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Accurate correction of Motion Artifacts in Medical Image

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Abstract- Respiratory Motion during the scan causes motion artifacts, in order to reduce these artifacts here is an algorithm called Pixel-specific back projection. PSBP is an approximate filtered back-projection algorithm that corrects for in-plane motion by performing the reconstruction using a coordinate system that is specific to each pixel. To reduce artifacts caused by respiratory motion in chest CT scans, an algorithm called pixel specific back-projection (PSBP) has been developed. PSBP is an approximate filtered back-projection algorithm that corrects for in-plane motion by performing the reconstruction using a coordinate system that is specific to each pixel. The coordinate systems move according to the in-plane motion in the slice at the time the projection was acquired. PSBP reduced artifacts caused by motion in both simulated and patient scan data.The coordinate systems move according to the in-plane motion in the slice at the time the projection was acquired. Depending on the intensity of the pixels this algorithm works.

***Keywords*: Artifacts, back projection, PSBP,Warping**

1. INTRODUCTION

Cardiac and respiratory motion can cause artifacts in computed tomography scans of the chest. These artifacts are clinically significant because they may obscure pathology or mimic disease. These noise, or artifact, sources include: line noise from the power grid, eye blinks, eye movements, heart beat, breathing, and other muscle activity. Some artifacts, such as eye blinks,produce voltage changes of much higher amplitude than the endogenous brain activity. In this situation the data must be discarded unless the artifact can be removed from the data. Crawford introduces an alternative algorithm called filtered back-projection. In this algorithm time-varying magnification motion model (TVMBP) was used. But this algorithm was not effective because the time-varying magnification model did not accurately describe in-plane respiratory motion nor did it account for cross-plane motion.

In this research further improvement of the algorithm is done. We are using Pixel-specific back-projection algorithm which implements time-varying magnification motion model on a pixel-by-pixel basis. Reconstruction is performed in a coordinate system specific to each system. By using this model we can minimize the motion artifacts in an image.

i)Eye Blink artifact: It is very common in EEG data, produces a high amplitude signal that can be many times greater than EEG signals of interest. Because of its high amplitude an eye blink can corrupt data on all electrodes, even those at the back of the head. Eye artifacts are often measured more directly in the electrooculargram (EOG), pairs of electrodes placed above and around the eyes. Unfortunately, these measurements are contaminated with EEG signals of interest and so simple subtraction is not a removal option even if an exact model of EOG diffusion across the scalp is available

ii) Eye Movement: These artifacts are caused by the re orientation of the retino corneal dipole [3]. The effect of this artifact is stronger than that of the eye blink artifact. Eye blinks and movements often occur at close intervals.

ii)Line Noise: Strong signals from A/C power supplies can corrupt EEG data during transfer from the scalp electrodes to the recording device. Notch filters are often used to filter this artifact containing lower frequency line noise and harmonics. Notch filtering at these frequencies can remove useful information. Line noise can corrupt the data from some or all of the electrodes depending on the source of the problem.

iv) Muscle Activity: These artifacts are caused by activity in different muscle groups including neck and facial muscles. These signals have a wide frequency range and can be distributed across different sets of electrodes depending on the location of the source muscles.

v)Pulse. When an electrode is placed on or near a blood vessel, it causes pulse, or heart beat, artifact. The expansion and contraction of the vessel introduce voltage changes into the recordings

2. DESCRIPTION OF PSBP

In TVMBP, the two-dimensional object function from which parallel projections are being measured is f(x,y). Crawford assumed that during projection acquisition, respiratory motion transformed the object function into f(x’,y’) where $x'=\alpha_x+\beta_x x$ and $y'=\alpha_y,+\beta_y y$. In these expressions, the α’s represent translations and the β’s represent magnification factors. Crawford showed that f(x,y) could be reconstructed by

$$f(x,y)=\int_0^{\pi} q_\theta\left(\left[\frac{(x-\alpha_x)}{\beta_x}\right]\cos\theta+\left[\frac{(y-\alpha_y)}{\beta_y}\right]\sin\theta\right)d\theta, \quad (1)$$

, where θ is the projection angle, and q_θ () is a projection convolved with a ramp filter. Note that in (1) the terms in square brackets are the inverses of the mapping of (x’,y’) into (x,y). Therefore, (1) demonstrates that f(x,y) can be recovered by back-projecting into the coordinates where the pixel was located at the time the projection was acquired. To derive (l), the time-varying motion model was assumed to be applied to the entire image plane. In PSBP we applied the time-varying motion model to individual pixels in the image plane. We assumed that the correction of one pixel would not generate artifacts in neighboring pixels that would affect the pixel being corrected. Instead of defining a specific motion model, we defined a general, spatially- and temporally-varying model of the form x’=G(x,y,θ) and y’=H(x,y,θ), where G and ***H*** were called warping functions and θ was a function of time.

This block diagram is a further extension of the TVMBP algorithm of Crawford.The reading and writing images are located at the beginning and end of the data processing pipeline. These classes are known as data sources (readers) and data sinks (writers). Generally speaking they are referred to as filters, although readers have no pipeline input and writers have no pipeline output.

CTX Algorithm reduces motion artifacts by performing the back-projection in a frame of reference that moves with the object. The motion during scanning is modeled as a shift and as a magnification about some origin point *(X0,* Y0). CTX uses projection data during back-projection that corresponds to the location at which each point resided at the time each projection was measured.

In CTX, let f(x, y) be the cross section that is to be reconstructed. A magnified and shifted version of *f (x ,* y), *f'(x,* y) is given by

$$f'(x,y) = f(\alpha_x + \beta_x x, \alpha_y + \beta_y y)$$

Where α_x and α_y, are shift factors, and β_x and β_y are magnification factors. Both the *α’s* and β’s the are assumed to be functions of projection angle θ**,** which is in turn a function of time. The direction of the *z* axis is assumed to be the superior-inferior direction, and the *z* axis is perpendicular to the xy-image plane.

A parallel projection *P’(θ, t)* of *f ’ (x , y)* is given by the radon transform

$$P'(\theta,t) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f'(x,y)\delta(t - x\cos\theta - y\sin\theta)$$

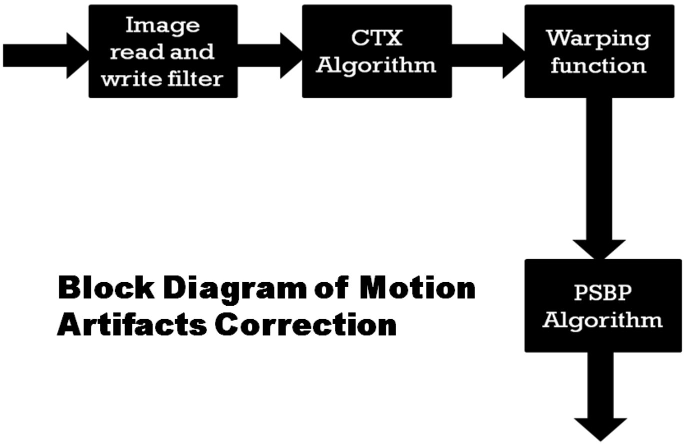
By substituting the inverses of G and ***H*** into (l),

$$\mathbf{f}(x, y) = \int_0^{\pi} q_\theta\left(\left[G^{-1}(x, y, \theta)\right]\cos\theta + \left[H^{-1}(x, y, \theta)\right]\sin\theta\right)d\theta, \quad (2)$$

f(x,y) can be recovered from projections measured from f(x’,y’).

3. METHODS AND MATERIALS

Here is a small block diagram which will explain about the motion artifacts correction.



Block Diagram of Motion Artifacts Correction

Image warping is the process of digitally manipulate image such that any shapes portrayed in the image have been significantly distorted. Warping may be used for correcting image distortion as well as for creative purposes While an image can be transformed in various ways, pure warping means that points are mapped to points without changing the colors. This can be based mathematically on any function from (part of) the plane to the plane. If the function is injective the original can be reconstructed. If the function is a bijection any image can be inversely transformed. **PSBP Algorithm**, each pixel is reconstructed in a frame of reference local to that pixel. To develop such an algorithm, we made the assumption that local Correction was valid in CT reconstruction. Although the CTX algorithm is mathematically correct, it is based on a model that does not describe motion in the chest. Furthermore, an exact back-projection algorithm could not be derived that accounted for this motion. Therefore, we made the assumption that the CTX model was valid only in a small region around each pixel, and that α and β parameters of the CTX model for each of these regions need not be identical. We then developed an algorithm in which each pixel was reconstructed in a frame of reference local to that pixel. To develop such an algorithm, we made the assumption that local Correction was valid in CT reconstruction.

To perform local correction, the motion in a body is first described by a temporally and spatially varying function (called a warping function). These warping functions are, in General, a function of space and projection angle.

$$x' = G(x, y, \theta)$$
$$y' = H(x, y, \theta)$$

where *(x'*, y') are the warped Cartesian coordinates, (x, y) are the nonwarped coordinates, θ is the projection angle, and G and *H* are the warping functions.

4. RESULTS AND DISCUSSION

Experiments for motion artifact reduction, a major problem of wearable images, was accomplished with real-time algorithm The paper summarizes the overview of Artifacts and their removal in medical image. Various techniques has been discussed for artifact removal..Artifacts are removed by using the Back-projection method of each pixels of one slice of image from a list of frame, and depending upon the intensity of each pixel in an image. Reconstruction of an image is done. Rescale Intensity Image filter is also used for pixel shifting.

Fig-1 shows a CT image of the chest with motion artifacts and Fig-2 shows an image after reconstruction using PSBP algorithm.

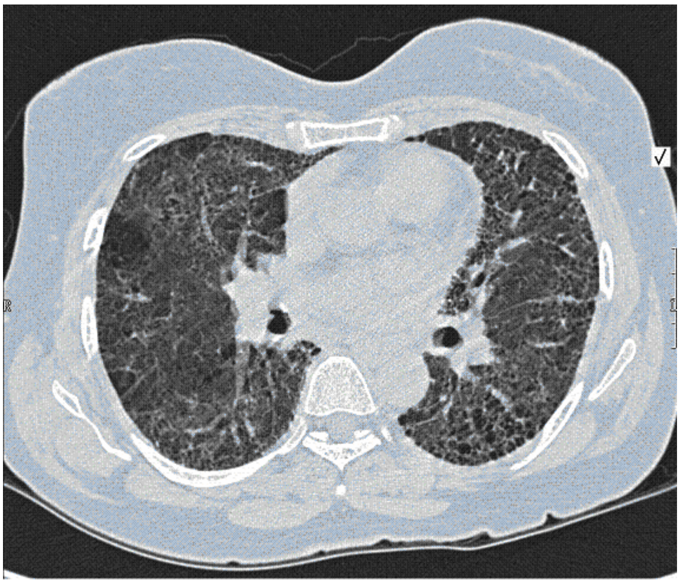


Fig 1- Image before reconstruction with artifacts

5. ACKNOWLEDGMENT

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Fig 2- Image after reconstruction using PSBP algorithm

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