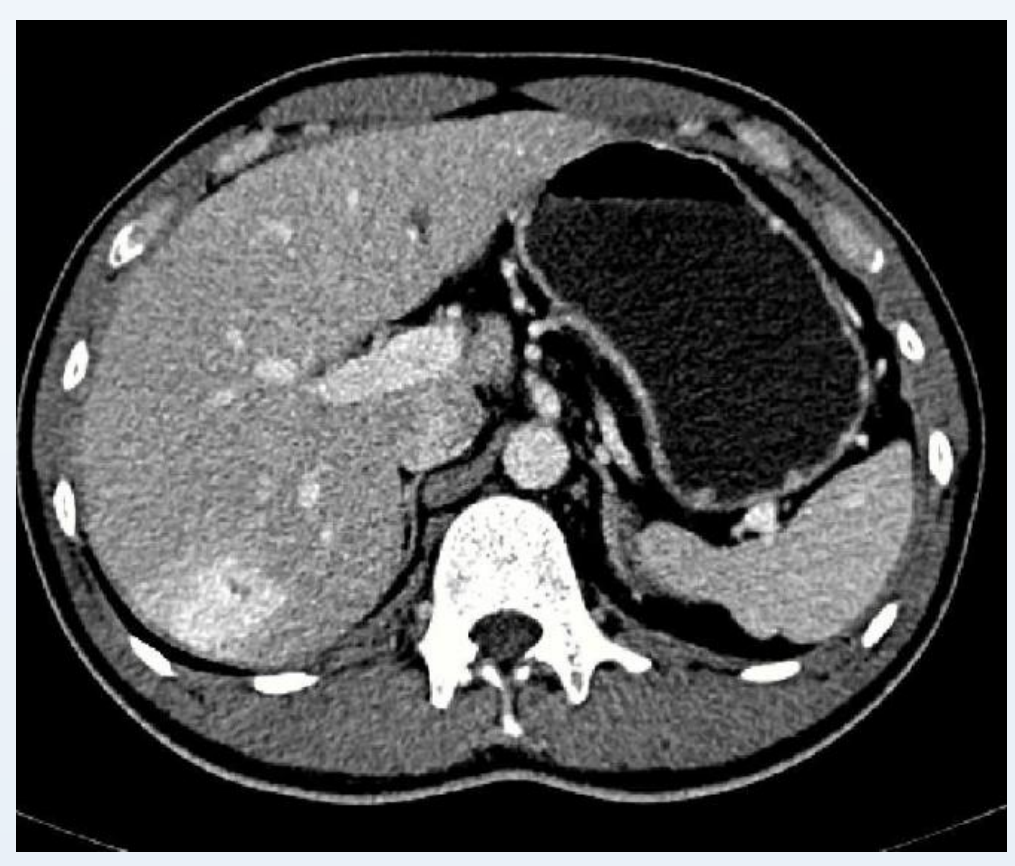
We trying to find the density of objects in hounsfield in the image so that we can find the different subpart in the liver like liver (110 HU), spleen (110 HU), pancreas (95 HU), aorta (150 HU), gastric lumen (350 HU), gastric wall (40 HU), abdominal musculature (65 HU), intraabdominal and body wall fat (−100 HU), inferior thoracic ribs (260 HU), and proximal lumbar vertebral bodies (cortical bone, 685 HU; cancellous bone, 235 HU). From the above we create a table in the Microsoft excel then the density of organs in compared with those in the image and then tumor is segmented from the image. Once set a 12-15 such tumor images is created then these tumor images are stacked at Z axis to create a 3D view of the tumor.

Separated Tumor from above image
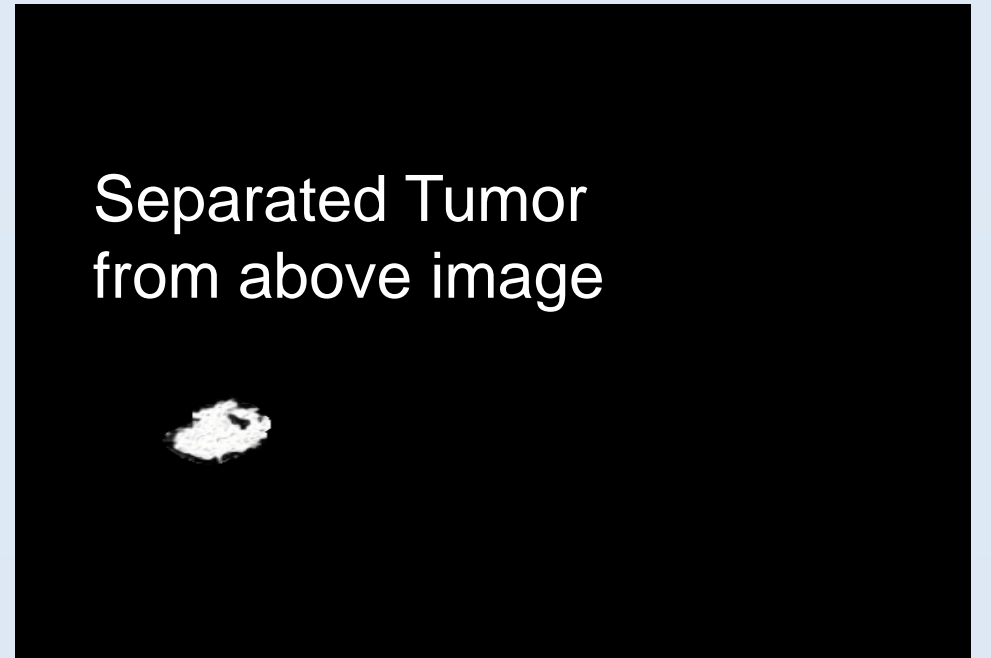
♦ Radiological Aspect

Ability to automatically measure the tumor will make it much easier to scan through the images. Automatic tumor volumetric measurement will further enhance the capability to asses tumor response and may bring changes to current RECIST criteria.

Image with Hypodense Tumor

♦ Conclusion

The system will help the radiologist in finding and detecting and measuring tumor. Apart from this the software will provide volumetric data of the tumor thus helping in treatment planning. The software will help save plenty of time for the radiologist, in this era of image based healthcare. 3D view provides an appropriate insight needed for surgical planning. Case comparative study enables radiologist to monitor the tumor in the easiest way possible.

♦ References

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Automated Retrieval of CT Images of Liver Lesions on the Basis of Image Similarity
Sandy A. Napel , PhD Christopher F. Beaulieu , PhD , MD, Cesar Rodriguez , MD, Jingyu Cui , MS, Jiajing Xu , MS, Ankit Gupta , BS, Daniel Korenblum , MS, Hayit Greenspan , PhD, Yongjun Ma , PhD, Daniel L. Rubin , MD , MS

Image Analysis for Liver Tumor Ablation Treatment Planning
Yrjo Hame, Tuomas Alhonnoro and Mika Pollari

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