Original Research Article

Construction a Three-Dimensional Model Fetus From Devices Ultrasound by Using Optical Scanning Hologram (Osh)

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Abstract

Photos of the fetus lacks the resulting devices ultrasound two-dimensional to the clarity and precision, leading to the emergence of the need to provide three-dimensional vision of the fetus allows visualization of the width and height and angle, in order to obtain information additional disclosure of the fetus and fetal abnormalities. In this paper we explain the way we generate three-dimensional models of the fetus from two-dimensional images using a computer system without the need to change the two-dimensional imaging equipment, and without the need for a sensitive site. Depends on the way we pass the sensor on the belly Pregnant above the fetus and conduct a survey of the entire manual body of the fetus from the top of his head and his feet until the bottom, and the survey Keota video store, then Send it to a computer is cut into several video images are stored and treated using the principles of digital image processing.

The second simulation is build a program to implement the Optical scanning holography(OSH) technology, where the recorded hologram of original image using fast Fourier transform FFT2. High contrast images were used to demonstrate numerical reconstruction process by Matlab. Sine, cosin, and amplitude holograms were reconstructed. Can the doctor to get the most accurate details of the new image by changing the angle and view stereoscopic images to a specific part of the body of the fetus.

Key words: Ultrasound, Optical Scanning Hologram, imaging fetus
Introduction

Researchers have developed a technique for imaging the human body using lasers, which would grant doctors the opportunity to explore the way comic Member 3D, which was a revolution in the world of medicine. Technical help on photographing the human body and internal organs, the early detection of diseases and tumors.

In this paper holographic Imaging (Holography) of the achievements of modern science and technology, holographic technology (Holography) which possess unique property to return the original objects picture three dimensions with a very high degree. The word holograiv is derived from the Greek word origin holos (Halos which all) graphic any writing the meaning the full picture or record art holographic.

An ultrasound Compute Tomography (CT) image is composed of pixels, whose bright correspond to the absorption of ultrasound in a thin rectangular slabs of the cross-section, which are call a ‘‘voxel’’ [1,3]. The Pixel Region tool provided by MATLAB R2010a superimpose the pixel region rectangle over the image display in the Image tool, defined the group of pixels that are displayed, in extreme close-up view, in the pixel region tool window. The pixel region tool show the pixel at high magnifications, overlay each pixel with its numeric value [1]. Scanning three-dimensional imaging (OSH) is a technique that three-dimensional (3-D) object of visual information able to be obtain by two-dimensional (2-D) scan [2,3]. That is, not only the capacity but also the recording phase field light object during the process. And called on the severity of recording such information scanned optical three-dimensional [7]. The object is illuminate by the interference pattern produced by the overlap of the two beams that coherent, which is scanned across the object. This contrasts with the traditional linear bond, which the reference beam and the object beam interfere with detection. This difference is the source of many exciting unique interesting of its kind for occupational health and safety that are not available in the three-dimensional conventional techniques is that the light emitted from the object does not need to be consistent [2]. The aim of this research was to improve the two-dimensional images into three-dimensional images using OSH technology and then was then improve the image of the fetus to the three-dimensional image without into the need device four – Ultrasound.

Materials and Methods

Fresnel transformation method

Fresnel Holograph refer to the configurative where the objects are optical distanceas of the plane hologram is off-axis with respects to reference wave plane[7] irreconstruction, lighting three-dimensional image with the results of reference nceplanean other wave in the images formigin the position of the object and the position of the mirror with respect to its three-dimensional image, with unit magnification. This is usually the reconstruction of the numerical out using Fresnel con version method, which is necessary for the recon struction from scratch every system and twin images without aliasing[7].

\[ S(x, y; z) = \frac{ik}{2\pi z} \exp \left[ i \frac{k}{2z} (x^2 + y^2) \right] \] .... (1)

Where \( S(x, y; z) \) Fresnel diffraction, \( z \) is distance and \( k \) is the wave number of light \( K = \frac{2\pi}{\lambda} \)

And the reconstructed wave field is;

\[ E(x, y; z) = \frac{ik}{2\pi z} \exp \left[ i \frac{k}{2z} (x^2 + y^2) \right] \]
\[ \times \int \int E_0(x_0, y_0) \exp \left[ i \frac{k}{2z} (x_0^2 + y_0^2) \right] \]
\[ \times \exp \left[ -i \frac{k}{2z} (xx_0, yy_0) \right] dx_0 dy_0 \]
\[ = \exp \left[ -i \frac{k}{2z} (x^2 + y^2) \right] \xi [E_0, S] \] ....... ...(2)

Where \( E_0(x_0, y_0) \) is the modify wave field, \( (x_0, y_0) \) of the point object. \( x, y \) and \( \xi [E_0, S] \) denote the spatial coordinates in the hologram and reconstruction plane, respectively.
The resolution $\Delta x$ of the reconstructed image determined directly from that can be represented as a function of diffraction Fresnel distance $z$ and reconstruction [5-8]

\[ z_{\text{min}} = \frac{a^2}{n_x \lambda} \] ....... (4)

Where $a_x = n x \Delta x$ represents the size of the hologram, and $n x$, is the number $\Delta x$ is the size of pixels, wave length of light. At a Very close, and the spatial frequency of the three-dimensional image of a very low aliasing occurs. Typically, the minimum object distance outside this position. Camera (1024 x 1024 pixels) resolution ($\Delta x = 0.213 \mu m$), (NA = 1.2).

**Reconstruction Holography**

This represents the reconstruction of sine-hologram, And it is expressed as a three-dimensional image of the hologram condition and term cosin of spatial frequency. then, we have [3,4,5].

\[ i_0(x,y) = Re \left[ \mathcal{F}^{-1} \{ \mathcal{F} \{ \Gamma_0(x,y;z) \} \} \right] O T F_{\Omega}(k_x,k_y;z) dz \]

\[ i_s(x,y;z) = \mathcal{F}^{-1} \{ \mathcal{F} \{ \Gamma_0(x,y;z) \} \} O T F_{\Omega}(k_x,k_y;z) dz \]

Where $O T F_{\Omega}(k_x,k_y;z)$ is the planar intensity

\[ \exp \left[ \frac{z}{2k_0} (k_x^2 + k_y^2) \right] = O T F_{\Omega}(k_x,k_y;z) \] ....... (7)

Indicates $Im \left[ \right]$ imaginary part of the quantititin side the $Re\left[\right]$ arc, and reindicatasa realpart of the content inside the area, and visual function transfer, and transparency amplitude of $\Omega_0(x,y;z)$ located on the $Z$ distance $\mathcal{F}^{-1}$. Impulse responses spatial optical system of the image shows a three-dimensional condition and cosine, three-dimensional image. Since two

\[ \Delta x = \frac{\lambda z}{N \Delta x_0} \]

$N$ is the represented number of pixels, $\Delta x_0$ is the represented width pixel of the camera CCD,

hologram can be store digital, we can also build a three-dimensional digital image using a complex equation[9,10,11,12].

\[ H_{c+}(x,y) = H_{cos}(x,y) = \int \left[ \left| \Gamma_0(x,y;z) \right|^2 + \frac{k_0}{2\pi} \exp \left[ \pm \frac{k_0}{2\pi} (x^2 + y^2) \right] \right] dz \] ....... (8)

$H_{c+}(x,y)$ is called a complex FZP hologram $H_{cos}(x,y)$ is the cosine-hologram, hologram, and $H_{sin}(x,y)$ is the sine-hologram; the sine-hologram will be expressed in terms of spatial frequencies. To obtain real image reconstruction produced in front of the hologram, we will use the follow equation:

\[ H_{any}(x,y) = h(x,y;z_0) \] ....... (9)

Where $H_{any}(x,y)$ represents any holograms, that is, the sine-hologram, the cosine-hologram or the complex hologram.

Digital reconstruct, we will simply convolve the above hologram with the spatial impulse responded in order to simulated Fresnel diffraction for a distance of $z_0$ To obtain real image, reconstruct is formed in front of the holograms, a planar object at a distance of $z_0$ away from the $x$-$y$ scanning mirrors, that is,

\[ \left| \Gamma_0(x,y;z) \right|^2 = I(x,y) \delta(z - z_0) \]

Where $I(x,y)$ is the planar intensity distribution.

**Reconstructed real image is**

\[ H_{c+}(x,y) = H_{cos}(x,y) + jH_{sin}(x,y) \] ....... (10)

Note that the complex hologram is constructed as

\[ H_{c-}(x,y) = H_{cos}(x,y) - jH_{sin}(x,y) \] ....... (11)
Figure 1: Image of foetal ultrasound obtained using ultrasound. The heart, spine and other features are clearly visible.

Figure 2: Original image

Figure 3: Sine–Fresnel zone pattern holography

Figure 4: Cosine–Fresnel zone pattern holography

Figure 5: Reconstruct of cos-holography

Figure 6: Reconstruct of sin-Fresnel zone pattern holography
Results and Discussion

In figure (1) is entered into the program. The dimensions of this image reduced by using (Microsoft Office Picture Manager) Program. The resulted dimensions became (640x480 pixels). The selected images is colored then converted to the difference colors scales. The program is designed using (MATLAB 2010a) and set its steps in the flowchart (1). The figure (2) shows the original image in the difference colors scales. Then optical transfer function (OTF) of OSH is complex numbers consisted of (640 columns) and (480 rows). The recorded hologram of the original images using Fourier transform consists of two holograms. The first hologram is sine–FZP hologram, the real part, as shown in figure (3) and the second hologram the cosine–FZP hologram, the imaginary part, as shown in figure (4). The sine and cosine the reconstruction image of parts are obtained by using the inverse Fourier transform as shown in figure (5) and figure (6) complex FZP respectively. The real image reconstruction of, Hologram \( Hc_+ \) is shown in figure (6) represent quiet similar to the original images and restoration of imaginary complex FZP, Hologram \( Hc_- \) is shown in figure (7) embody the negative of the original image. The figure (8) and figure (9) show original image of three-dimension figure (10) show pixel Region. In this research was to improve the two-dimensional images into three-dimensional images using OSH technology and then was then improve the image of the fetus to the three-dimensional image without into the need device four–Ultrasound.
Start OSH

Reading input image I

Displaying image size

Visualize original image in (pink or gray or summer) scale

For r=1:COLS

K_y=K_y+0.1

For c=1:ROWS

K_x=K_x+0.1

\[ \sigma = \frac{z}{2}K_0, \text{ rows}=800, \text{ cols}=600 \]
Creating OTF_{OSH}

Displaying the image ary part

cosin –FZP hologram

Displaying the image real part

sine –FZP hologram

Recycling hologram

Visualize sine –FZP hologram

In (gray, summer,pink) scale

Visualize cosin –FZP hologram

In (gray, summer,pink) scale

Recording hologram

Reconstruction of sine-hologram

Reconstruct of cosin-hologram

\[ FI=\text{fft}2(I) \]
Taking Fourier transform of I;

Visualize Reconstruction of sine-hologram

Visualize Reconstruction of complex FZP hologram

Visualize Reconstruction of cosin-hologram

\[ FH=FI*OTF_{osh} \]
Recorded hologram in Fourier domain

Imagine the reconstruction of the true picture of complex three-dimensional image of the FZP, HC

End
References