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Removal of Artefacts and Measurement of Stenosis for Coronary Angiographic Images

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Abstract: Arteriosclerosis is a Coronary Artery Disease (CAD) that is caused due to the deposition of plaque in the walls of arteries by which the arteries narrows down (stenosis) and the blood flow gets restricted. Computed Topographic Angiography (CTA) has been used in clinical diagnosis and it is very difficult to visualize the blood vessels and the stenosis due to the presence of bones and tissues. Moreover, the measurement of stenosis is important for stent employment which improves the blood flow. In clinical practice, with modern imaging techniques, visualization of stenosis and stents remains challenging and researchers go to image processing techniques. This parchment focuses on three main strategies to improve the image quality. First, blood vessel visualization is done by employing a technique named Temporal Mask Time Mode Digital Subtraction Angiography (TMDSA). This can effectively reduce the motion artefacts in angiographic images. Second, the TMDSA image is further enhanced by image processing techniques such as histogram equalization, thresholding, morphological and advanced morphological operations for better visualization. Third, shape detection and measuring operations have been developed for detection of stenosis and measurement of stenosis. The proposed method have been evaluated on various CT angiography images qualitatively and quantitatively.

Key words: Digital subtraction angiography, stenosis, thresholding, LabVIEW, blood flow

INTRODUCTION

The important rise of medical imaging during the twentieth century, mainly induced by physics breakthroughs related to nuclear magnetic resonance and x-rays has led to the development of imaging modalities devoted to visualize vascular structures. The analysis of such angiographic images is of stoking interest for several clinical applications. Coronary Artery Disease (CAD) is the leading cause of death worldwide. It occurs when the coronary arteries that supply blood to the heart muscle become hardened and narrowed due to the build-up of plaque (fat deposits) on their inner walls, termed arteriosclerosis. As the plaque increases in size, the interior of the arteries, the lumen, gets narrower (stenosis) and less blood can flow through eventually, blood flow is reduced and the heart muscle does not receive sufficient oxygen. This can result in a myocardial infarction (heart attack) when a blood clot develops at the site of the plaque and suddenly cuts off most or all of the blood supply causing permanent damage to the heart muscle (Taleb *et al*., 2001). Once the lumen becomes impaired it can be studied by x-ray arteriography or coronary angiography and the blood vessels can be visualized by a technique called Digital Subtraction Angiography (DSA). Therefore, DSA is the widely used technique for the visualization of blood vessels in a sequence of x-ray angiographic images (Katzen, 1995; Umarani and Asha, 2012). In DSA imaging, a sequence of images is obtained before and after injection of contrast media. The first few sequence of images taken before the application of contrast media are called as mask image and it does not contain any information about blood vessels. The sequence of images acquired after application of the contrast media is the phase image which clearly shows the blood vessels clearly. The background is removed by subtracting a mask image from the phase image happened in the resulting in the subtracted images except high contrasted vessels. The major problem encountered in DSA images is the presence of motion artefacts which arise due to patient motion, image acquisition, photon gearbox, etc. and degrade the image quality. Such artefacts can lead to misdiagnosis of DSA images. In such a situation, the patient would have to retake the

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examination till the required quality of the image sequence for diagnosis is obtained. In order to overcome this problem and to improve the diagnostic value of DSA images, special precautions concerning the patient and the image acquisition system are taken to prevent the motion artefacts. However, in many cases the motion artefacts cannot be entirely eliminated and one is forced to go for further technique called Temporal Mask Time Mode Digital Subtraction Angiography (TMDSA). Many image registration techniques has been proposed to remove the motion artifacts (Shechter *et al*., 2005; Pouladian *et al*., 2005). Bentoutou and Taleb (2005) proposed a registration technique to remove the motion artefacts based on local and global similarity detection by means of template matching using combined invariant-based similarity measure. But it shows some grey level distortion even though it does not affect any diagnostic value (Bentoutou and Taleb, 2005). The purpose of this technique is to suppress the background structure off the process of temporal mode of subtraction that comprises of two images that has no mismatch in the pixel value and are acquired at same frame rate and at the same time. Furthermore, in order to separate the foreground from the background image pre-processing techniques are carried out. This parchment focuses on, three main strategies to improve the image quality. First, blood vessel visualization is done by employing a technique named Temporal Mask Time Mode Digital Subtraction Angiography (TMDSA). This can effectively reduce the motion artefacts in angiographic images. Second, the TMDSA image is further enhanced by image processing techniques such as histogram equalization, thresholding, morphological and advanced morphological operations for better visualization. Third, shape detection and measuring operations have been developed for detection of multiple stenosis and measurement of stenosis in CTA images. The technique that is proposed is relatively fast to implement, even when applied to worst cases of DSA images.

Literature review: Arteriosclerosis, a widespread disease of the arteries. It is a kind of arteriosclerosis that causes Coronary Artery Disease (CAD) in the form stenosis (lumen decrease). Several techniques were developed to identify the stenotic lesion, the most widely used is digital subtraction angiography where the goal is to remove the stationary background structure of radiographic images and to highlight the foreground structures of interest. To measure the stenosis the affected part of the vascular structure of the coronary artery must be extracted separately. Presence of motion artefacts can be eliminated by an edge defection approach and on local similarity defection by means of matching according to a combined invariants-based similarity measure (Puentes *et al*., 1998; Bentoutou *et al*., 2002; Bentoutou and Taleb, 2005). In this approach, a 3D Space-Time Motion Detection algorithm was used for selecting, moving points, belonging to moving structure. The degradation of the image is eliminated by the above approach. This approach does not concentrate on gray level variations or distortion even though it does not affect any diagnostic value, therefore sometimes it leads to misinterruption of data. A Scanline Tracking algorithm is proposed (Zou *et al*., 2009) to extract the vascular vessel network for DSA image sequence. Further, this study report on shufty ahead detection schemes for continuation points in the vascular tree but the drawback is it leads to discontinuities of vessels. Due to the vessel overlap, multiple projections are necessary to evaluate the coronary artery. To overcome this problem, Chen and Carroll (2000) proposed a technique of constructing of 3D coronary artery from 2D DSA image sequences employed with some bifurfication which reduces the overlapping area and automatically extract coronary artery but this required number of bifurfication and does not consider the noise effects. Franchi *et al*. (2009) deals in highlighting the vessel in a given projection of DSA image, an efficient segmentation algorithm for 2D x-ray DSA images is produced by reducing false positive and false negative employing anisotropic Gaussian filter technique and the technique is applicable to a noisy images also. The computational time will be more and the method is semiautomatic and it requires human interventions. Few researches have dealt (Shechter *et al*., 2005; Blondel *et al*., 2006; Hansis *et al*., 2008) with iterative reconstruction of coronary arteries from 2D x-ray angiography data. It analysis the compensation for cardiac and respiratory motion. The visualization of blood vessel depends on the injection of contrast material. To validate this, experiments were conducted on the live animal (De Lin *et al*., 2008). This is important for blood vessel visualization but sometimes overdose of the contrast material leads to misinterruption of data. Therefore, the image quality of DSA image is increased (Baia *et al*., 2006) by a new algorithm named adaptive bolus chasing CT images. In this study, bolus peak position and imaging can be synchronized. Table position and various parametric measurements may leads to misregistration of data. Various image registration techniques (Shechter *et al*., 2005) have been proposed for motion correction and to suppress the background structure. Artificate appears even if DSA images subjected to motion correction oscillation caused by CAD in peripheral arteries is experimentally determined using arterio-oscillagraphy

(Pouladian *et al*., 2005) and the the study does not deal with stenoses analysis and stent enhancement. Enhancement of coronary vascular structure is required a result of preprocessing. Vessel extraction is the main concern of information extraction. To further enhance the quality of DSA images, it is subjected to post processing techniques such as histogram equalization, thresholding and morphological analysis (Zana and Klein, 2001). Vessel fancy pattern is detected based on mathematical morphological operations and curvature evaluation algorithm. Only limited to eye fundus and can be used for other general images rather than medical images. Further, a method is proposed to determine stenosis occultation experimentally, analyzed using software phantoms (Puentes *et al*., 1998). System is semiautomatic and it does not show any measurement or calibration of stenosis. Irrigation deficiency produced by stenosis is highly documented by Gil *et al*. (2008). However, visualization of stents in conventional angiography images is difficult and challenging, indeed coronary stent are characterized by their low tranny-opacity and fast motion. The recommended solution for stent and irrigated regions visualization is a stent enhancement technique that is proposed by Bismuth *et al*. (2011). The study involves landmark detection tracking, image registration, image combination and display processing to enhance the stent deployment in a coronary artery. This algorithm enhances the stent images to identify the irrigated area. The approach is proposed to completely analyze the DSA images, starting from removal of artifacts to image enhancement, stenosis analysis and measurement and stent image enhancement.

Process flow overview of the proposed method: According to the capturing rate the angiography video images are converted into image slices. First step comprises of image subtraction. For image subtraction two images namely mask and phase images are considered with no deviation in frames and in the pixel values. Subtraction is carried out to remove patient anatomical structures thereby ensuring clear visualization of blood vessels. The second step, comprises of post processing techniques such as image convolution, equalization, thresholding, morphological operations and particle analysis for further enhancement of the DSA image. After subtraction an image mask is created from the entire image with a Region of Interest (ROI). An image mask is an image containing values of 0 and 1. The mask image is further convoluted to highlight the edges of the image. Then, a low pass smoothing filter is employed to smoothen the image by eliminating background details and blurring the edges with a kernel size of 3×3. Equalization is done to increase the intensity dynamics of the image and distribute a given gray scale interval over the full gray scale. Thresholding is carried out to perform background correction by eliminating the non uniformity lightening effect using interclass variance thresholding algorithm with a kernel size of 64×64. Thresholding is followed by a morphological operation which removes the unwanted particles and smoothens the contour of the object with a 3×3 structuring element and the artery subjected to stenosis alone is extracted. From the extracted image, the shape and the thickness of the stenosis is determined automatically using the proposed tool. The complete process flow of the proposed method is shown in Fig. 1.

Image equalization: Histogram equalization is a straightforward image-processing technique often used to achieve better quality images in black and white colour scales. The most common standardization technique is histogram equalization where one attempts to change the histogram into a flat, kit or equalized histogram in which

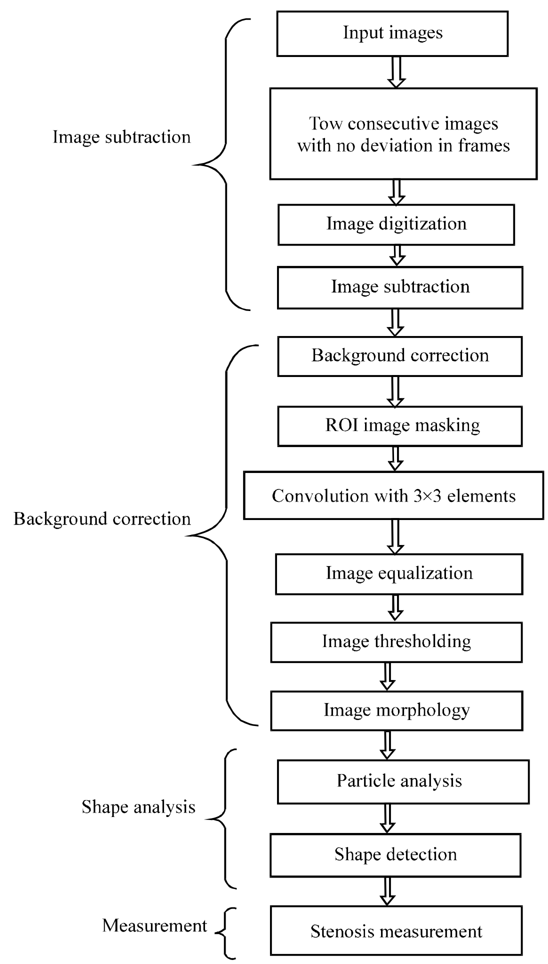

Fig. 1: The process flow of the proposed research

every pixel value occurs equally frequently. The expectation is that this maximizes the information conveyed in the image and that the transformed image has an enhanced appearance. It increases the intensity dynamic by distributing a given grayscale interval [min, max] over the full grayscale [0, 255]. This function redistributes pixel intensities in order to provide a linear cumulated histogram.

Thresholding: Thresholding according to intensity/ brightness is a simple technique for images which contain solid objects on a background of different but kit, brightness. Each pixel is compared to the threshold: if its value is higher than the threshold, the pixel is considered to be "foreground" and is set to white and if it is less than or equal to the threshold it is considered "background" and set to black. The success of thresholding depends critically on the selection of an appropriate threshold. Segments pixels in grayscale images. There are different types of thresholding. Manual threshold operation enables to select ranges of grayscale pixel values. Local threshold operations select pixels using a locally adaptive thresholding algorithm. It is used in applications whose images exhibit non-kit lighting changes that may result from a strong illumination gradient or shadows. The proposed method performs a background correction with a kernel size of 64×64 to eliminate non-kit lighting effects and then performs thresholding using the interclass variance thresholding algorithm.

Morphological analysis: Morphological image processing consists of a set of operations that transform images according to rules of set theory. The bog standard idea in binary morphology is to probe an image with a simple, pre-defined shape, called the structured element, drawing conclusions on how this shape fits or misses the shapes in the image. The value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbours. By choosing the size and shape of the neighbourhood, researchers can construct a morphological operation to extract the vessel pattern that is sensitive to specific shapes in the input image (Zana and Klein, 2001). Vessel fancy pattern is detected based on mathematical morphological operations and curvature evaluation algorithm only limited to the eye and can be used for other general images rather than medical images. Dilation and erosion are two fundamental morphological operations. Dilation adds pixels to the boundaries of objects in an image whilst erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image. Dilation and erosion are often used in combination to implement image processing operations. Morphological operations are generally neighbourhood based (the new value of the Pixel Under Inspection (PUI) is determined from the values of its neighbouring pixels). Morphological operations are very similar to filters except the kernels used are dependent on the original value of the PUI. The bog standard morphological operation used in our approach is properly open It removes wee particles and smoothes the contour of objects based on the structuring element. The structuring element used is 5×5. It is a finite and dual combination of openings and closings. Standard morphological operation is followed by advanced morphology. It perform high-level operations on particles in binary images such as removing wee particles from an image, labelling particles in an image or filling holes in particles with specified iterations.

MATERIALS AND METHODS

Using the real time CT x-ray images that we collected from the Government Rajaji Hospital, Madurai the researchers performed a simulation to test the feasibility and performance of the proposed method. The real time dataset includes the DSA images of coronary arteries. The images were acquired on a Toshiba see arm machine which is equipped with a image intensifier and a digital flat panel detector The imaging modality provides single plane (2D) fluoroscopic cine window. The scans are performed at 15-30 frames sec^{-1} (fps). The data sets were saved in the Digital Imaging and Communication in Medicine (DICOM) format, a medical standard in most modalities for transfer of images, movies and other diagnostic data (Baia *et al*., 2006). Each DICOM patient data file was opened then the film information was extracted and saved as a windows media video clip (AVI). An algorithm is developed using National Instrument Lab VIEW (Version 11) to extract the frames in cine sequence and processes these images for analysis.

Problem formulation: The heart is a muscular organ that pumps blood to the body at an average of 72 times min^{-1}. Oxygen and nutrients serve as a fuel supply to the pump and are carried to the heart in the form of blood that flows through the coronary arteries. Thus, the coronary arteries serve as fuel pipe lines to the heart muscle. The three major coronary are arteries (Left Anterior Descending (LAD), Circumflex (Circ) and Right Coronary Artery (RCA)). Coronary arteries have muscle fibers within their walls. By contracting the muscle, the artery can reduce blood flow; relaxing the muscle increases flow. In this way, the coronary arteries can regulate blood flow to different portions of the heart. Occasionally, the coronary arteries that supply blood to the heart muscle become hardened and narrowed due to the build-up of plaque (fat deposits) on their inner walls, termed atherosclerosis. As the plaque increases in size, the interior of the arteries, the lumen, gets narrower (stenoses) and less blood can flow through them. Eventually, blood flow is reduced and the heart muscle does not receive sufficient oxygen. This can result in a myocardial infarction (heart attack) when a blood clot develops at the site of the plaque and suddenly cuts off most or all of the blood supply causing permanent damage to the heart muscle. The patients affected by atheroscelorosis are subjected to x-ray exposure and images are obtained to identify the stenosis (Blondel *et al*., 2006). The images are performed with a C-Arm rotational angiography system by acquiring frames 30-65 frames sec^{-1} at a maximum x-ray peak voltage of 150 kVp and a maximum tube current of 800 mA. The images are acquired before and after injecting contrast medium to visualize the blood vessels clearly. The whole process of acquiring the image, digitization and subtraction process is done using the C-Arm machine along with the DICOM Software which is cost effective and cannot be used in rural areas. In the hospital the clinician manually diagnosis the stenosis from the phase image and accordingly and approximately the thickness of the stenosis is measured and the stent is employed. Conventional angiographic images contain approximately 512×512 pixels and inspecting these images can be labor-intensive for a radiologist or physician (Bentoutou and Taleb, 2005) and many times it leads to misinterpretation of image analysis and this miscalibration of stenosis which leads to stroke. The proposed method uses Lab VIEW Software for image analysis and accurate determination of thickness of stenosis. The real time images are considered for image analysis. The slices of images are acquired at certain intervals for different doses of contrast medium till the clear image is obtained. Each slice of image consists of 30-75 frames sec^{-1}. The proposed tool extracts every frame in the cine sequence and is subjected to digitization and TMDSA thereby helps to visualize the blood vessels clearly. For example, if each pixel in the current frame is subtracted from its counterpart pixel in the mask frame, stationary objects in the sequence will be suppressed. This will increase the quality of the image and hence the resolution is improved and a high definition image is obtained. The image obtained is a grayscale image (pixel with only one intensity value). Further, advanced post-processing techniques are being developed to support effective diagnosis with CTA data and therefore, Laboratory Virtual Instrument Engineering Workbench (Lab VIEW) Software is employed for qualitative and quantitative analysis of data.

Experimental analysis clinical DSA: The equipment used for the examination of DSA consists of a radiographic table, an x-ray tube and a tele-fancy monitor. Fluoroscopy which converts x-rays into video images is used to watch and guide the progress of the procedure. The video is produced by the x-ray machine and an x-ray image intensifier is suspended over a table on which the patient is laid. In ordinary x-ray machine the x-ray tube can access a power of 100 mA whereas x-ray tube employed with C-Arm equipment can access a power of 1200 mA and therefore the amount of x-ray generation is more and thereby for 2 sec 30-45 frames is obtained. Single plane contrast angiograms are performed in the Anterior Position (AP Strat), Caudial View (CV), Cranial view, Right Anterior Oplique (RAO), Left Anterior Oplique (LAO) position or in the region of interest during power injection of iodinated contrast material at a rate of 3-5 mL sec^{-1} using a 9 inch image intensifier, 20-25 filming was performed at 25-60 frames sec^{-1}. The modes of image employed in the machine are DSA mode, dynamic imaging mode and Serial Image Pulse Mode (SIPM). Any mode can be used to view the image. But for clinical image analysis is DSA mode. Images are obtained by passing light photons from the CRT into the patient's body and are detected by the flat panel detector. The detected photons are further processed using a photo multiplier tube in the flat panel detector. These processed images are used for digitization and subtraction. The contrast agent (dose) used is iodine and the actual dose varies with patient weight and anatomy being imaged. The clinical method does not concentrate on digitization and subtraction of all the frames and thereby the lesions are identified visually and measurements are done approximately by taking into account three or four images. Moreover, even though C-Arm machine set up is capable of producing images of higher resolution, it is cost effective and limits its usage mainly in wee hospitals and in rural areas. Since, the interventional radiology procedure required high quality image for diagnosis, researchers have gone the proposed methods for image analysis using Lab VIEW Software which satisfies the clinician criteria and is user friendly. The clinical qualitative analysis of the image is shown in Fig. 2. It is found that the background object is not suppressed completely and therefore it is difficult to find the stenosis. The arrow mark in Fig. 2c shows the background object which is an obstacle to view the blood vessels. Figure 3 and 4 show the analysis of the clinical phase

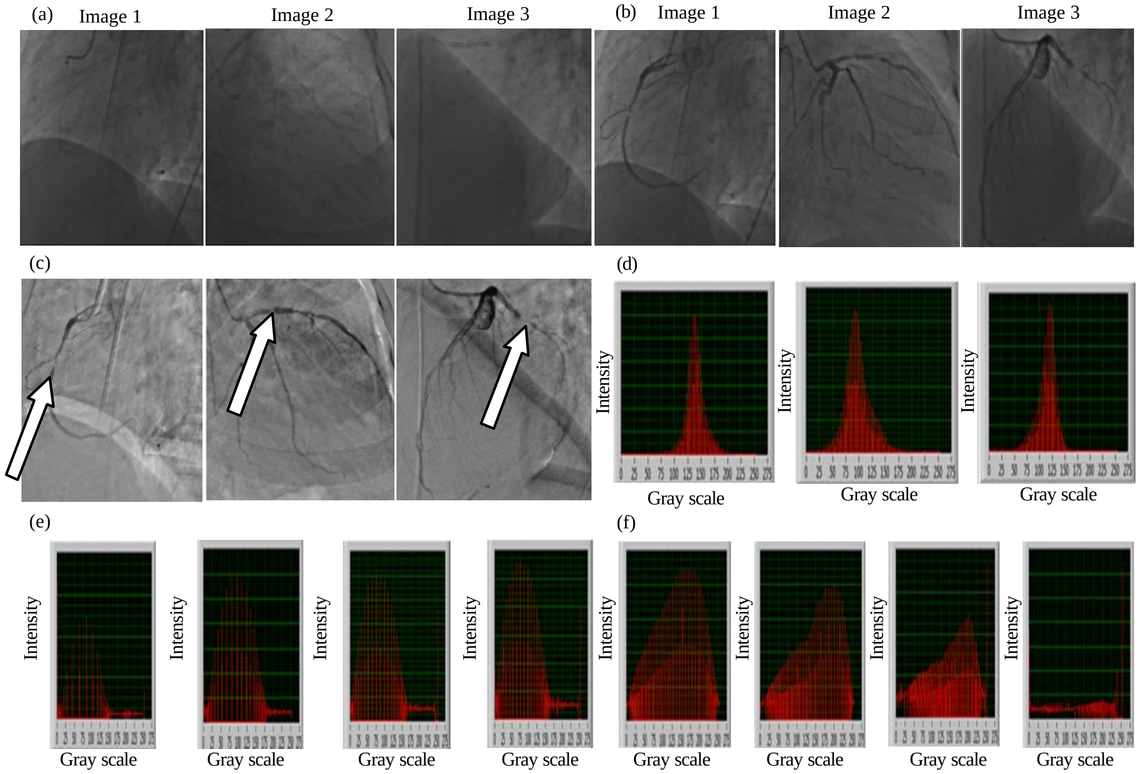

Fig. 2: Clinical analysis of image; a) mask image; b) phase image; c) clinical subtracted images; d) histogram of clinical phase image; e) histogram analysis of brain images and f) histogram analysis of renal image

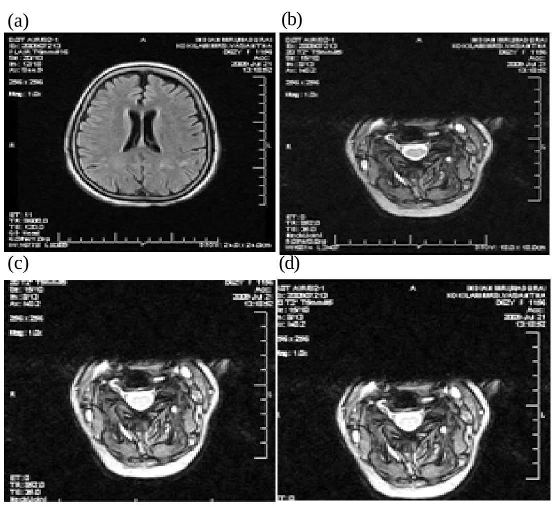

Fig. 3: Brain angiographic image; a) mask image; b) phase image; c) linear subtraction of images and d) logarithmic subtraction of images

image brain angiographic images and renal image. It is found that for coronary angiogram the intensity values are not distributed to the entire grayscale values and therefore the quality of the image gets degraded and for the brain image and renal image the intensity distribution of mask image, phase image, linear subtraction and logarithmic subtraction is shown in Fig. 2e.

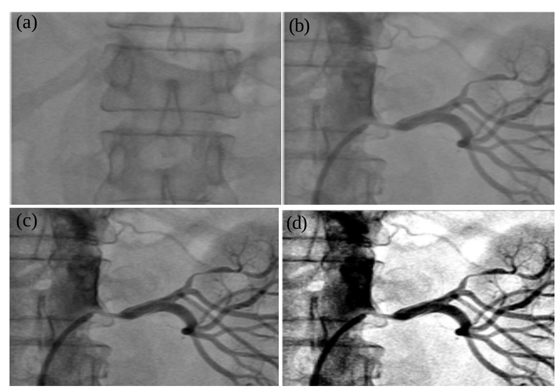

Fig. 4: Renal Angiographic image; a) mask image; b) phase image; c) linear subtracted images and d) logarithmic subtracted images

Proposed DSA: The real time dataset used here was collected from the Government Rajaji Hospital, Madurai, Tamilnadu, India. For analysis, images with different angles LAO 61 (Left Anterior Oplique), RAO 31 (Right Anterior Oplique) and Cranial view (CRAN) 25 is considered. The images include a mask image and series of phase images of coronary arteries. The phase images comprise of 20 image slices which in turn consists of 15-66 frames sec^{-1}. Using the Lab VIEW Software, all the frames of the phase image are digitized and subtracted with the digitized mask image and it is described by study. Through, this process the quality of the image is improved and it enhances the clear visually of the blood vessels eliminating the surrounding tissues and the obtained image is a Digital Subtracted (DSA) angiography image. The registered DSA is further subjected to post processing techniques to extract the affected vessels using the proposed software and it automatically selects the high defined image to identify the lesions and also the thickness of the lesions or stenosis is calibrated and calculated accurately. The proposed system overcomes the limitation of the clinical method such as misinterpretation of images and miscalibration of stenosis and produces the images with improved quality.

RESULTS AND DISCUSSION

In this study, the qualitative and quantitative performance of the proposed technique is validated. The dataset used for the evaluation consist of sequences of 512×512 images and has a gray value resolution of 8 bit and the grey values varied from 0-255, i.e., 256 grey level. The proposed method has been validated both on synthetic data and real time DSA and has been applied to test set of 15 DSA drawn from clinical practice for the purpose of analysis, researchers have considered three different patient images. The intensity distribution of the subtracted image is shown in Fig. 2d and f. From the intensity curve, it is found in the clinical phase image shown in Fig. 2d, the grey values are not distributed over the entire scale and it is narrowed down and therefore the image is not that much clear dice to identify the stenosis. A viewpoint determination algorithm is proposed by Sato *et al.* (1998) to identify the stenosis and to obtain a mint quality of image. But the determination of optimal view point is a difficult task in clinical applications. Therefore, as stated before, the TMDSA technique is emphasized linear subtraction in which only some part of the artifacts were eliminated and to further to highlight the foreground vessels we are going for a logarithmic subtraction. In order to extract the vessel alone the registered DSA is further subjected to image processing technique and it is shown in the Fig. 5. By choosing the size and shape of the neighbourhood, researchers can construct a morphological operation to extract the vessel pattern that is sensitive to specific shapes in the input image (Zana and Klein, 2001). The final image is a extracted vessel alone fro where the stenosis can be identified clearly. In order to evaluate the quality of the enhanced image over the clinical angiogram, the Signal to Noise Ratio (SNR) and Contrast to Noise Ratio (CNR) is estimated. For medical imaging, the goal is to

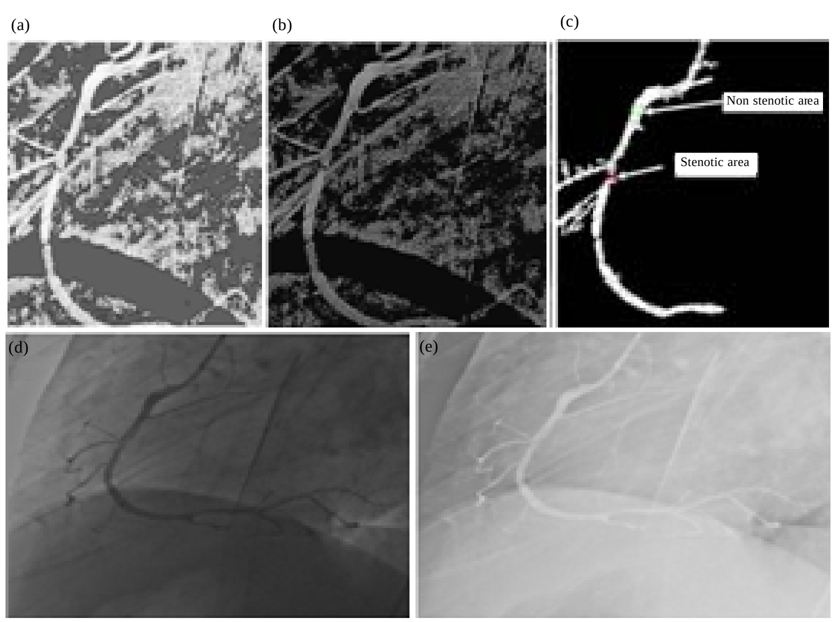

Fig. 5: Image processing techniques; a) threshold image; b) filtered image; c) extracted vessel to identify the stenosis (Morphological analysis); d) image after stent deployment and e) image negative after stent employment

Table 1: Quantitative assessment of clinical parameters

Images	Image 1	Image 2	Image 3
Angles (deg)	Lao 61 cranial	Rao 31 Cao 0	Cao 61 Cra 20
x-ray peak (voltage)	87.02	86.59	100.16
Exposure time pulse width (mS)	378	340	333
Tube current (mA)	458	460	795
Source image distance (mm)	1020	1000	1200
Field of view (mm)	150	150	150
Frame per second	60	54	53

Table 2: Quantitative analysis of clinical phase image and proposed enhanced DSA images

	Image 1			Image 2			Image 3		
	Clinical	Proposed		Clinical	Proposed		Clinical	Proposed	
Sl. No	Phase image	Linear sub	Log sub	Phase image	Linear sub	Log sub	Phase image	Linear sub	Log sub
Min.	33.00	33.00	32.00	38.00	37.00	37.00	16.00	15.00	129.00
Max.	151.00	141.00	150.00	141.00	140.00	140.00	127.00	126.00	222.00
Mean	79.02	72.13	126.11	73.16	72.16	113.80	63.75	62.76	189.92
SD	13.78	14.40	6.88	18.04	18.04	11.18	12.98	12.99	9.06
SNR (dB)	15.16	13.90	25.26	12.16	12.04	20.15	13.82	13.68	26.43
CNR (dB)	8.56	7.50	17.15	5.71	5.71	9.21	8.55	8.54	10.26

Table 3: Determination of length of stenosis for clinical and proposed method

Methods	Minimum value of stenosis area (mm)	Maximum value of stenosis area (mm)	Mean value of stenosis area (mm)	Standard deviation of stenosis area (mm)	Length of stenosis (mm)
Clinical	1.26	2.88	2.24	0.37	23.91
Proposed	0.00	255.00	115.20	126.40	21.02

distinguish a foreground structure from the background. In such cases it is better to estimate the Contrast to Noise Ratio, CNR, rather than the Signal to Noise Ratio, SNR which is more useful and for the angiographic vessel enhances the value of CNR must be less than the value of SNR. The quantitative estimation of clinical parameter analysis is given in the Table 1 and the estimation for the clinical images and the enhanced image using the proposed tool is given in the Table 2. It is found that the SNR of the enhanced images is greater than the SNR of the original images and CNR is less than that of SNR from which we tend to conclude that the enhanced images have a more coherent image quality than the original. The stenosis can be measured by taking into consideration the non-stenotic area and stenotic area which is shown in Fig. 5c. The proposed tool automatically identifies the length of the stenosis and it is compared with clinical stenosis measured value. The area or the length of the stenosis is determined by considering the stenotic area and the non stenotic area and it is shown in Table 3.

CONCLUSION

By considering the stenotic area of the artery as reference, the length of the lesion is determined and it is found to be closer to the clinical diagnosed value images is proposed. Further, to extract the affected vessel separation image processing techniques such as equalization, histogram, thresholding and morphological analysis is carried out. The length of the stenosis is measured using Lab VIEW Software. For DSA images, qualitative and quantitative analysis and the comparison of clinical method with the proposed method is done. The experimental results conducted in real time clinical data have shown the feasibility of the proposed method. The technique employed not only for coronary angiograms but also for angiograms such as brain, renal and neck. It is found that for clinical diagnosis and analysis of coronary angiogram, it is feasible to use the Lab VIEW Software along with the C-arm machine. Future graft will involve the stent enhancement analysis and experimental verification of restonosis deployment.

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