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An Approach for the Extraction of Lungs using Border Repair

Sasidhar B.
Professor,Dept. of CSE, School of Engineering,
Nalla Narasimha Reddy Group of Institutions, Hyderabad

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Abstract:
Extraction of lung regions reduces time taken for the recognition of carcinoma in lungs. The previous methods were not able to segment lungs with juxta pleural nodules. In this paper, border repair is used to extract lungs with juxta pleural nodules based on region growing, convex hull, XOR operations and morphological operations. The border repair algorithm is evaluated on 50 images and 98.2% of average overlap measure (AΩ) is calculated.

Keywords: *Border Repair, Lung Regions, Morphological Operations, Threshold, Region Growing, Convex Hull.*

I. INTRODUCTION

Early identification and diagnosis of lung carcinoma is a challenging task. Extraction of lungs is an essential preprocessing step in identification of lung cancer with less time. The challenging task is to extract lungs with tumors which are connected to the border of the lungs. Figure 1 depicts the tumors connected to the pleura of lungs.

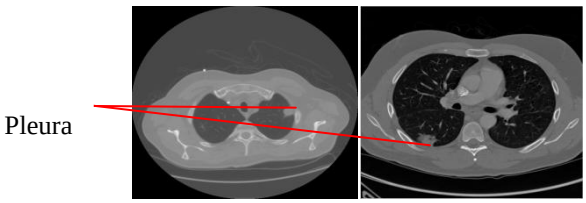

Figure 1: Lung Nodules at pleura

The existing algorithms [4],[15] unable to extract the lungs with tumors connected to the lung walls. In this paper, border repair is used to extract lungs with juxta pleural nodules with the help of region growing, convex hull, XOR operations and morphological operations. To segment the lungs attenuation values for different substance (tissue) is required. The attenuation values of different tissues measured in HU are discussed in [6].The remaining content of the work is Literature Survey, Proposed Methodology, Results and Conclusion.

II. LITERATURE SURVEY

have applied adaptive thresholding method to segment lung regions. However the method fails to extract the lungs with juxta pleural nodules. applied SNAKE model to extract lungs but the drawback is manual interaction for the contour. Active Contour Model (SNAKE) moves in a smooth continuous manner towards the desired object boundary and to segment object borders. have suggested region growing to extract lungs. have extracted lungs with the help of threshold and labelling.have proposed Genetic Algorithm(GA) and morphological operations to segment lung regions and the proposed method is completely an automated approach.have taken out the lungs with juxta pleural nodules using active contour.used morphological processing to extract lung regions. used morphological closing operations to extract the lung regions.used thresholding and morphological operators to extract the lungs in the CT scan images. used morphological operations to extract the lungs.The AΩ of the existing approaches for the segmentation of lungs needs to improve.

III. PROPOSED METHODOLOGY

The proposed algorithm uses border repair which includes Convex Hull, Morphological Operations and XOR operations to get the lungs with nodules at the borders of lungs. The steps involved in extraction of lung regions are :threshold technique [6] is used to get

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different components of the image and then compute the centroid c(x1,y1) for the image. Compute mid-point m1(x2,y2) from border of left lung to centroid c(x1,y1) and compute another mid-point m2(x3,y3) from border of right lung to centroid c(x1,y1). Region Growing [14] is applied twice with two seed points i.e. m1(x1,y1) and m2(x2,y2) to get lung regions without lung tumors at the borders of the lungs. To get lungs with nodules at the borders of the lungs, Convex Hull, XOR operation and morphological operations are performed to get the mask. Overlap the lung mask with the input DICOM image to extract regions of lung

Algorithm:

Psudo code for extraction of lungs using border repair with Region Growing , Convex Hull, XOR Operations and Morphological Operations

Input: DICOM CT Image
Output: Lung Regions
Begin
Step 1. Extract different components of the CT image using HU range of lungs.
Step 2. Compute the centroid c(x1,y1) of image.
Step 3. Compute the mid points m1(x2,y2) from c(x1,y1) to the edge point of the left lung.
Step 4. Compute the mid points m2(x3,y3) from c(x1,y1) to the border point of the right lung.
Step 5. Extract left lung using the region growing algorithm[14] with the seed point as m1(x2,y2)
Step 6. Extract right lung using region growing algorithm[14] with the seed point as m2(x3,y3).
Step 7. Merge left and right lungs to get lung mask.
Step8. Apply convex hull, XOR and morphological operations to extract the mask forthe lungs with the tumors at the border of the lungs.
Step 9.The mask is superimposed with the input image to get the lungs.
End

IV. RESULTS

The proposed method takes 10 patients datasets with 50 images as an input and Overlap measure (Ω) [10] is used to evaluate proposed method.

The average overlap (AΩ) measure in % can be calculated by using (1)

$$A\Omega = \frac{(\Omega 1 + \Omega 2 + \Omega 3 + \Omega 4 + \cdots + \Omega n)}{n} \qquad (1)$$

Where Ω_i(Overlap Measure), i=1 to n and n is sum of images.In Figure 2 DICOM image, removal of lungs using [4], [15] and proposed approach overlap measure is shown.In Figure 3 shows comparison of all methods . At x-axis, number of masks and at y-axis, overlap measure is depicted in Figure. 3.

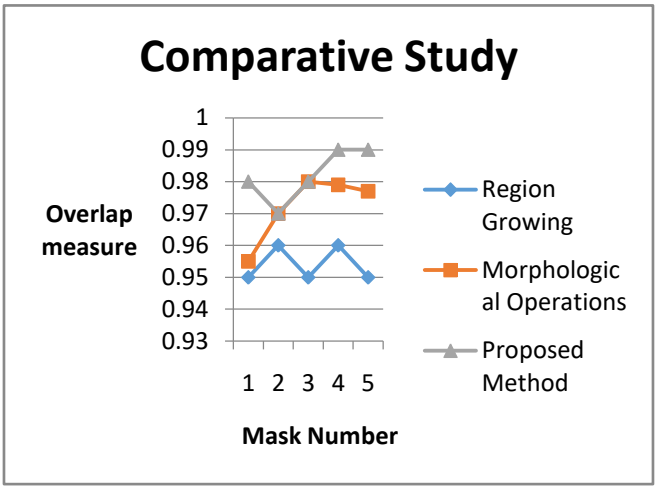

Figure 3: Graph shows the comparison among existing methods[4],[15] and proposed method

In table II, AΩ of proposed system, existing algorithms [4],[15] are calculated.

TABLEII AVERAGE OVERLAP MEASURE(AΩ)

AΩ Region-Growing[4]	AΩ Morphological Operators[15]	AΩ Proposed System
95.4	97.2	98.2

V. CONCLUSION

Morphological Operations, region growing method could not extract lungs with juxta pleural nodules. The proposed method extracts lungs with juxta pleural nodules. The proposed method shows the average accuracy as 98.2 % which is better than existing algorithms.

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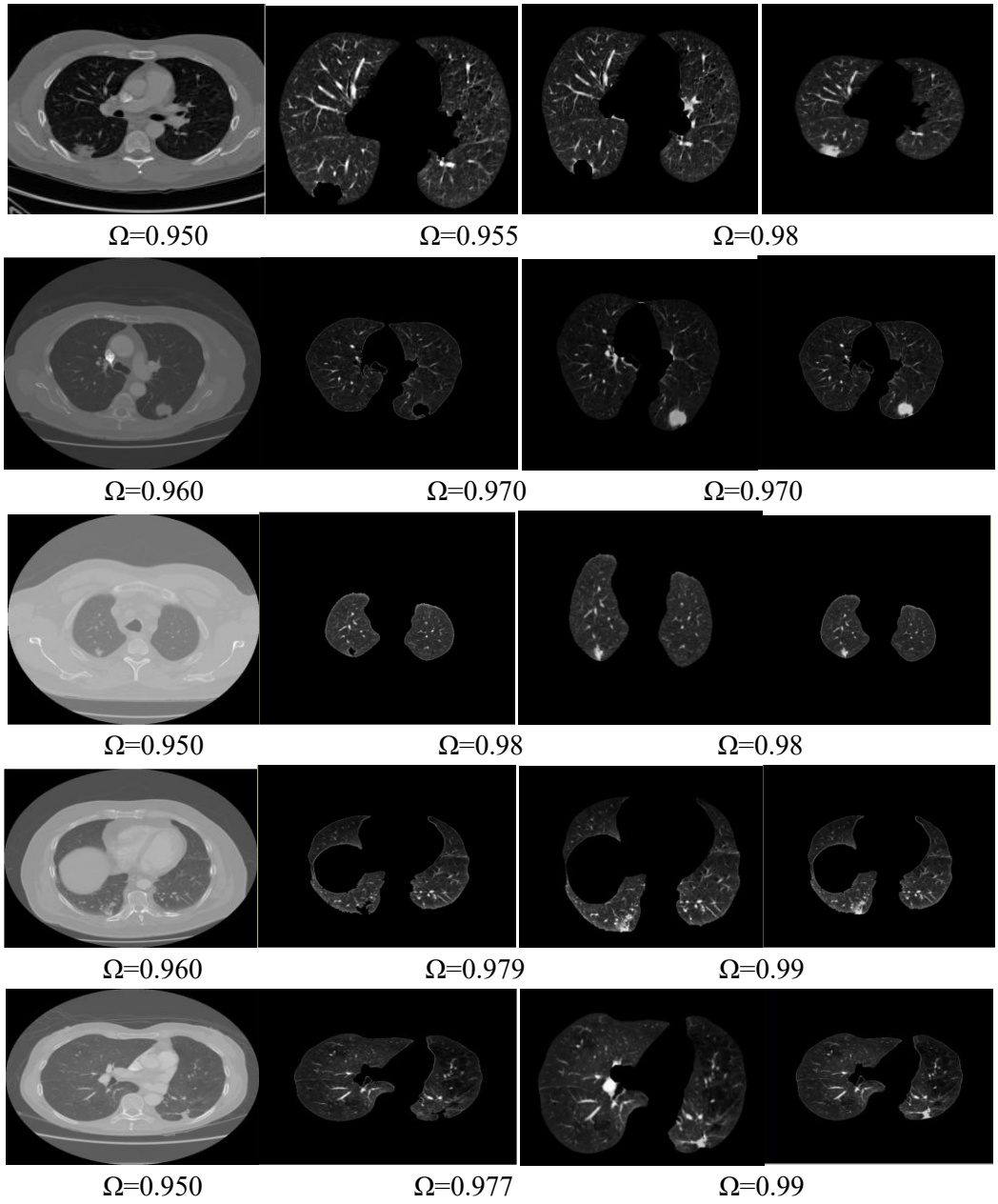

Figure 2: (a) Input Image (b) Extraction of lungs using Region-Growing[4] with Ω (c) Extraction of lungs using Morphological Operations[15] with Ω (d) Proposed Method for the extraction of lungs with Ω

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