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# NOISE REMOVAL IN ULTRASOUND IMAGES

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***Abstract***

*This paper presents the noise cleaning of biomedical ultrasonic images and its VLSI implementation. An optimized architecture has been designed with proper parallelism and pipelining as well as removing redundancies. In Ultrasound Images the quality of image is degraded by a special type of acoustic noise known as speckle noise. This is reduces the ability of human observer to fetch important information from the image by masking the low contrast portions of the same, and this is multiplicative in nature. This noise can be removed through the homomorphic filter. The proposed method reduces the functional complexity when compared to the existing method. The VLSI implementation is done using modelsim 6.3 and xillinx 12.3.*

***Index terms***: *Ultrasound Images, Speckle noise, Homomorphic filter*

## 1. INTRODUCTION

Biomedical signal and image processing applications often need proper filtering since these signals or images are generally corrupted with a large amount of noise. In case of Ultrasound Images the quality of image is degraded by a special type of acoustic noise known as speckle noise.

Speckle is a random, deterministic, interference pattern in an image formed with coherent radiation of a medium containing many sub-resolution scatterers. The texture of the observed speckle pattern does not correspond to underlying structure. The local brightness of the speckle pattern, however, does reflect the local echogenicity of the underlying scatterers.

Speckle has a negative impact on ultrasound imaging. This noise is caused due to the scattering effect from the ultrasound beam former. This speckle noise reduces the ability of human observer to fetch important information from the image by masking the low contrast portions of the same. Bamber and Daft show a reduction of lesion detect ability of approximately a factor of eight due to the presence of speckle in the image. This radical reduction in contrast resolution is responsible for the poorer effective resolution of ultrasound compared to x-ray and MRI.

Conventional linear filtering approaches like mean filtering removes this noise to some extent but at the same time makes the image blurry. Homomorphic filtering is a much better option since it removes impulsive noise excellently while preserving the edge information.

To make the illumination of an image more even, the high-frequency components are increased and low-frequency components are decreased, because the high-frequency components are assumed to represent mostly the reflectance in the scene (the amount of light reflected off the object in the scene), whereas the low-frequency components are assumed to represent mostly the illumination in the scene. That is, high-pass filtering is used to suppress low frequencies and amplify high frequencies, in the log-intensity domain.

## 2. HOMOMORHIC FILTER

Homomorphic filter is sometimes used for image enhancement. It simultaneously normalizes the brightness across an image and increases contrast. Here homomorphic filtering is used to remove multiplicative noise. Illumination and reflectance are not separable, but their approximate locations in the frequency domain may be located. Since illumination and reflectance combine multiplicatively, the components are made additive by taking the logarithm of the image intensity, so that these multiplicative components of the image can be separated linearly in the frequency domain. Illumination variations can be thought of as a multiplicative noise, and can be reduced by filtering in the log domain. To make the illumination of an image more even, the high-frequency components are increased and low-frequency components are decreased, because the high-frequency components are assumed to represent mostly the reflectance in the scene (the amount of light reflected off the object in the scene), whereas the low-frequency components are assumed to represent mostly the illumination in the scene. That is, high-pass filtering is used to suppress low frequencies and amplify high frequencies, in the log-intensity domain.

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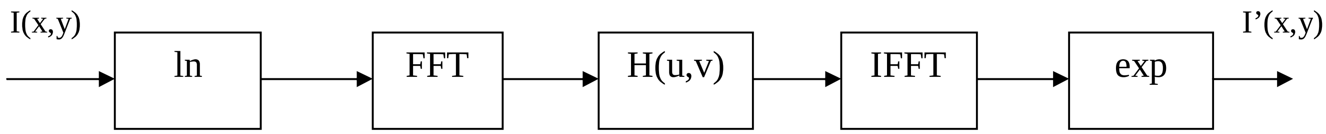


Homomorphic filtering is a generalized technique for image enhancement and/or correction. It simultaneously normalizes the brightness across an image and increases contrast.

An image can be expressed as the product of illumination and reflectance

$$\mathbf{f(x, y) = i(x, y) \cdot r(x, y)}$$

Now define

$$\mathbf{g = \ln f = \ln i + \ln r}.$$

Then

$$\mathbf{F\{g(x, y)\} = F\{\ln i(x, y)\} + F\{\ln r(x, y)\}}$$

$$\mathbf{G(u, v) = Il(u, v) + Rl(u, v).}$$

We then apply a filter to G:

$$\mathbf{S(u, v) = H(u, v)G(u, v) = H(u, v)(Il(u, v) + Rl(u, v)).}$$

In the spatial domain:

$$\mathbf{s(x, y) = F{-}1\{S(u, v)\}}$$

$$\mathbf{= F{-}1\{H(u, v)Il(u, v)\} + F{-}1\{H(u, v)Rl(u, v)\}}$$

$$\mathbf{= i0(x, y) + r0(x, y)}$$

We then exponentiate s(x, y) to get the enhanced image:

$$\mathbf{s0(x, y) = \exp(s(x, y)) = \exp(i0(x, y)) \cdot \exp(r0(x, y))}$$

$$\mathbf{= i00(x, y) \cdot r00(x, y)}$$

Now i00(x, y) and r00(x, y) are the illumination and reflectance of the "enhanced" image. The illumination component tends to vary slowly across the image. The reflectance tends to vary rapidly, particularly at junctions of dissimilar objects.

Therefore, by applying a frequency domain filter of the form

$$\mathbf{H(u, v) = (\gamma H - \gamma L)[1 - \exp[1 - c(D^2(u, v)/D^2{}_0)]\,] + \gamma\, L}$$

We can reduce intensity variation across the image while highlighting detail.

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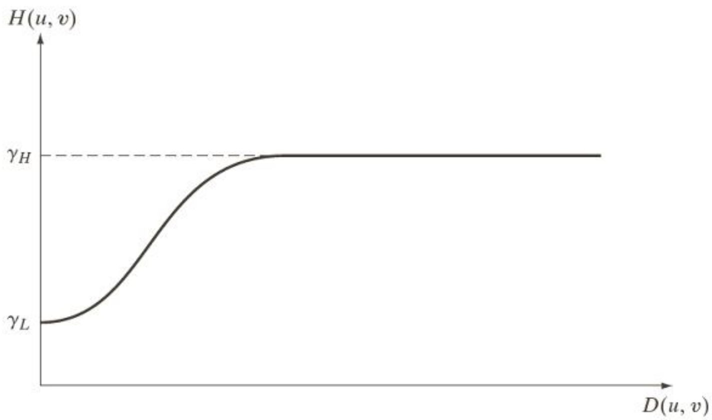
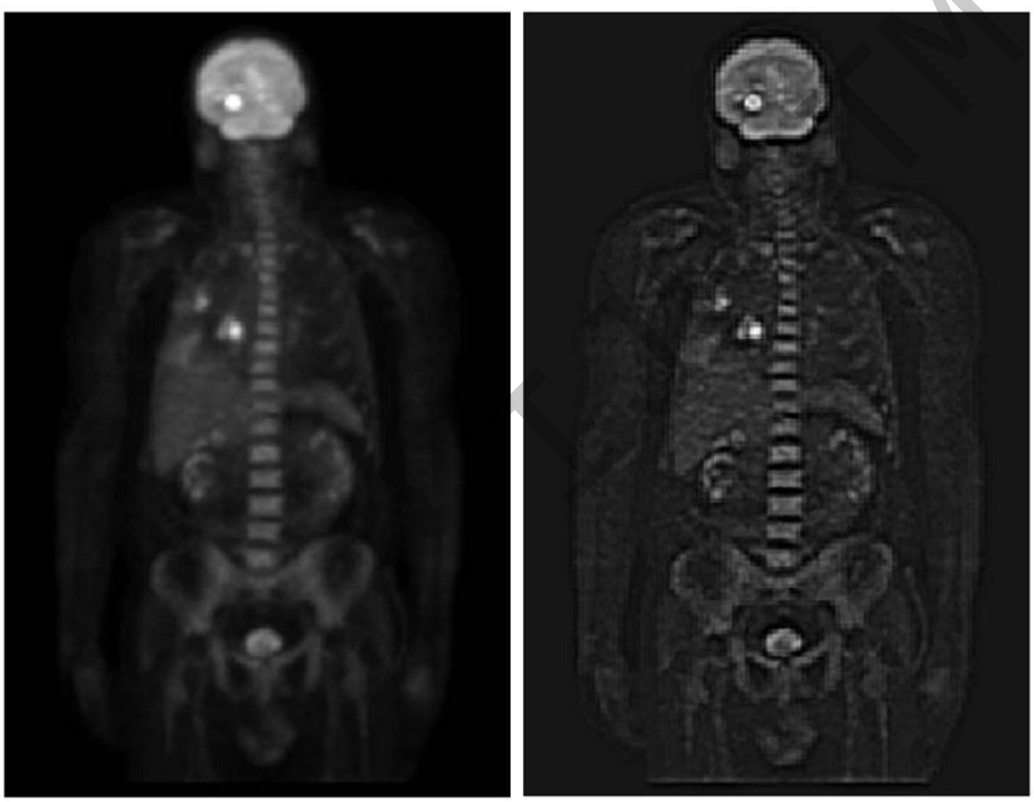



MODEL GRAPH

## 4. RESULTS AND DISSCUSSIONS



## 5. CONCLUSION

Homomorphic filter plays an important role in bio medical image noise cleaning. This filter used to remove speckle noise from ultrasound images and enhance the image quality. In this project the functional blocks of Homomorphic filter designed and implemented using VHDL in Modelsim. Homomorphic filter is used to reduce the functional blocks, memory and computational complexity.

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