FAST ENHANCED CT METAL ARTIFACT REDUCTION IN MEDICAL IMAGE AFFECTED BY DEEP METALLIC IMPLANT

T.Gophika[*], M. Moghana priya[*1], S. Monisha[*2], R. Minukumari [*3]

***Assistant Professor, Department of ECE*

[1]*EASWARI ENGINEEERING COLLEGE, RAMAPURAM, CHENNAI*

[2]*EASWARI ENGINEEERING COLLEGE, RAMAPURAM, CHENNAI*

[3]*EASWARI ENGINEEERING COLLEGE, RAMAPURAM, CHENNAI*

[*]*EASWARI ENGINEEERING COLLEGE, RAMAPURAM, CHENNAI*

Abstract: *3D X-ray commercial computed tomography is especially appropriate for MMC examination, as it lets you to capture internal interfaces and external interfaces of every single material of the fully assembled part. 3DXCT enables material analysis such as exploration of material properties such as internal defects of porosity and detection. As it causes severe artifacts, the presence of highly absorbing metal within low absorbing plastics strongly impacts the 3DXCT analysis. Dark-band or the streaking artifacts or may distort neighbouring areas with lower density materials in the reconstructed volume and may also hinder dimensional measurement tasks. It is a great challenge to reduce the production of streaking and dark-band bands using the reconstructed volume without having to know more about its geometry and materials. we focus on (MAR) metal-artifact reduction technique were this technique uses 2D projections obtained during the 3DXCT scan. In the first stage of workflow the original set of projections reconstructs a 3D volume. In the second phase, the metal parts are divided into a reconstituted 3D volume. In the Third stage segmented voxels from the 3D reconstruction space to the 2D projection space are maped using forward projection. This determines to subsequently remove the metal areas from each projection .The emptied regions are interpolated from adjacent areas without metal content. The next stage, to reconstructs a 3D volume with reduced artifacts and without metal from the corrected projections. Finally, the 3D volume is fused with the metal parts, extracted from the originally reconstructed 3D volume. We evaluate workflow of MAR connector housings using various real-world MMCs.*

Keywords: : *MAR, Deep Learning, Artifact, Deep Metallic Implant.*

1. INTRODUCTION

Computed Tomography (CT) has become an invaluable imaging tool for diagnosing or further evaluating various medical conditions. With evolving technology, reduced acquisition times and improved resolution, the use of CT has increased tremendously in recent years. It is found that more than 85 million scans such as CT and MRI were performed in the United States in 2011. Several researchers have documented the growing use of CT scans. Trauma is one of the medical domains that attract wide use of the computed tomography modality. In India, more than 1.2 million trauma patients are reported annually. Among these trauma cases, a common reported problem is scratches on CT images near the metal implant. Nowadays, three-dimensional (3D) imaging is one of the most successful clinical applications. where researchers also face various problems. High-density materials are present in CBCT images such as metal implants and dental fillings and create a wide range of art objects. The materials have created a reduction in image quality and altered bone formation around metal. This algorithm, which comes from the data acquisition component, can be used in conjunction with other mitigation algorithms that alter the scanning algorithm to reduce artifacts. Computed tomography (CT) imaging techniques have been developed and researched for nearly 40 years. Metal objects such as a dental filling, artificial hip, spine implant, or surgical clip in the field of view will strongly attenuate x-rays or even completely block their penetration, resulting in corrupt or missing projection data received by the detector known as artifacts. It may result in the improper Diagnosing of the report of the concerned patient. We will discuss some advanced methods to correct artifacts. The longest-lasting image of the image quality is a metal object, such as a tooth filling, a prosthetic hip, a spinal implant, or a surgical clip. The metal objects in the field greatly reduce x-rays and block their penetration, leading to deceptive or lost speculation information detected by the detector. Due to incomplete data the reconstructed image leads to an unnatural change in appearance, known as an artifact, which is often seen as a bright or dark light in an image. The Errors in CT number throughout the image affects the diagnostic ability and also affects hinder accurate distinction of tissue types. This is especially true of radiation therapy in the form of cancer treatment, where improperly performed tumors and surrounding tissue can spread to dose-calculating errors that significantly affect the success of treatment. Another clinical area in which metal artifacts are a major impediment is orthopedics due to the high quality of high-demand imaging near metal implants Overcoming CT artifact caused by metal objects, extensive research and development efforts have been devoted to reducing iron artifact reduction (MAR) over the past forty years.

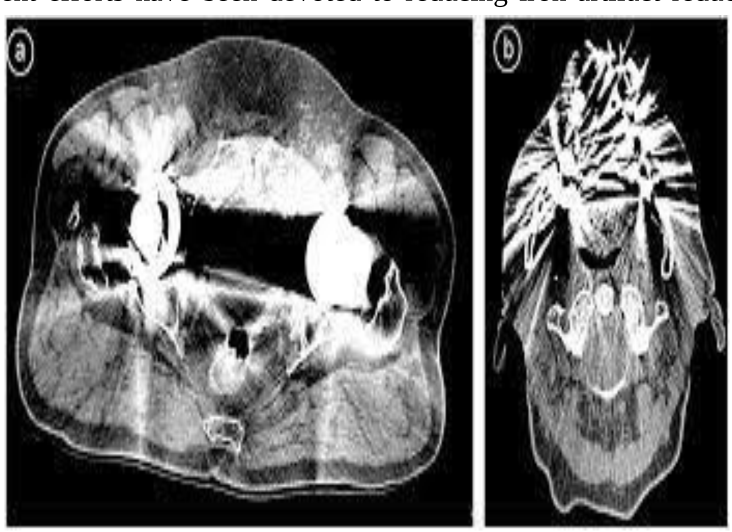

Fig : 1 – (a) & (b) image with artefact

2. RELATED WORK

We had proposed a new method which reduces the metal artifacts without degrading the image quality and improve the sinogram completeness. This paper proposes three-stage process:

- The first stage process is pre-filtering where The large scale non local means filter suppress the noise and enhance the original CT image.
- The second stage process is image segmentation , The metal artifacts and metallic objects are segmented using a mutual information maximize segmentation algorithm .
- The third stage process is sinogram in-painting , the exemplar totally based in-painting technique used to repair the corrupted projection data in sinogram By merging the segmented metallic object image with the filtered back-projection reconstructed image.
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From the in-painted sinogram we obtain the final corrected image. In both simulated phantom and clinical CT images quantitative and qualitative experiments have been conducted and a study has been done with Bal's algorithm which proposes a similar segmentation-based method.

3. PROPOSED SYSTEM

The proposed algorithm corrects reconstructed CT images. The projected data which is affected by metal fillings is detected and replaced. From the MR images, the missing projections are replaced with data obtained from the MR image. A study was conducted to compare the reconstructed images with the images reconstructed through linear interpolation, which is a common metal-artifact reduction technique along with the different thresholding techniques and correction algorithms accordingly. The outcome of this proposed method is successful in reducing intense metal artifacts without introducing enormous amount of secondary artifacts.

(I) Data Collection

For NMAR refinement network training 30 pre-operative CTs datasets without metal artifact was constructed. The field of view was 360 × 360 mm2 , and the matrix size was 512 × 512. For the region including the pelvis and proximal femur the slice thickness was 2.0 mm, for the femoral shaft region 6.0 mm, and for the distal femur region 1.0 mm. To make the slice thickness to 2.0 mm uniform throughout the entire volume a linear interpolation was performed. To perform a simulation study, we simulated metal artifacts on these 30 CT data.

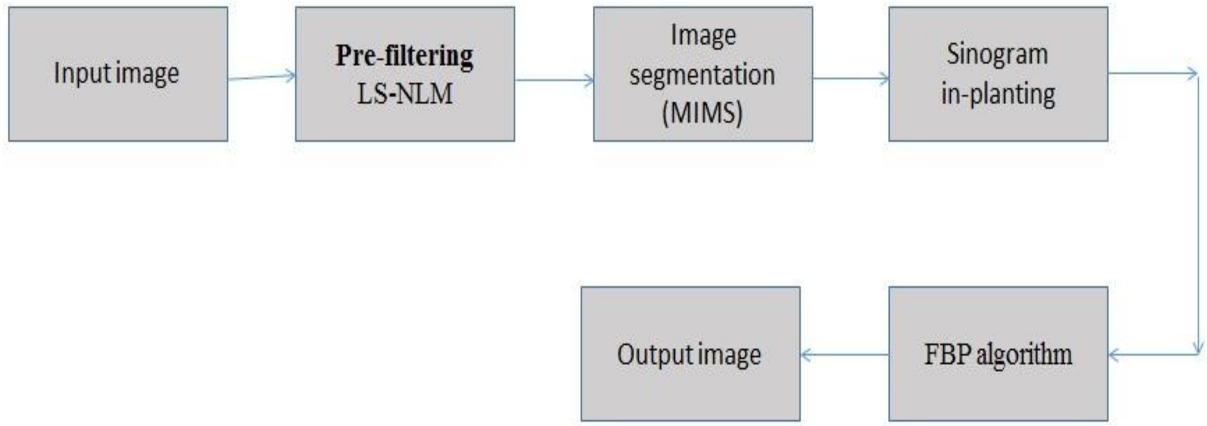

Fig :2- Block diagram

(II) Data Preprocessing:

Data preparation includes the following process such as data cleaning, data integration, data transformation, and data reduction. This steps are followed to suppress the noise and enhance the original CT image.

(III) Image segmentation:

For image segmentation we are using mutual information maximized segmentation algorithm method. Which uses two step mutual information based algorithm.

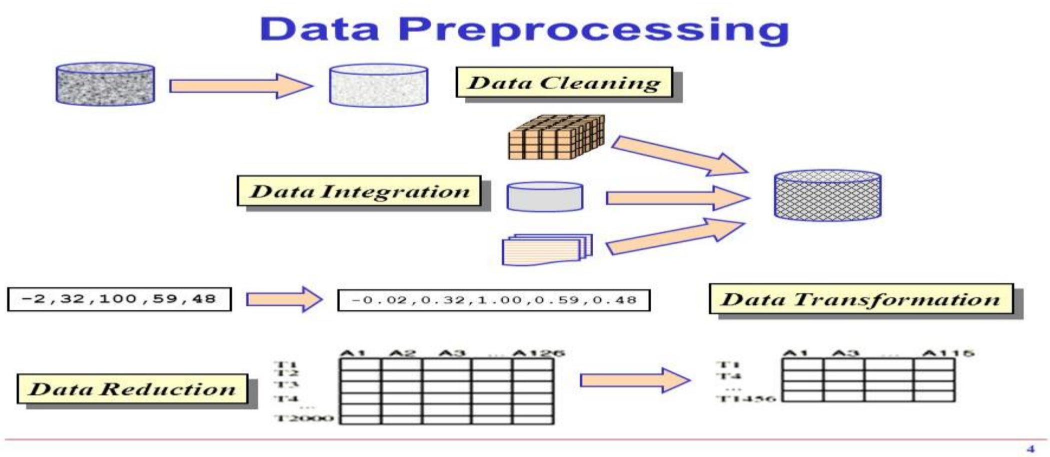

Fig :3- data preprocessing

(IV) sinogram inpainting

once the steel gadgets and artifacts had been extracted, the segmented artifact photograph is forward projected to decide the projection statistics within the sinogram space which are suffering from the artifacts. A subtraction is done between the corrupted sinogram and the unique one. The missing projection facts within the subtracted sinogram are then restored the use of a changed exemplar-based totally in-portray approach.

(V) backward projection

The artifact remunerated photograph is then reconstructed from the in-painted sinogram the utilization of the Forward Back Projection algorithm. Afterward, the closing corrected photograph is acquired with the aid of using putting the formerly segmented steel issue into the reconstructed photograph.

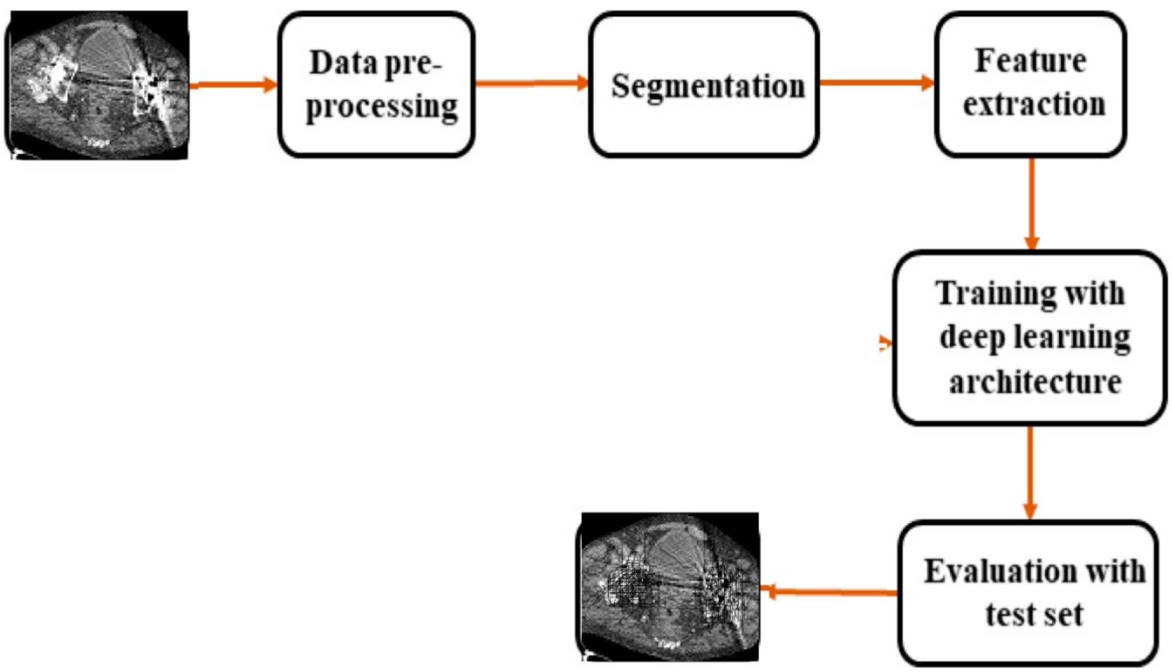

Fig :4- Flow chart of method used

4. IMPLEMENTATION RESULT

Fig :5 Input image with artifact and output image without Artifa

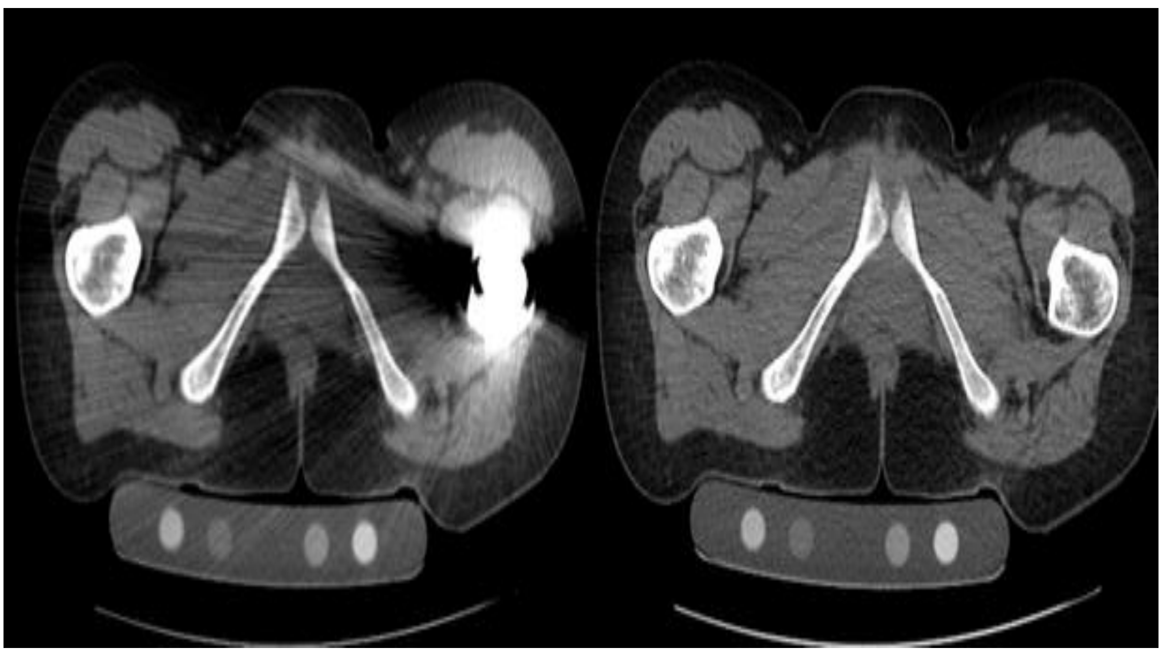

Fig :6- Image with and without artefact

The image (a) CT image including metal artifact.
The image (b) output image with reduced artifacts.
The output images are obtained after the three stage process and the final corrected image is obtained by merging the segmented metallic object image with the filtered back-projection reconstructed image from the in-painted sonogram.

5. CONCLUSION

This proposed method reduces the metal artifacts without degrading the image quality and improve the sinogram completeness. This possessed method using sonogram in-painting is better than the existing method and it ensures that the anatomical structure close to metal implants are better preserved. Our results in the simulation experiment indicated that combining metal artifact reduction and segmentation methods is potentially effective in segmentation from postoperative image whose quality is severely degraded by the metal artifact.

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