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Analysis of Atherosclerotic Carotid Lumen Segmentation and Motion Estimation in B – Mode and Contrast Enhanced Ultrasound Images

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Abstract-The Stroke is one of the most important causes of death in the world and the leading cause of serious, long-term disability. There is an urgent need for better techniques to diagnose patients at risk of stroke based on the measurements of the intima media thickness (IMT) and the segmentation of the atherosclerotic carotid plaque. The objective of this work was to carry out a comparative evaluation of despeckle filtering on ultrasound images of the carotid artery, and develop a new segmentation system, for detecting the IMT and the borders of common carotid artery of the atherosclerotic plaque in longitudinal ultrasound images of the carotid artery. Combination of BMUS and CEUS can be using. Our method outperforms in segmentation the artery plaque in CCA images. The *lsmv* despeckle filter can be used for despeckling asymptomatic images include the expert is interested mainly in the plaque composition and texture analysis, are considered. A geometric despeckle filter (*gf4d*) can be used for despeckling of symptomatic images in identifying the degree of stenosis and the plaque borders. The IMT snakes segmentation results showed that no significant difference was found between the manual and the snakes segmentation measurements. The proposed despeckling and segmentation methods in corporate on a larger number of ultrasound images.The texture analysis of the segmented plaque, providing an automated system for the early diagnosis and the assessment of the risk of stroke.

I.INTRODUCTION

RISK OF STROKE presents the 10 leading causes of death in the world where stroke is the third leading cause after heart disease (42%), and cancer (30%), with 9% of death incidents worldwide per year.

According to the 2002 world health report [134] cardiovascular deaths in 2001 accounted for 36% of all deaths in women, and 30% of all deaths in men, and all predictions suggest growing figures for the next decade especially for the developing world. It was also reported from the Heart and Stroke Foundation of Canada [134], that each year in Canada, about 700,000 people develop a stroke, with 500,000 of these being first attacks, and 200,000 recurrent attacks. Stroke costs the Canadian government more than $40-$50 billion dollars per year. One of the most important causes of death in the world and the leading cause of serious, long-term disability in the United States today is cardiovascular disease [134]. Stroke killed 283,000 people in the United States in 2000 and accounted for about one of almost every 14 deaths. The worldwide statistics for the year 2001 were 20.5 million strokes, 5.5 million of which were fatal [134]. Stroke accounts for some non-modifiable risk factors such as age, gender, family history and race and for some modifiable factors such as hypertension, cardiac disease, diabetes, hyperlipedemia, asymptomatic carotid stenosis (ACSRS), smoking, alcohol consumption, transient ischemic attacks (TIA's), physical inactivity, and others [134], [208].

Atherosclerosis is a disease of the large and medium sized arteries that is characterized by progressive intimal accumulation of lipid, protein, and cholesterol esters [48], which significantly reduces blood flow. Atherosclerosis may be present in different sites of the body, including the coronary arteries, the superficial femoral artery, the infarenal aorta, and the carotid arteries at the area of the common carotid bifurcation see Atherosclerotic plaque formation, initially causes compensatory enlargement of the vessel with little or no compression of the lumen [352].

Carotid plaque is defined as a localized thickening involving the intima and media in the bulb, internal carotid, external carotid or common femoral arteries. The risk of Stroke increases with the severity of carotid stenos is (the narrowing of the artery caused by plaque, and is reduced after carotid endarterectomy . The degree of internal carotid stenosis is the only well established measurement that is used to assess the risk of stroke, and it is mainly the current criterion used to decide whether carotid endarterectomy is indicated or not [208]. It is increasingly accepted that carotid artery plaque thickness measurements, can serve as early indicators of cardiovascular disease development. In other words, it is assumed that an increased plaque thickness in the carotid artery is a predictor of future cardiovascular events like heart attack and stroke.

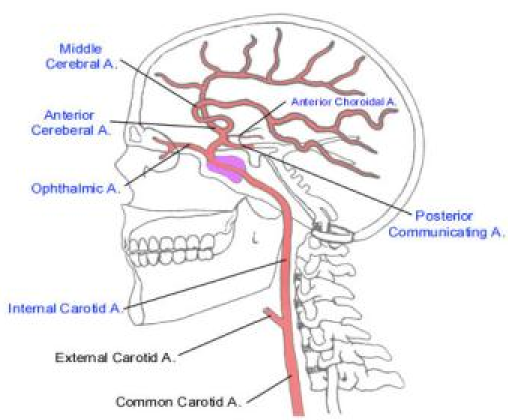

Fig. 1. The Carotid System

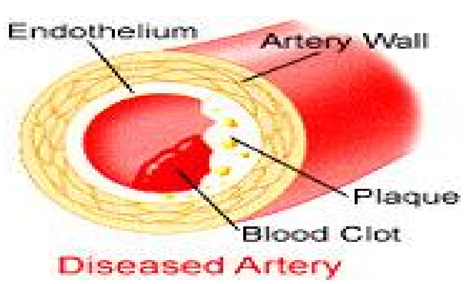

Fig.2.Longitudinal section of a Carotid Artery

Embolisation (left).

(a) The carotid system [130], (b) longitudinal section of a carotid artery with plaque (right) and embolisation (left) [153] (c) transverse section of a carotid artery with plaque, (e) stable and unstable plaque Recent studies involving angiography, high-resolution ultrasound, thrombolytic therapy, plaque pathology, coagulation studies, and more recently molecular biology, have implicated atherosclerotic plaque rapture as a key mechanism responsible for the development of cerebrovascular events [369]-[371].

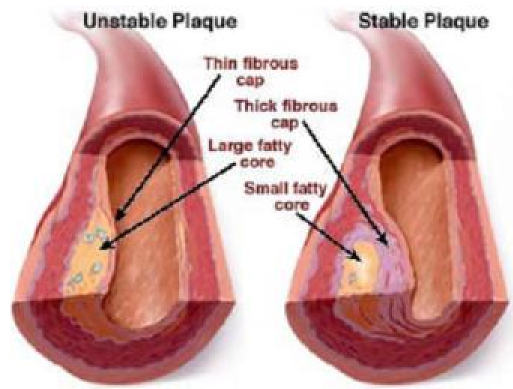

Fig.3. Transverse Section of Carotid (right) Artery with Plaque.

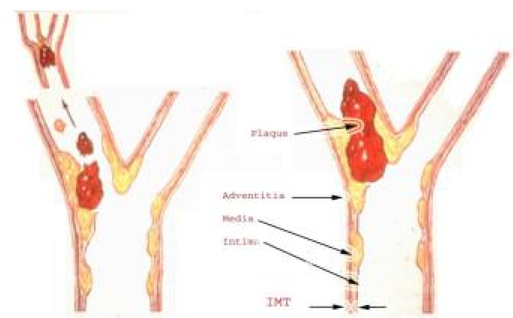

Fig.4. Stable and Unstable Plaque

Atherosclerotic disease has two main clinical manifestations, a) asymptomatic bruits and,

b) cerebrovascular syndromes such as amaurosis fugax, TIA's or stroke which are often the result of plaque erosion or rupture with subsequent thrombosis producing occlusion or embolisation [367], [368] (see also Fig. 1.). A stroke occurs usually when the blood supply to parts of the brain is suddenly interrupted or becomes blocked (Ischemic stroke). Ischemic strokes caused by artery stenosis, account for approximately 75% of all strokes. This blockage, caused by fatty build-up, is referred to as atherosclerosis [10], [51], [61], [100], [149]. Atherosclerosis changes the mechanical properties of the vessel walls and the buildup of a plaque making the artery walls stiffer [99]. The plaque accumulates in the inner lining of blood vessels and results in narrowing and irregularity of the artery, (see Fig. 2,3). When a blood vessel in the brain bursts, spilling of blood occurs into the spaces surrounding brain cells and we have a

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hemorrhagic stroke. For all types of stroke, treatment must be given immediately, as neuronal death processes quickly after the onset of symptoms.

The decision to treat narrowing of the carotid artery is not always straightforward. The potential benefit of the surgery must be weighted against the risk of the surgery. The degree of stenosis of the carotid artery, the intima-media thickness (IMT), which is the thickness of the artery walls (see also Fig. 4), and the presence or absence of symptoms are some of the important factors to consider when taking this decision. Measurements of IMT are better predictors of risk than any combination of conventional risk factors.

Compared to medical therapy alone, surgery (carotid endarterectomy) has been found highly beneficial for patients who have already had a stroke or experienced the warning signs of a stroke and have a severe degree of stenosis of 70-99% [208]. Usually these patients are considered to benefit from a carotid endarterectomy [52], [266]. Based on the evidence of the North American Symptomatic Carotid Surgery Trial (NASCET), and the European Carotid Surgery Trial (ECST), for a degree of stenosis of less than 30%, medical therapy is preferred [208], [353]. For a degree of stenosis between 30% and 70%, the best therapy has not been yet determined, since the risk/benefit ratio varies between the conditions of the patients. Patients that are at a high risk for a surgical procedure may be placed on medications to inhibit their blood from clotting [208], [266].

The primary aim of most digital carotid image-processing techniques is to provide human–independent aids for assessing the condition of the arteries and assessing the risk of stroke.

II. DATA

A. Image processing of the carotid artery

Ultrasound imaging provides a well-established technique in the diagnosis and assessment of cardiovascular disease, by visualising the IMT, vessel stenosis, plaque composition, and size [99]. Monitoring of the arterial characteristics, like the vessel lumen diameter, the IMT, and the morphology of atherosclerotic plaque, are very important in order to assess the severity of atherosclerosis and evaluate its progression [7], [93], [138]. Due to its non-invasive nature, and continuing advances in ultrasound transducer instrumentation, and digital image processing technology, vascular imaging is progressively achieving a more important role in helping the expert visualize the morphology of vascular structure, as well as measure blood velocity and flow, arterial wall changes, volume and texture of atherosclerotic plaque [8], [9]. Information that can be determined from visualizing carotid arteries with ultrasound includes: plaque compositions (such as necrotic lipid core and fibrous cap), total plaque area and volume, lumen area, IMT, and plaque distribution. Improved imaging techniques may help in determining the ideal treatment and clinical outcomes for asymptomatic or symptomatic patients by providing more information about carotid athrerosclerotic plaque and IMT.

Segment the atherosclerotic carotid plaques [from ultrasound images. Other researchers tried to identify the degree of artery stenosis and to classify arteries as being either as asymptomatic or symptomatic]. If ultrasound shows a stenosis of grater than 70%, magnetic resonance or CT angiography is recommended. If the results correspond, no further investigation is needed for surgery. If they do not correspond then a carotid angiogram is required.

Fig.2. shows a typical longitudinal ultrasound image from a normal adult subject. A close view of the IMT is shown in Fig. 5, with the far wall of the artery being depicted by a double line pattern, marked with asterisks by an expert. The upper set of asterisks corresponds to the echogenic lumen-intima and the lower set of asterisks corresponds to the media-adventitia, which are separated by a sonolucent region. One of our objectives is to apply despeckle filtering to enhance the boundaries in the image and aid in the identification, localization, and extraction, of this important ultrasound structure which is associated with several risk factors for atherosclerosis.

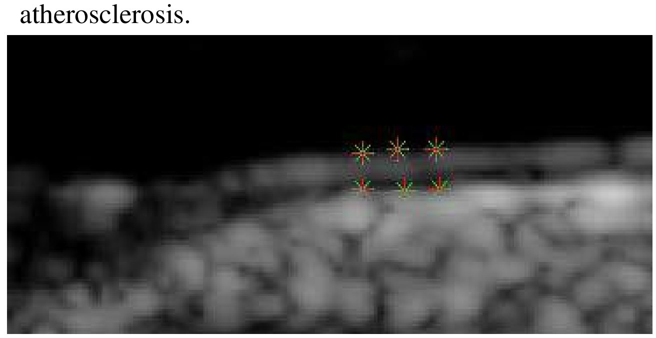

Fig. 5. Close view of manual measurements of the IMT

B. IMT segmentation

Segmentation of the carotid artery is an important operation before further analysis of the image can take place. IMT borders are usually traced manually by experts but it is time consuming [58], [59], and results show poor reproducibility. Several studies have been presented in the literature for the detection of the IMT [55], [64], [178], [241] in the carotid artery.

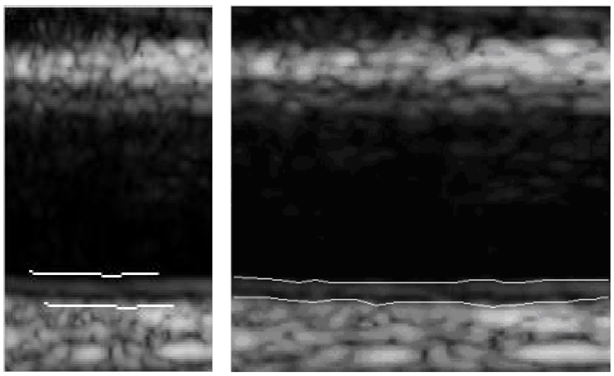

Fig. 6. Longitudinal Ultrasound Images of the CCA.

The development and testing of new methods for computing the IMT will greatly help the expert in the assessment of the carotid artery disease. In the segmentation of an ultrasound image of the carotid artery, interest lies in identifying and measuring the IMT, determining the presence or absence of a plaque, and determining its contour provided that a plaque exists. Christo Ananth et al. [1] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The main design of this project is to track the heart attack of patients who are suffering from any attacks during driving and send them a medical need & thereby to stop the vehicle to ensure that the persons along them are safe from accident. Here, an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller.If eye blinking gets stopped then the signal is sent to the controller to make an alarm through the buffer. If spO2 sensor senses a variation in pulse or low oxygen content in blood, it may results in heart failure and therefore the controller stops the motor of the vehicle. Then Tarang F4 transmitter is used to send the vehicle number & the mobile number of the patient to a nearest medical station within 25 km for medical aid. The pulse rate monitored via LCD .The Tarang F4 receiver receives the signal and passes through controller and the number gets displayed in the LCD screen and an alarm is produced through a buzzer as soon the signal is received.

Furthermore, snakes or deformable models to detect the IMT in 2D [241], and 3D [55], ultrasound images of the carotid artery were developed. These methods are based on the active contour model first introduced by Kass [243]. In general, the snake-based methods require that the initial snake contour must be specified by an expert, although recently a method that automatically detects an initial snake contour for the IMT was introduced, as a first step towards the automated segmentation of the IMT and plaque in the carotid artery images.

Fig. 6. shows a longitudinal ultrasound image of the CCA with computed initial contours at the far wall, of the intima and the adventitia layers based on despeckle filtering and morphology operators, whereas shows the final result after the two contours were deformed using the Williams&Shah snakes segmentation method.

C. Plaque Segmentation

As it has been mentioned in the previous section on IMT segmentation, the segmentation of an ultrasound image of the carotid artery necessitates the need to identify and measure the IMT and determine the presence or absence of a plaque. If there is a plaque its contour should be determined. Although in ultrasound imaging, different segmentation methods were developed for IMT segmentation, no method was developed for segmenting the atherosclerotic carotid plaque in longitudinal ultrasound images.

Traditionally, X-ray angiography is used for measuring manually the percentage of stenosis of the carotid artery. However this measure may not be reliably estimated because this modality depicts only the lumen of the artery. Furthermore, X-ray angiography is not capable of visualising the vessel wall and cannot determine the size or composition of the atherosclerotic plaque. The use of ultrasound significantly helps in determining the size or composition of atherosclerotic carotid plaque.

D. Diagnostic Ultrasonography

Diagnostic ultrasonography is an ultrasound-based imaging technique used for visualizing and

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diagnosing pathological changes of internal body structures such as muscles, vessels, heart or other organs. For example, vascular sonography has been widely used to examine vessels and pathological changes of the vessel wall. Ultrasound can also be used therapeutically (e.g. high intensity focused ultrasound is used to heat and destroy tumors).

Ultrasound is a sound pressure wave with a frequency higher than the human hearing range (20Hz-20kHz). An ultrasound transducer which consists of piezo-electric material is used to transmit and receive the sound wave. The sound wave is transmitted into the tissue and the reflected echo (wave) is recorded and used to construct an ultrasound image. As the average speed of sound through biological soft tissue is approximately 1540 m/s, the time of flight between the transmitted and received echo is used to localize an object and construct an acoustic image of the interrogated region. The propagation of an acoustic wave is characterized by its speed c and wavelength λ: $c =$.

Ultrasound has several advantages compared to other medical imaging techniques. It is safe as it does not use harmful ionizing radiation like X-ray and CT. It is considerably lower in cost. Images are provided in real-time. It is portable, can be transported to a patient's bedside, and is useful for patient screening and follow-up. The disadvantages of ultrasound include its strong operator dependence, and inability to examine areas of the body containing gas and bones.

E. Modes of Ultrasound

Different types of images can be formed by using ultrasound. There are several modes of ultrasound that are used in diagnostic ultrasonography. The most common are:

B-mode: Brightness mode (B-mode) is the most well-known ultrasound mode. A 2D cross section of a tissue is displayed by scanning an ultrasound beam over the tissue.

*M-mode:*Movement mode (M-mode) displays movement of structures over time. First, a scan line is placed on a region of interest in a B-mode image. The M-mode displays how the structure crossed by that scan line move toward or away from the probe over time.

Doppler mode: In this mode, blood flow is measured and visualized by using the Doppler effect which is the shift in frequency of a wave for an observer moving relative to its source. In diagnostic ultrasound, an ultrasound wave is emitted with a particular frequency by using an ultrasound probe. Ultrasound waves reflected from red blood cells (moving objects) return to the probe with a Doppler shift. This shift in frequency is used to calculate the velocity of the blood flow. Velocity information is presented as a color-coded overlay on top of a B-mode image, which is called color Doppler.

Harmonic mode: In this mode, a wave with a fundamental frequency is emitted into the body and the second harmonic of the wave is detected. In this way, noise, clutter and artifacts (side lobes and reverberations) are greatly reduced. Harmonic imaging also improves resolution and signal-to-noise ratio.

Contrast Mode: Contrast mode imaging is used for visualization of the lumen of cardiac cavities and blood vessels. Secondly, it is used to quantify blood perfusion in organs by use of ultrasound contrast agents. This mode is useful in vascular, cancer, and cardiology research for detecting perfusion abnormalities of tissues.

F. Contrast Enhanced Ultrasound

Contrast enhanced ultrasound (CEUS) can provide information about blood perfusion of organs by use of ultrasound contrast agents (microbubbles). Contrast agents can penetrate into the microvasculature network and are confined to the microvasculature. This also allows detection of plaque neovascularization (IPN) by using CEUS. Compared to B-mode anatomical ultrasound images, the tissue information is suppressed and only contrast agents flowing within the blood are displayed. CEUS is widely used to diagnose perfusion abnormalities of organs such as liver, prostate and myocardium. Beside this, CEUS is used to assess perfusion of atherosclerotic plaques. This allows detecting of these small microvessels by using CEUS. There are two types of contrast enhanced ultrasound:

1) Non-targeted CEUS using free-floating microbubbles
2) Targeted CEUS using targeted microbubbles which bind to certain receptors on endothelial. In this thesis work, we only focused on non-targeted CEUS.

G. Ultrasound Contrast Agents

Ultrasound contrast agents are gas-filled micro bubbles with a size distribution of 1 to 10μm, as small as red blood cells. They are intravenously injected and small enough to pass the lungs. Subsequently, they reach the left ventricle of the heartland enter the systemic circulation. Later, they are mainly eliminated by the lungs. A micro bubble consists of a shell and a gas core.

The shell material affects mechanical elasticity and residence time of the micro bubble in the systemic circulation. Currently, the shell of the microbubble is made of lipid, albumin, or polymers. The gas core of the micro bubble provides an efficient scattering due to high compressibility. Micro bubbles contain gasses such as air, sulphur-hexafloride (SF6) or octofluoropropane (C3F8). The gases such as SF6 and C3F8 have low solubility in blood and increase the residence time of microbubbles in the systemic circulation. In this thesis work, we only used SonoVue contrast agent, manufactured by Bracco Inc., which has phospholipid coating and contains SF6 gas. SonoVue has shown to be safe, is not trapped in microvasculature networks, and not diffusing across vascular or micro vessel walls. There has been no evidence of harmful effects of SonoVue. Micro bubbles respond to ultrasound insonification nonlinearly due to their high compressibility and resonance, which is different than the linear response of a tissue. This difference between the tissue and micro bubbles allows separating the tissue and micro bubble responses. Several contrast imaging techniques have been developed so far based on nonlinear response of micro bubbles.

H. Contrast Detection Techniques

Proper detection of ultrasound contrast agents is very important for their usability in diagnostic ultrasound. The strong scattering property of microbubbles can be used to change the response of the blood from echolucent (dark) to echogenic (bright) of the lumen of large arteries or the chambers of heart. However, when microbubbles are flowing within a microvasculature network surrounded by a tissue, their detection will be more difficult due to the combined response from tissue and microbubbles. To be able to detect microbubbles within the microvascular network, contrast-specific detection techniques are necessary. Pulse inversion and amplitude modulation techniques are the most common techniques that have been used to detect contrast agents. In addition, a technique called counter-propagation has been recently introduced by Renaud et al. [10] to detect microbubbles and suppress contrast-specific artifacts that are produced by the most common techniques.

I. Pulse Inversion

In pulse inversion technique, two pulses are transmitted, where the second pulse is a phase inverted copy of the first one. Their responses are added up. The tissue which is a linear target will reflect identical but inverted echoes back to the transducer as a response of these two pulses. Summing up these two responses will cancel out the linear response of the tissue. However, microbubbles will respond differently to these inverted pulses. When the received echoes for microbubbles are added.

J. Amplitude (Power) Modulation

This technique is also based on suppression of linear echoes and obtaining harmonic response. In this case, the scaling property of linearity is used to distinguish between the linear tissue and nonlinear microbubble responses. In power modulation, three pulses (two single-amplitude pulses and one double-amplitude pulse) of the same shape are transmitted. Summing up the response of the two single-amplitude pulses and subtracting from the response of the double-amplitude pulse will give no remaining signal for the linear tissue. However, microbubbles will respond differently to the two amplitudes. The generation of harmonics is dependent on the fundamental signal amplitude and therefore the double-amplitude pulse will generate stronger harmonics than the single-amplitude pulses. In this case, adding the responses of the two single-amplitude pulses and subtracting from the response of the double-amplitude pulse will result in a remaining harmonic signal that will allow distinguishing microbubbles from the tissue.

K. Counter-Propagation Technique

The techniques like pulse inversion and amplitude modulation require linear propagation along the tissue to detect nonlinear response of microbubbles. However, when a transmitted pulse crosses cavities with a high concentration of contrast agent, the waveform of the pulse is distorted due to nonlinear propagation medium. This will cause the tissue right behind these cavities to be misclassified as microbubbles, called pseudo-enhancement artifacts [11].[10] proposed a technique which distinguishes microbubbles from tissue based on the response of microbubbles to two acoustic waves propagating in opposite directions. In biological tissues, there will no effect observed when two waves pass over each other. However, microbubbles create an interaction between the two waves when they are passing over each other. This is used to detect microbubbles and create images free from nonlinear propagation artifacts (pseudo-enhancement artifacts). This technique has been recently developed but has not been used in clinical practice yet.

III. METHODS

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A.IMAGE NORMALIZATION:

The need for image normalization (standardization), or post-processing was suggested and some kind of normalization using only blood echogenicity as a reference was applied in ultrasound images of carotid artery. In this study, brightness adjustments of ultrasound images were carried out based on the method introduced in. It was shown that this method improves image compatibility by reducing the variability introduced by different gain settings, different operators, different equipment, and facilitates ultrasound tissue comparability.

The method illustrated in was implemented in MATLAB (6.1.0.450 version, release which was used for the implementation of the normalization procedure as well as for all other methods employed in this study. Algebraic (linear) scaling of the image was performed by linearly adjusting the image so that the median gray level value of the blood was 0-5, and the median gray level of the adventitia (artery wall) was 180-190. The scale of the gray level of the images ranged from 0-255. Thus the brightness of all pixels in the image including those of the plaque, were readjusted according to the linear.

In order to evaluate despeckle filtering, an artificial carotid image was generated. Despeckle filtering was evaluated visually by two experts (cardiovascular surgeon, neurovascular specialist), on

the artificial carotid image corrupted by speckle noise.

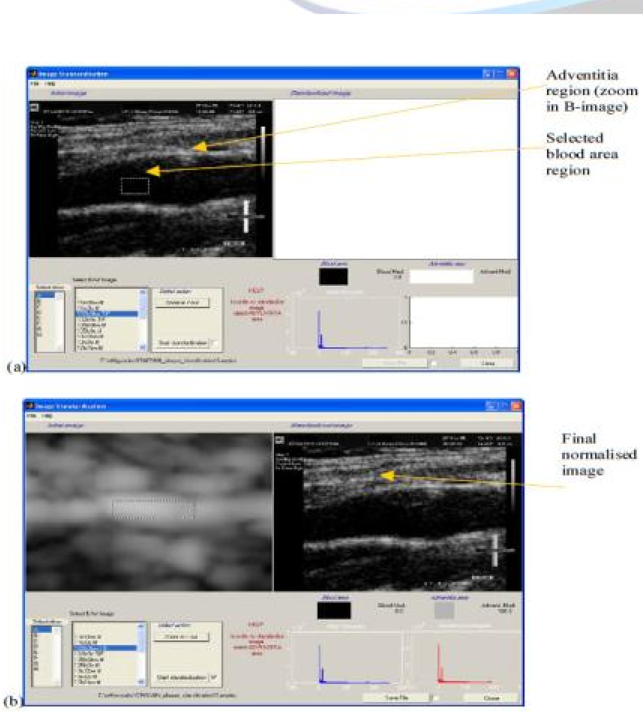

Fig. 7. Generation of an Artificial Carotid Image

The artificial image has a resolution of 150x150 pixels, and was generated with gray level values of the bottom, strip, middle and upper segments of 182, 250, 102, and 158 respectively. This image was corrupted by speckle noise, which was generated using the equation, where and are the noisy and the original images respectively, and a uniformly distributed random noise with mean 0 and a variance.

B. Image quality of two Ultrasound Scanners:

For evaluating the image quality of the two ultrasound scanners used in this work (ATL HDI-3000, and ATL HDI-5000), visual perception evaluation image quality evaluation metrics and texture measures were used. The evaluation was carried out on the original (NF), normalized (N), despeckled (DS), and normalized despeckled (NDS) images.

C. IMT Initialization:

Before running the IMT snakes segmentation algorithm, an IMT initialization procedure was carried out. The objective of this procedure was to place the IMT initial snake contour as close as possible to the area of interest, because of the problems.

a) Load the initial B-mode image, and select using the mouse the area of interest on the
image, where the IMT will be detected. The area may be drawn around the IMT borders.

b) Despeckle the selected area by applying the lsmv despeckle filter presented in .

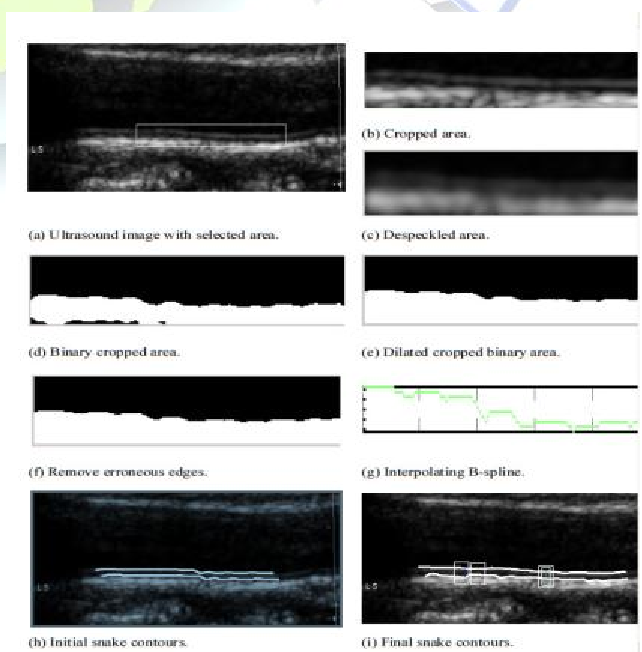

Figure. 8. IMT contour initialization procedure and final snakes contours:(a) Original ultrasound image with selected area, (b) cropped area, (c) despeckled area, (d) binary cropped area, (e) dilated cropped area, (f) dilated area after removal of small edges, (g) construction of the interpolating B-spline, (h) detected initial contours for the adventitia and the intima layers, and (i) final contours after the snake deformation

c) Convert the area to binary by image thersholding, in order to extract edges more easily. A threshold is calculated from the despeckled grayscale image according to which is then applied to all the pixels in the image. Pixels that have smaller intensity values than this threshold are set to zero, whereas pixels with larger intensity values are set to one.

D. IMT Segmentation:

The edge map of the original artificial carotid image,and the initial snake contour estimation. This was detected by the procedure described in at the far wall of the edge map. It is shown that the proposed method detects the initial IMT contours accurately, thus positioning the snake as close as possible to the borders of interest, and offering the possibility of using the method in real time applications. It is important to place the initial snake contour as close as possible to the area of interest otherwise the snake may be trapped into local minima or false edges, and converge in a wrong location. The snake is therefore initialised with the proposed IMT initialisation procedure followed.

Fig.9. Demonstration of the IMT segmentation module.

E. IMT Segmentation Analysis:

The edge map of the original artificial carotid image,and the initial snake contour estimation. This was detected by the procedure described in at the far wall of the edge map. It is shown that the proposed method detects the initial IMT contours accurately, thus positioning the snake as close as possible to the borders of interest, and offering the possibility of using the method in real time applications.

Using the snakes segmentation method, first proposed by Kass, and later enhanced by Williams Shah, as described, the final IMT contours for the image in detected, measured. The snake iterations are repeated until the number of snake points moved to new locations is less than a specified threshold or the user-defined maximum number of iterations has been reached. After tests made with the Williams Shah snakes segmentation method, Have chosen three as the maximum number of points moved to new locations, and 50 for the maximum number of iterations. A small number of points moved and a large number of iterations ensure that the energy functional in, will reach always its minimum in the observed area of points. chosen in our study the initial values, (6.0) (=$s\alpha$, 4.0) (=$s\beta$, and 2)to start the snake.

After both final snake contours have been extracted the distance lumen-intima interface to the media-adventitia interface is measured between pixel pairs. This distance is calculated at all points along the arterial segment of interest and then averaged to obtain the mean IMT (). Also the maximum (), minimum (), and median () IMT values, are calculated, displayed, and plotted on the B-mode image.

The detected, and values with a double line box, full line box, and a dashed line box respectively. IMT initialisation procedure as described. According to our experience it is much better to perform the IMT measurements on longitudinal images of the carotid artery, than in the transversal images. This is because the visualization is much better and more accurate in longitudinal images, whereas in transversal images the visualization is poor and many images of the same position are required in order to construct the whole carotid bulb. Additionally, in longitudinal images the whole length of the artery may be more easily inspected and thus the IMT and plaque are better visualized. connected to one of the three load terminals. whole length of the artery may be more easily inspected and thus the IMT and plaque are better visualized.

F. PLAQUE SEGMENTATION

Four different snakes segmentation methods were used for plaque segmentation. These methods were the Williams&Shah, Balloon, Lai&Chin, and the GVF snake, presented. An initialization procedure for detecting the initial plaque borders in longitudinal the

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detection of the plaque borders, by the snakes segmentation method manual delineation from the experts is required for comparison purposes.

G. *Manual measurements and visual perception evaluation*

Before the detection of the plaque borders, by the snakes segmentation method manual delineation from the experts is required for comparison purposes. The plaque identification and segmentation tasks are quite difficult, and must be performed by experts. In this work one neurovascular expert, manually segmented the images. The expert delineated the plaque borders, between plaque and artery wall, and those borders between plaque and blood, on 80 longitudinal B-mode ultrasound images of the carotid artery, before and after image normalization, using MATLAB software developed by other researchers from our group. procedure for carrying out the manual delineation process was established by a team of experts and was documented in the ACSRS project protocol. The correctness of the work carried out by the single expert was monitored and verified by at least another expert.

Type I: Uniformly echolucent (black) plaques, where bright areas occupy less than 15% of the plaque area. If the fibrous cup is not visible, the plaque can be detected as a black filling defect only by using color blood flow, or power Doppler.

Type II: Mainly echolucent plaques, where bright echoes occupy 15-50% of the plaque area.

Type III: Mainly echolucent plaques, where bright echoes occupy 50-85% of the plaque area.

Type IV: Uniformly echogenic (white) plaques, where bright echoes occupy more than 85% of the plaque area.

Type V: Calcified cup with acoustic shadow so that the rest of the plaque cannot be visualized.

In this work, only plaques of type II, III and IV, were delineated by the expert, as for these types of plaques, the fibrous cup, which is the border between blood and plaque, may be more easily identified and thus the expert may perform the manual delineation more reliably. For the type I plaques, borders are not visible well. Plaques of type V produce acoustic shadowing and the plaque is also not visible well. Plaques of type I, and V, were therefore not delineated in this study.

Demonstrates the manual outlining procedure, where an ultrasound image with the outline of the carotid plaque at the near wall, and the corresponding colour blood flow image are illustrated. The expert applied a log transformation on the grey scale. B-mode image and then prescribed the outline of the plaque by marking 20 to 40 consecutive points of the plaque border on the B-mode ultrasound image. The expert was guided by the blood flow image, which indicates the plaque-blood borders, in order to delineate the plaque on the B-mode image. The manually segmented plaque was saved in order to be compare with the snakes segmentation results are used for texture analysis.

IV. SIMULATION RESULTS

A. Input Image:

A stroke occurs usually when the blood supply to parts of the brain is suddenly interrupted or becomes blocked (Ischemic stroke). The input image shows that improper blood flowing to the Brain through the Carotid Artery with Atherosclerotic Plaque in the Patient's Body.

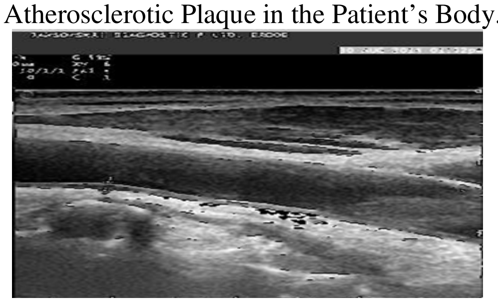

Fig .10. Input image

B. Pre Process Image:

In this preprocess image has to be identify the Plaque and then solving the problems of improper Blood flowing to the Brain.

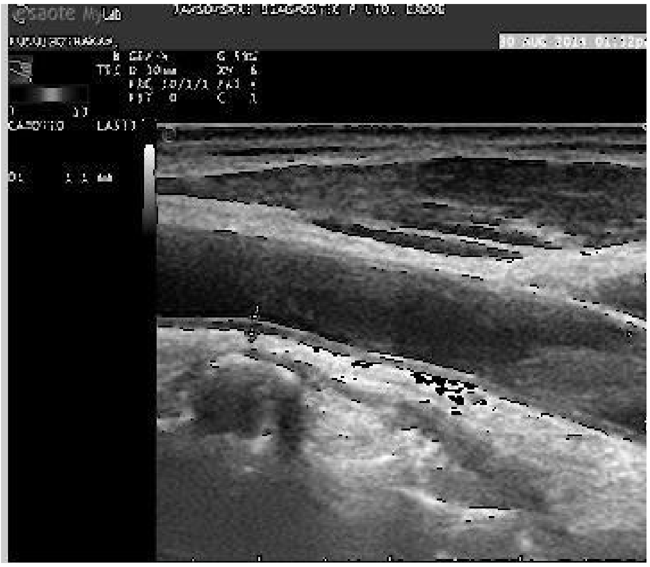

Fig. 10. Preprocess Image

C. Detected Plaque:

Fig .11. Detected Plaque region Image

Detected Plaque Region is to measuring the Stroke level of the Patient's Body such as in Normal or Severe stage.

D. Comparision Chart:

	Upper Lumen Contour		Lower Lumen Contour	
	IO	AG	IO	AG
RMSE Dataset I' Epitome images	110 ± 50	110 ± 50	220 ± 140	260 ± 70
Five time-frames	190 ± 80	170 ± 60	270 ± 70	290 ± 30
RMSE Dataset II Epitome images	226 ± 196	294 ± 100	321 ± 185	408 ± 252

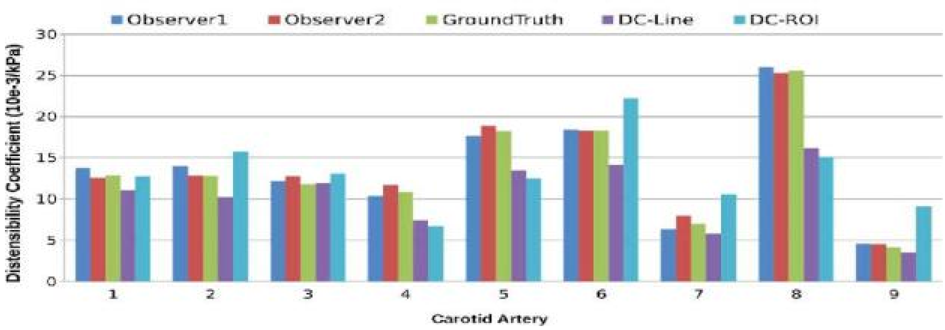

Fig. 12. Comparison of carotid artery distensibility based on manual and auto-mated measurements (DC-line and DC-ROI)

V. CONCLUSION:

Proposed Method to solve the Stroke problem which can be find out the accurate Lumen Segmentation of the Carotid Artery based on combined BMUS and CMUS images.

The segmentation approach enables the user to detect the Lumen intima border of the artery. Which can hardly be detected in standard BMUS.

The extraction of the motion pattern from the image sequence leads to epitome images that facilitate the Lumen segmentation, and furthermore, the assessment of the arterial disability, or other, more advanced arterial stiffness parameters. This method is automated, an extensive evaluation was performed.

Overall the obtained results of the proposed method for the stroke proposed method for the Stroke problems could be accurate and also establishes the effective solution for the improper of blood flowing in the Atherosclerotic Carotid Arteries

REFERENCES

[1] Christo Ananth, S.Shafiqa Shalaysha, M.Vaishnavi, J.Sasi Rabiyathul Sabena, A.P.L.Sangeetha, M.Santhi, "Realtime Monitoring Of Cardiac Patients At Distance Using Tarang Communication", International Journal of Innovative Research in Engineering & Science (IJIRES), Volume 9, Issue 3,September 2014,pp-15-20

[2] Destrempes. F. J.,Meunier, M.-F. Giroux, Soulez. G., and Cloutier, G., "Segmentation in ultrasonic B-mode images of healthy carotid arteries using mixtures of Nakagami distributions and stochastic optimization," *IEEE Trans. Med. Imag.*, vol. 28, no. 2, pp. 215–229, Feb. 2009.

[3] Filippo Molinari., Silvia Delsanto., William Liboni., "accurate and automatic carotid plaque characterization in contrast enhanced 2-D ultrasound images", Carotid plaque characterization., vol. 29,pp. 23 – 26,2007.

[4] Loizou. C. P.,Pattichis. C. S., Nicolaides. A. N., and Pantziaris. M.,"Manual and automated media and intima thickness measurements of the common carotid artery,"*IEEETrans. Ultrason., Ferroelectr.Freq.Control*, vol. 56, no. 5, pp. 983–994, May 2009.

[5] Naik. V., Gamad.R., and Bansod. P., "Carotid artery segmentation in ultrasound images and measurement of intima-media thickness," *BiomedRes.Int.*, vol. 2013, 2013.

[6] Nico de jong., Antonius F. W., Van der Steen., "automated carotid plaque segmentation in combined b-mode and contrast enhanced ultrasound",*Carotid plaque segmentation.,*vol. 223 ,no. 10,pp. 1109 ,2014.

[7] Noble J. A.,and Boukerroui. B., "Ultrasound image segmentation:
A survey," *IEEE Trans. Med. Imag.*, vol. 25, no. 8, pp. 987–1010, Aug. 2006.

[8] Sirlin*et C. B., al.*, "Contrast-enhanced B-mode US angiography in the assessment of experimental in vivo and in vitro atherosclerotic disease," *Acad. Radiol.*, vol. 8, no. 2, pp. 162–172, 2001.

[9] Silvia Delsanto.,Filippo Molinari., "characterization of a completely user independent algorithm for carotid artery segmentation in 2-D ultrasound images", *Artery segmentation.,* vol. 56, no. 4,pp.1265, 2007.

[10] ten Kate. G. L.,*et al.*"Noninvasive imaging of the vulnerable atherosclerotic plaque," *Curr. Problems Cardiol.*, vol. 35, no. 11, pp.556–591, 2010.

[11] ten Kate. G. L.,*et al.*, "Usefulness of contrast-enhanced ultrasound for detection of carotid plaque ulceration in patients with symptomatic carotid atherosclerosis," *Am. J. Cardiol.*, vol. 112, no. 2, pp. 292–298, 2013.

[12] van den. S. C.,Oord*et al.*, "Assessment of subclinical atherosclerosis and intraplaque neovascularization using quantitative contrast-enhanced ultrasound in patients with familial hypercholesterolemia," *Atherosclerosis*, vol. 231, no. 1, pp. 107–113, 2013.

[13] ZeynettinAkkus., Johan G. Bosch., AssafHoogi., "motion compensation method for quantification of neovascularization in carotid atherosclerotic plaques with contrast ultrasound",*Atherosclerotic plaques.,* vol. 284 ,no. 10,pp. 1159, 2011.