



IMPROVED AND RELIABLE B-LINES DETECTION IN LUNG ULTRA SOUND IMAGES

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ABSTARCT: The main objective of this concept is accurate detection and visualization of B-lines in ultrasound lung images. Patterns of disease distribution within the secondary lobule have been well established pathologically. Identifying normal and abnormal components of the lobule is therefore a potential aid in distinguishing different parenchymal diseases. More cost for CT , MRI scanned images and results should know to higher official doctorates with large amount of money. This designed feature is able to differentiate between the healthy and unhealthy classes based on B-lines in ultrasound lung images. B-lines are important ultrasound artifacts used in LUS for detection of pulmonary disease. Further As an extension of this concept Morphological Top-hat as well bottom hat transformation is applied to improve image efficiency. This efficiency is yielded in the form of Peak signal to Noise ratio.

KEYWORDS: Lung Images, Ultra sound, B-lines, Secondary Pulmonary Lobule, bronchiolo vascular.

INTRODUCTION: Lung ultrasound (LUS) has received increasing attention in recent years, as it enables a quick visual evaluation of the lung tissue and pleura without imposing radiation [1]. B-lines are important ultrasound artifacts used in LUS for detection of pulmonary disease. They are defined as discrete laser-like vertical hyperechoic reverberation artifacts that arise from the pleura, spread down without fading to the edge of the screen, and move synchronously with lung sliding. In years gone by examination of patients with pulmonary disorders rested essentially on a clinician's bedside physical examination, of auscultation and percussion, complimented with blood gas analysis and X-ray imaging. Lung ultrasound has emerged into this context as a real-time bedside procedure, delivering information relevant to the clinician's differential diagnosis. A large part of sonographic lung examination involves the interpretation of artefacts, thus knowledge of the origin of typical artefacts is important. Although indirect sonographic signs, nonetheless reliable conclusions on the condition of the lung can be inferred. Particularly the of quantity and distribution of B-lines can establish important assessment of the cause and degree of fluid load within the

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interstitium. All focused ultrasound investigations, including bedside lung ultrasound, allow symptom evaluation considering multiple organ-systems yet with minimal time delay. Such integration of imaging with clinical assessment and treatment is called Point-of-Care Ultrasound (POCUS) and should be understood as an extension of the physical examination. POCUS offers a unique but crucial role, integrating clinical and other imaging findings, including cardiac ultrasound (echocardiography), chest radiography, and computed tomography (CT) scans is crucial, which alone may lack the required accuracy. The emergence of differences in approach to lung sonography, technique and nomenclature, provided the incentive for a consensus process examining six major areas; terminology, technology, technique, clinical outcomes, cost effectiveness and future research. A scientific pathway process was followed, to generate evidencebased guidelines with recommendations for clinical lung ultrasound applications [1]. B-line artefacts and their use have been recently described in detail [2]. The use of thoracic ultrasound in the evaluation of thoracic diseases [1-5] is a recent application and the use of ultrasound for an indication of underlying parenchymal lung disease is even more recent [6-9]. When particular lung pathologies are present, ultrasound imaging shows image artefacts, i.e. echographic signs, the interpretation of which is very helpful when dealing with such pathologies. However, the genesis of such signs has not yet been understood and a standard ultrasound imaging technique can only report their presence. Despite extensive acoustic characterization studies [10-15] a lot is still unknown about the way US interacts with lung tissue. Some common ultrasound artefacts are well-known to the physician [16, 17] while others are less known, but the physicians are aware of the fact that there can be significant discrepancies between the ultrasound images and the anatomy of the examined medium. In the case of the lung, basically all that we see beyond the pleura plane represents artefactual information since the pleura plane reflects most of the energy of the ultrasound pulse because of the high mismatch between the acoustic impedances of air and intercostal tissues. Fluid balance is an integral component of hemodialysis treatments to prevent under- or overhydration, both of which have been demonstrated to have significant effects on intradialytic morbidity and long-term cardiovascular complications. In recent years, the use of lung ultrasonography to detect extravascular lung water has received growing attention in clinical research in adult patients with heart failure, intensive care and chronic kidney disease undergoing hemodialysis (HD) and peritoneal dialysis (PD). Recent studies have shown the benefit of lung ultrasound in fluid assessment for children on dialysis [1, 2]. A key challenge in the detection of B-lines is operator dependency. Identifying and counting B-lines by eye are variable and open to error between different ultrasound operators. During acquisition of lung ultrasonography, the difference in acoustic impedance between the lung and the surrounding tissues will be increased when lung density increases due to extravascular fluid. This results in some vertical narrow based lines arising from the pleural line to the edge of the ultrasound screen, known as B-lines. The presence of a few scattered Bline comets can be a normal variant, as found in healthy subjects, whilst multiple B-lines are considered the sonographic

sign of lung interstitial syndrome [3]. Currently, the observation of B-lines in the lung ultrasonography is solely done by experts. However, to deal with the large data and to further analyse or use for detecting the early stage of some disease conditions, an automatic B-line detection is required.

LITERATURE SURVEY: In 1997, Lichtenstein [10] showed a correlation between B-lines in ultrasound, and chest computed tomography (CT) with edema. Even though LUS already had been used for evaluation of pleural effusion, it was the first time that the diagnostic value of B-line artifacts was shown. In 2004, Picano [11] showed the correlation between the number of B-lines detected by LUS and X-ray findings for assessing the presence of extra-vascular lung water (EVLW). Since then, multiple studies have shown the methodological validation and clinical application of B-lines for diagnosing pulmonary diseases. The common practice for diagnosing pulmonary edema with ultrasound is based on visual analysis and interpretation of B-lines [4], [5], [6], [12]. Several B-lines distributed bilaterally in more scans on each lung defines diffuse alveolar-interstitial syndrome (caused by hydrostatic pulmonary edema, lesional pulmonary edema or fibrosis) [5]. The standard pathological routine for diagnosing this disease is to investigate the number of B-lines in a single scan or frame. A study performed by intensivists showed that the mean distance between two adjacent B-lines at the lung surface is never more than 7 mm, and this should be the widest distance between B-lines to be significant [3]. Another study used the criteria of counting at least three artifacts with a distance between adjacent lines of no more than 7 mm for identifying edema [13]. On the other hand, visualization of isolated B-lines, or visualization of multiple B-lines of more than 7 mm apart in a single scan, was considered a normal finding [13]. Major factors affecting the accuracy of the examination are interpretation error due to inexperience and habituation. Computer-assisted interpretation can potentially address the issue of these errors, and facilitate the adoption by users. This phenomenon creates some vertical reverberation artefacts known as B-lines [7]. Similarly appearing artefacts that should not be confused with B-lines are Z-lines. They are short, broad, ill defined, vertical comet tail artefacts arising from the pleural line but not reaching the distal edge of the screen. They are less echogenic than the pleural line and do not erase A-lines. The A-lines are repetitive horizontal echoic lines with equidistant intervals, which are also equal to the distance between skin and pleural line. Two automatic B-line detection techniques have been proposed in the literature. The first method was proposed by Brattain et al. [4] using angular features and thresholding (AFT). Five features are employed and the B-line is detected in a particular image column if each feature exceeds a predefined threshold. This method

is not robust to the different machine settings, as noise and intensity of the images can be significantly different thereby requiring different values of the threshold. The second method was proposed by Moshavegh et al. [5] using alternate sequential filtering (ASF). Firstly, the method detects the pleural line using a random walk technique. The binary mask for the area underneath the pleural line is then generated from the absolute values of the Hilbert transform of the axial gradient components. A repeated sequential morphological opening and closing approach is applied to the mask until possible B-lines are separated. The drawback of this method is that the results always overestimate the number of B-lines because the Z-lines are not discarded. A semi-automatic approach was proposed by Weitzel et al. [8].

PROPOSED TECHNIQUE:

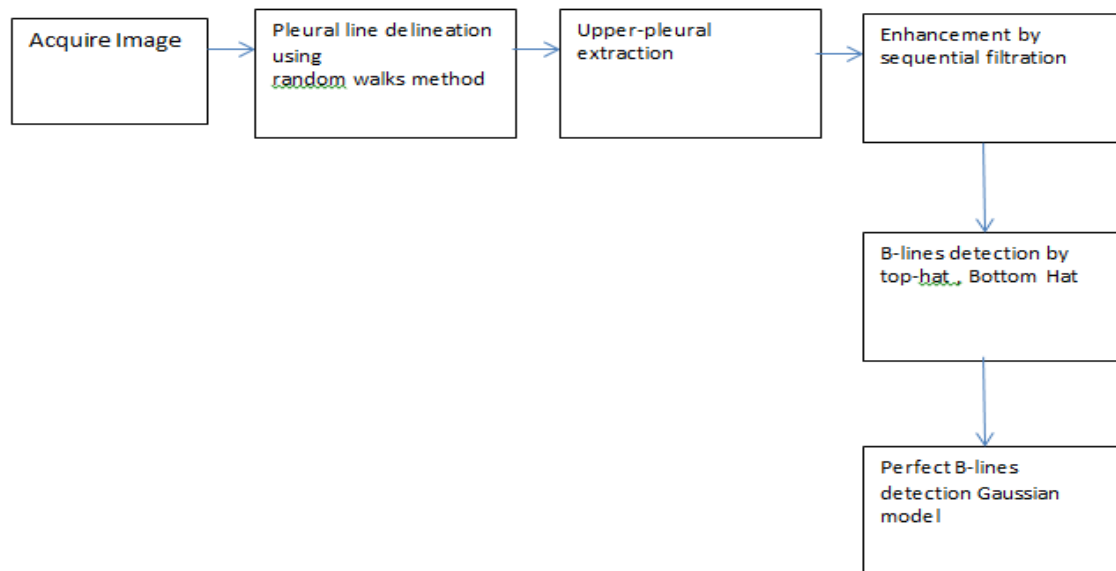


Fig1: Proposed block diagram

The purpose of the algorithm is two folded, first to automatically detect the B-lines, and second to characterize the distribution of B-lines to discriminate between healthy volunteers and patients with pulmonary edema. The proposed method contains five distinct steps. First, the pleural line is delineated using a random walks method [21]. Second, the upper-pleural region is excluded from the scan, and the B-line artifacts are identified on the scan plane. Third, an alternate sequential filtration is applied to the results of step 2 to better highlight the B-lines. Fourth, the result of step 3 is top-hat filtered to make sure that B-

lines are laterally detached. Finally, a Gaussian model is fitted to each detected B-line, and the peak point of the fitted Gaussian models corresponding to the B-lines are calculated and used to determine the position of B-lines. B-lines are then overlaid on the B-mode image. The first essential step in detection of B-lines is to delineate the pleural line on the lung scans. For this purpose, a graphbased approach that computes a per-pixel uncertainty map based on the information depicted by an ultrasound image was used . This method measures the uncertainty in attenuated and/or shadow regions, and generates a normalized gray scale map that can be used for delineation of different structures in ultrasound images. To identify the map for each ultrasound frame, a random walks framework was used that takes into account ultrasound specific constraints .

GAUSSIAN MODEL FITTING

Gaussian functions are suitable for describing many processes in mathematics, science, and engineering, making them very useful in the fields of signal and image processing. For example, the random noise in a signal, induced by complicated physical factors, can be simply modeled with the Gaussian distribution according to the central limit theorem from the probability theory. Another typical example in image processing is the Airy disk resulting from the diffraction of a limited circular aperture as the point-spread function of an imaging system. Usually an Airy disk is approximately represented by a two-dimensional Gaussian function. As such, fitting Gaussian functions to experimental data is very important in many signal processing disciplines. This article proposes a simple and improved algorithm for estimating the parameters of a Gaussian function fitted to observed data points.

MORPHOLOGICAL TOPHAT:

Usually, opening and closing operations are used in morphological filters to smooth the image. Opening an image will smooth the contours, eliminate small islands and sharp peaks or capes, while closing an image will smooth the contours, eliminates small holes and fills gaps on the contour.

The selection of proper morphological filter depends on the prior knowledge of target's shape, size and direction. Opening and closing operations with SE will eliminate the structures unmatched with SE in image. These structures can be restored through difference operation between original image and its opening or closing results. Based on the difference operation, morphological transformations called WTH (white Top-Hat) and BTH (black Top-Hat) are proposed.

The WTH transformation obtains all bright features and sub graphs that are unable to accommodate SE:

$$g^w(f) = f - \gamma_B(f)$$

BTH is the dual operation of WTH, which sieves out the dark features and sub-graphs smaller than SE:

$$\begin{aligned}
& [g^b(f^c)]^c \\
&= t_{max} - g^o(t_{max} - f) \\
&= t_{max} - t_{max} + f + \gamma_B(t_{max} - f) \\
&= t_{max} + f - \phi_B(f)
\end{aligned}$$

In practice, the BTH transform of image f is defined as the difference between closing of the original image and the original image:

$$g^b(f) = \phi_B(f) - f$$

In text information images, information is represented by the intensity of transformation in image. The change of image information is more drastic and intensive than that of uneven illumination background, which means that the connected regions of image is much smaller than that of the illumination background in poor light. Since opening (closing) operation can remove image features smaller than size of structural element SE, image area smaller than SE size will disappear after the opening function transformation, and connected regions bigger than the SE will be saved. Therefore, all features will be eliminated with brightness function retained if large scale SEs is used on image for opening (closing) operation.

RESULT:

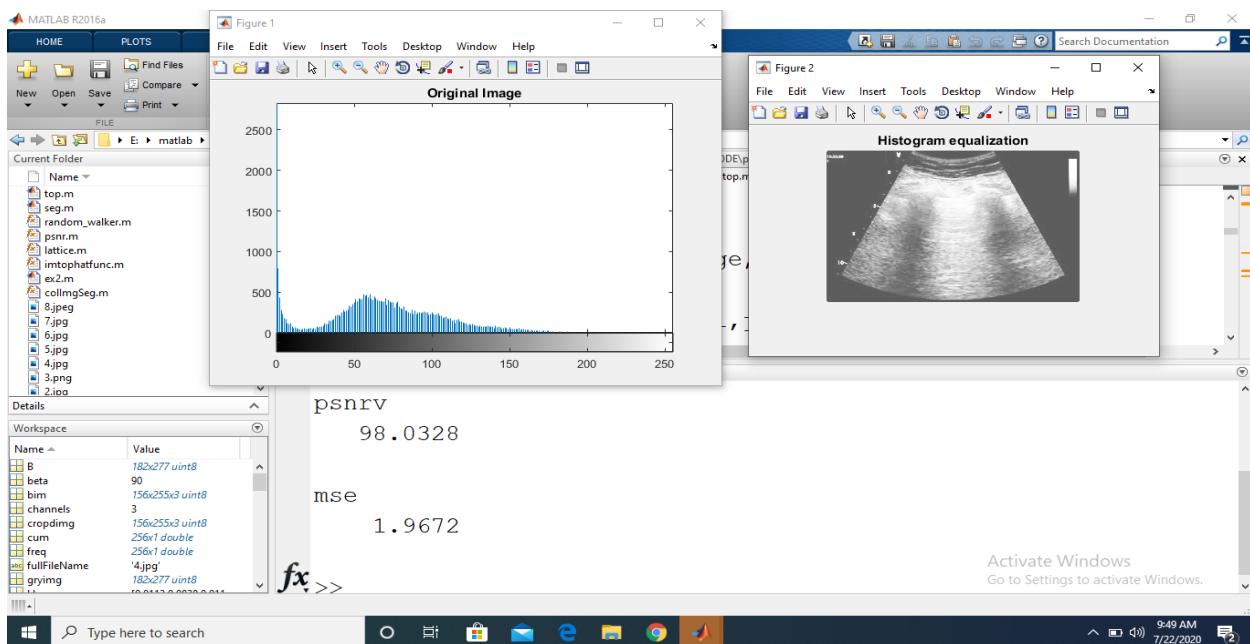


Fig:2 Proposed B line detection query

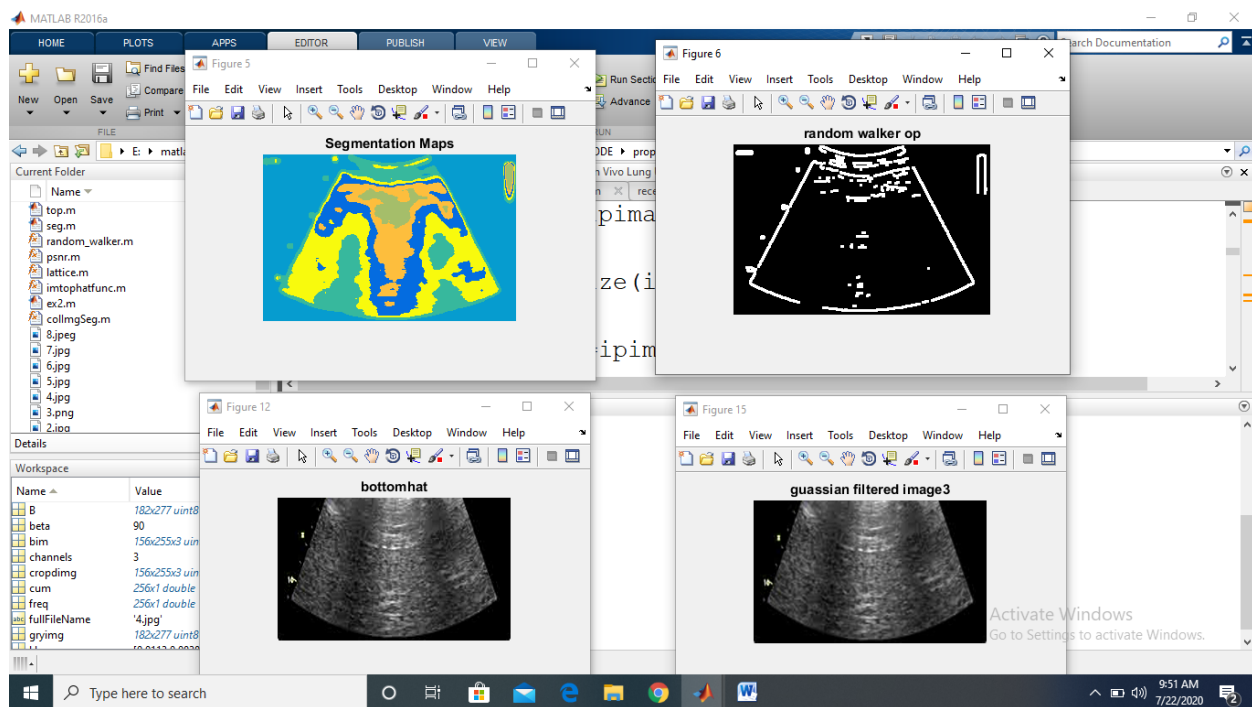


Fig:3 Proposed B line detection results

CONCLUSION:

Lung ultrasound, while an innovative application to novice providers, is a well-researched and supported ultrasound subspecialty. Understanding the various ultrasound signs and artifacts encountered in lung ultrasound examinations is critical to correct diagnosis of normal and pathologic states. The results indicated the proposed technique was able to detect the B-lines and was able to differentiate the ultrasound scans acquired from the patients after cardiac surgery and those acquired from healthy subjects.

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